GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2025-2026

Precision Agriculture (I002739)

Course size *(nominal values; actual values may depend on programme)*

Credits 5.0 **Study time 150 h**

Course offerings in academic year 2025-2026

null

Lecturers in academic year 2025-2026

Offered in the following programmes in 2025-2026	**crdts**	**offering**
null		

Teaching languages

English

Keywords

Sensing, Site specific management, variable rate technologies, robotics.

Position of the course

Precision agriculture aims at improving the management of spatial and temporal variability within agricultural fields, by applying the right amount of farm input (fertilisers, water for irrigation, pesticides, seeds, tillage etc.) into the right place in the right time by using of the right technologies and practices. In crop production the scale of management of variability is down to within field or subfield scale. The final target of precision agriculture is successful management of within field variability to maximise yield at reduced input cost, and reduced environmental impacts and waste. The final farm output is increased profit and farming production efficiency, whereas a reduced risk for pollution can be achieved by applying less agrochemicals into the environment (e.g., into soil, water and air). The implementation of precision agriculture requires the combination of several technologies into an integrated agricultural management system. These technologies often include global positioning systems, geographical information systems, remote sensing of crop, proximal soil and crop sensing, yield monitoring, geostatistical modelling and mapping, decision support tool (PA software), and variable rate technologies.
Despite this course is of an multidisciplinary nature, it will focus on the technology of sensing, modelling and control, given by the lecturer in charge who will takes up a coordinating role in inviting 2 guest lecturers by specialists in the respective disciplines (e.g., environmental and socio-economics of PA, in the cloud data management and decision support). The guest lecturers are from the Faculty of Bioscience Engineering or External Institutions, The concrete contents will be adapted as a function of the foreknowledge of the students who select this optional course.

Contents

The different parts of this course are detailed below:

- General philosophy of precision agriculture (Introduction to PA; Implementation of PA; A case study; Auto-steering; Control traffic farming and Adoption of PA – barriers and opportunities
- Proximal soil sensing I – Reflectance spectroscopy (visible and near infrared and mid infrared, and their potential for field deployment in nutrient measurement and mapping in PA)
- Proximal soil sensing II – Emission spectroscopy (LIBS and XRF), gamma ray

spectroscopy and electrochemical methods (basic working principles, including field deployment for nutrient measurement and mapping in PA)
- Proximal crop sensing including yield sensors (crop biomass; crop diseases; crop N content; crop water stresses; weeds; and yield [cereal crops and tuber crops] monitoring)
- Multi-sensor data fusion for accurate monitoring and decision making in PA (Theoretical background and methods; Site specific applications of nutrients, manure, seeds, water for irrigation and pesticides; Yield forecasting; and Case study on site specific tillage)
- Variable rate technologies – VR pesticide, seeding, fertilisation, manure (map-based, sensor-based and map-sensor-based VR technologies; Agricultural machinery and control systems and requirements (hardware and software) for pesticides spraying and spreading, manure application, and seeding)
- The role of robotics in precision agriculture
- Guest lecture I – Plant disease detection and precision crop protection
- Guest lecture II – Economics and/or environmental benefits of PA
- Agricultural machinery demonstration & CNH, AVR, or Bottelare HoGent
- Visit to a commercial farm (e.g., Van De Borne farm), adopting PA
- Student feedback with group lectures

Initial competences

The students will need to have knowledge on Remote Sensing and GNSS, which they obtained while attending the Course I002651A - Monitoring systems in agriculture, during the Bachelor in Bioscience Engineering.

Final competences

1 Have insight in precision agriculture in the context of managing within field spatial variability.
2 Have knowledge on proximal and crop sensing technologies including machine learning and mapping tools.
3 Have knowledge of agricultural machinery with VR technologies.
4 Know the basic principles of robotics and their potential uses in precision agriculture.
5 Have knowledge of the economic and environmental benefits of precision agriculture.
6 Have insight in the multidisciplinary and multifunctionality nature of precision agriculture.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Extra information on the teaching methods

The theoretical lessons are lectures supported with illustrations. The practical exercises are composed out of demonstrations and excursions with two visits to: 1) a farm applying precision agriculture, and 2) agricultural machinery manufacturer. An interactive workshop will be organized after the two visits to discuss student opinion of precision agriculture and potential adoption.

Study material

None

References

Castrignanò, A.; Buttafuoco, G.; Khosla, R.; Mouazen, A.M.; Moshou, D.; Naud, O., *2019. Agricultural Internet of Things and Decision Support for Precision Smart Farming. ACADEMIC PRESS, Elsevier, pp. 459.*
Martens, H., Naes, T., *1989. Multivariate Calibration, 2nd ed. John Wiley & Sons, Ltd., Chichester, United Kingdom.*
Mouazen, A.M., Ramon, H., *2006. Development of on-line measurement system of bulk density based on on-line measured draught, depth and soil moisture content. Soil & Tillage Research 86 (2) 218–229.*
Stenberg, B.; Viscarra Rossel, R.; Mouazen, A.M.; Wetterlind, J., *2010.*

Visible and near infrared spectroscopy in soil science. Advances in Agronomy, ***107****: 163-215.*
Mouazen, A.M.; Alexandridis, T.; Buddenbaum, H.; Cohen Y.; Moshou, D.; Mulla, D.; Nawar, S.; Sudduth, K.A., *2019. Chapter 2: MONITORING. In: A. Castrignanò et al. (Eds.), Agricultural Internet of Things and Decision Support for Precision Smart Farming. ACADEMIC PRESS, Elsevier, 36-138.*
Pedersen, S.M.; Pedersen, M.F.; Ørum, J.E.; Fountas, S.; van Evert, F.K.; van Egmond, F.; Knierim, A.; Kernecker, M.; Mouazen, A.M.; 2019. Chapter 2: ECONOMIC, ENVIRONMENTAL AND SOCIAL IMPACTS. In: A. Castrignanò et al. (Eds.), Agricultural Internet of Things and Decision Support for Precision Smart Farming. ACADEMIC PRESS, Elsevier, 280-330.
Castrignanò, A.; Buttafuoco, G.; Khosla, R.; Mouazen, A.M.; Moshou, D.; Naud, O., 2019. Agricultural Internet of Things and Decision Support for Precision Smart Farming. ACADEMIC PRESS, Elsevier, pp. 459.

Course content-related study coaching

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment with open-ended questions, Assignment

Examination methods in case of periodic assessment during the second examination period

Written assessment with open-ended questions

Examination methods in case of permanent assessment

Participation, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Extra information on the examination methods

The exam will consist of a combination of questions from the diverse disciplines which are covered in this course, with a focus on the interdisciplinary nature of Precision Agriculture and the practical experiences gathered during the farm and machinery visits.

Calculation of the examination mark

- End-of-term assessment: Periodic evaluation 70 % and non-periodic evaluation 30 % .
- Students who eschew period aligned and/or non-period aligned evaluations for this course unit may be failed by the examiner.