

PRECISION AGRICULTURE

ENAE 355

Lecture : 2
Tutorial : 1
Practical : 1

Year : III
Part : II

Course Objectives:

The objective of this course is to provide fundamental knowledge of precision agriculture principles and technologies. Upon completion, students will be able to apply tools such as GIS, GPS, remote sensing, IoT, and variable rate technologies, analyze spatial and temporal agricultural data, evaluate sustainable and intelligent farming practices, and design precision-based solutions for efficient, modern, and sustainable agricultural production.

1 Introduction (8 hours)

- 1.1 Precision agriculture and agricultural engineering
- 1.2 Principle of precision agriculture and major components
- 1.3 Mapping and decision making in farm business via precision agriculture
- 1.4 Automation in precision agriculture (Seeders, sprayers, harvesters)
- 1.5 Geographical concepts (Coordinate system, scale, projection and resolution)
- 1.6 Soil and water spatial variability (Soil formation and change, soil mapping technology and utility, precision land management, irrigation and drainage)
- 1.7 Nutrient spatial variability (Grid and zone sampling approaches, nutrient-specific sensors, equipment for nutrient variable rate application)
- 1.8 Crop spatial variability (Yield monitoring, calibration of monitors, yield map interpretation, crop quality sensors)

2 Emerging Tools and Technologies in Precision Agriculture (7 hours)

- 2.1 Geographical positioning system (GPS)
- 2.2 Geographic information system (GIS)
- 2.3 Remote sensing
- 2.4 Agricultural drone and robots
- 2.5 Artificial intelligence
- 2.6 Laser land leveler
- 2.7 Smartphone and tablets application

3 Processes Involved in Precision Agriculture (3 hours)

- 3.1 Major data collection methods
- 3.2 Data analysis: Concept, resolution and data analysis
- 3.3 Analysis for application: Interpretive products (Application map, charts)

4 Precision Livestock Farming (3 hours)

- 4.1 Importance of precision agriculture in livestock sector
- 4.2 Sensors in livestock monitoring system
- 4.3 Automatic milking system
- 4.4 Automated feeding system to livestock

5 Internet of Things, Sensor Networks and Artificial Intelligence (4 hours)

- 5.1 IoT devices and sensor networks; Connectivity options (Wi-Fi, GSM)
- 5.2 Types of Sensors: Explanation of soil moisture sensors, weather stations, crop monitoring devices and their integration in IoT systems
- 5.3 AI and machine learning concepts and their applications in precision farming
- 5.4 AI applications in crop yield prediction, disease detection, and weather

6 Sustainability of Precision Agriculture (3 hours)

- 6.1 Role of precision agriculture in climate change management
- 6.2 Environment/ecological aspect of precision agriculture
- 6.3 Basic economics (Cost-benefit analysis) of precision agriculture
- 6.4 Selection of precision equipment and software based on economics
- 6.5 Climate smart systems: Monitoring/weather predicting models, systems needed for agriculture
- 6.6 Best management practices for precision agriculture

7 Policy and Practices of Precision Agriculture in Nepal (2 hours)

- 7.1 Policies in precision agriculture
- 7.2 Current practices of precision agriculture in farm
- 7.3 SWOC analysis of precision agriculture

Tutorial (15 hours)

1. Learning essential tools in ArcGIS/QGIS
2. Configuring IoT sensor networks: Step-by-step guide to setting up soil moisture sensors, weather stations, and connecting them to cloud platform
3. Analyzing IoT data: Introduction to cloud platforms for collecting and visualizing sensor data in real-time
4. Design of an intelligent drip/sprinkler irrigation system
5. Cost-benefit analysis of an agricultural drone/ laser land levelling system
6. Group project in common precision agriculture tools
7. Assessing resource use efficiency: Case studies on how precision agriculture can improve water, fertilizer, and energy use efficiency

Practical (15 hours)

1. Principles involved in precision field leveling with laser land leveler
2. Working with Arduino UNO and newly developed robotic microcontrollers

3. Working with development of sensor technologies: Temperature sensor and its controlling mechanism; Humidity sensor and its controlling mechanism; Light sensor and its controlling mechanism; Soil moisture sensor
4. Uses of GSM Modem with open data platform and API for the IoT that enables to collect, store, analyzed, visualized data from sensors or actuators.
5. Development of an operating, monitoring and controlling application in smartphone and tablets
6. Application of agricultural drone in crop management practices (Pesticide/Herbicide application)
7. Use of multispectral images: Detect crop health and soil moisture
8. Application of GIS technologies: Mapping, measurement and identification of crops and crop yield estimation in a study area

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	8	8
2	7	7
3	3	3
4	3	3
5	4	4
6	3	3
7	2	2
Total	30	30

* There may be minor deviation in marks distribution.

References

1. Michael, A. M., Ojha, T. P. (2015). Principles of agricultural engineering (Vol. 1). Jain Brothers.
2. Srinivasan, A. (2006). Handbook of precision agriculture: Principles and applications. CRC Press.
3. Pierce, F. J., Nowak, P. (Eds.). (2018). Advances in precision agriculture. CRC Press.
4. Mulla, D. J. (Ed.). (2013). Precision agriculture: Basics and applications. American Society of Agronomy.
5. Lillesand, T. M., Kiefer, R. W., Chipman, J. W. (2015). Remote sensing and image interpretation. Wiley.
6. Chang, K. T. (2018). Introduction to geographic information systems. McGraw-Hill Education.
7. King, A. (2017). The future of agriculture. Nature, 544, S21–S23. <https://doi.org/10.1038/544S21a>