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- Gupta RB. 2017. *Production Technology*, Vol I - Production Process. Satya Prakashan, New Delhi.
- Hoyos L. 2010. *Fundamentals of Tool Design*. American Society of Tool and Manufacturer Engineers. Sixth Edition.
- Jain RK. 1994. *Production Technology: A Textbook for Engineering Students*. Khanna Publishers, New Delhi.
- Polukin P, Gringerg B, Kantenik S, Zhadan V and Vasilye D. *Metal Process Engineering*, MIR Publishers Moscow.

I. Course Title   : **Machinery for Precision Agriculture**

II. Course Code   : **FMPE 517**

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

IV. Aim of the course

To learn the principles behind precision agriculture and the systems for implanting the same.

V. Theory

Unit I

Importance of precision agriculture. Mapping in farming for decision making. Geographical concepts of PA.Understanding and identifying variability

Unit II

Geographical Position System (GPS) Basics (Space Segment, Receiver Segment, Control Segment), Error and correction, Function and usage of GPS. Introduction to Geographic Information system (GIS), function of GIS, use of GIS for decisions. IDI devices usage in Precision Agriculture Yield monitor, variable rate applicator for fertilizers, seed, chemicals etc. Remote sensing Aerial and satellite imagery. Above ground (non-contact) sensors.

Unit III

Data analysis, concepts of data analysis, resolution, Surface analysis. Analysis application interpretive products (map, charts, application map etc).

Unit IV

Electronics and Control Systems for Variable rate applications, Precision Variable Equipment, Tractor-Implement interface technology, Environmental Implications of Precision Agriculture.

Unit V

Goals based on end results of Precision Agriculture, Recordkeeping, Spatial Analysis, Variable Rate Application, Reducing of negative environmental impact, Crop/ technology cost optimization. Economic of precision agriculture and determining equipment and software, review of Cost/Benefit of Precision Agriculture, System vs. Parcels. Making a selection.

VI. Practical

Calculation of the benefits of Data and Mapping, Determining Latitude/Longitude, UTM or State Plane Position Navigation with Waypoints, Configuring a GPS System. Defining area of field for prescriptive treatment. Making the Grid, The Grid Sampling Process, generation of yield maps, Thematic or Spatial Resolution, Yield

Map Example, Surface Analysis in Arc-View.

VII. Learning outcome

Knowledge about the principles guiding the concept of precision agriculture and Farm Machinery and equipment systems that make muse of this principle.

VIII. Lecture Schedule

S.No.	Topic	No of Lectures
1.	Introduction to precision agriculture, its importance and applications	1
2.	Mapping in farming for decision making and geographical concepts of PA.	2
3.	Understanding and identifying variability	1
4.	Introduction to Geographical Position System (GPS). Function and usage of GPS	2
5.	Basics of GPS (Space Segment, Receiver Segment, Control Segment), Error and correction	2
6.	Introduction to Geographic Information system (GIS), function of GIS, use of GIS for decisions.	2
7.	Remote sensing including aerial and satellite imagery	2
8.	IDI devices usage in Precision Agriculture Yield monitor, variable rate applicator for fertilizers, seed, chemicals etc. Above ground (non-contact) sensors	2
9.	Data analysis, concepts of data analysis	3
10.	Surface analysis. Analysis application interpretive products (map, charts, application map etc)	2
11.	Precision Variable Equipment	2
12.	Electronics and Control Systems for variable rate applications	2
13.	Tractor-Implement interface technology, Environmental Implications of Precision Agriculture	2
14.	Recordkeeping, Spatial Analysis	2
15.	Rate Application, reducing of negative environmental impact, Crop/technology cost optimization	2
16.	Economic of precision agriculture and determining equipment	2
17.	Review of Cost/Benefit of Precision Agriculture, Making a selection	2
	Total	**33**

IX. Practical Schedule

S.No.	Topic	No of Practicals
1.	Calculation of the benefits of data and mapping	1
2.	Determining Latitude/Longitude, UTM or State Plane Position Navigation with Waypoints	2
3.	Configuring a GPS System	1
4.	Defining area of field for prescriptive treatment	1
5.	Making the grid and grid sampling process	2
6.	Collection of tractor-implement interface data	1
7.	Generation of yield maps	2
8.	Example of spatial and temporal variability and resolution	1
9.	Surface Analysis using software like Arc-View	2
10.	Economic of precision agriculture and determining equipment	2
11.	Cost/Benefit of Precision Agriculture for making a optimized selection	2
	Total	**17**

X. Suggested Reading

- Clay SA, Clay DE and Bruggeman SA. 2017. *Practical Mathematics for Precision Farming* American Society of Agronomy, Crop Science Society and Soil Science Society of America, 5585 Gulford Rd, Madison, WI 53711
- Henten EJV, Goense D and Lokhorst C. 2009. *Precision Agriculture*. Wageningen Academic Publishers.
- Ram T, Lohan SK, Singh R and Singh P. 2014. *Precision Farming: A New Approach*. Astral International Pvt. Ltd., New Delhi, ISBN: ISBN 978-81-7035-827-5 (Hardbound) ISBN 978-93-5130-258-2 (International Edition).
- Shannon DK, Clay DE and Kitchen NR (editors). 2018. *Precision Agriculture Basics* American Society of Agronomy, Crop Science Society and Soil Science Society of America, 5585 Gulford Rd, Madison, WI 53711
- Singh AK and Chopra UK. 2007. Geoinformatics Applications in Agriculture. New India Publishing Agency, PritamPura, New Delhi.

I. Course Title : **Machinery for Horticulture and Protected Agriculture**

II. Course Code : **FMPE 518**

III. Credit Hours : **2+0**

IV. Aim of the course

To learn about the different machinery used in cultivation of vegetable crops, orchard crops and also in protected agriculture.

V. Theory

Unit I

Vegetable cultivation, nursery machinery, tray seeders, grafting machines, vegetable trans-planters. Machinery for planting crops on raised beds, mulch laying and planting machines. Harvesting of vegetable crops: Harvesting platforms and pickers.

Unit II

Machinery for orchard crops: Pit diggers, inter-cultivators and basin forming equipment for orchards. Machinery for transplanting of trees. Harvesters for fruit crops: Shaker harvesters, types and principle of operation. Elevated platforms for orchard management and harvesting. Pruning machines.

Unit III

Machinery for orchards, vineyard machinery spraying machines, inter-cultivation machines. High clearance machines and special purpose machinery for crops on trellis. Machinery for special crops: Tea leaf harvesters, pruners and secateurs.

Unit IV

Machinery for lawn and garden: Grass cutters, special machinery for turf maintenance. Turf aerators and lime applicators.

Unit V

Protected agriculture: Principles, mechanical systems of greenhouse, ventilation systems, shading system, water fogging system, irrigation system, sensors, electrical and electronic system. Intelligent Control system for greenhouses. Machinery for processing of growth media, tray filling machines-tray sowing machines, transplanting machines. Robotic grafting machines. Weeding and thinning equipment. Crop protection and harvest under protected agriculture.