Spring 2024

BASIC INFORMATION

Course prefix, catalog number, and title: PAG, 454/654, Applications of Precision Agriculture
Number of credits: 3
Term and year: Spring/2023
Time and place: Lecture: Tuesday & Thursday 09:30 – 10:20 am; Location: QBB, Room 422
             Lab: Thursday 2:00 pm – 4:00 pm; Location: QBB, Room 132
Instructor's name: Dr. Paulo Flores
   Office location: 104L Ladd Hall
   Office hours: Tuesday and Thursday, 10:30 am – 11:30 am. Students can also meet the instructor by appointment. Drop-ins are acceptable at other times, but instructor availability cannot always be guaranteed. Students are also welcome to call the office number or Zoom, request a Zoom meeting, or send questions via e-mail.
   Phone Number: 701.231.5348
   Email Address: paulo.flores@ndsu.edu
   Zoom PMI : 573.779.7527

Communication

➢ The primary method by which course-related information will be communicated is during class. Reminders, notification of any schedule or assignment changes will be communicated through NDSU email and posted on Blackboard announcements page.
➢ Your NDSU email address is the official route for information.
➢ The class will be face-to-face. Zoom will be used mainly for recording purposes. When virtual participation in this course is needed (decided by the instructor on case-by-case basis), it will require both video and audio capabilities.

Technology Concerns

For any technology concern, please contact the IT Help Desk.
Email: ndsu.helpdesk@ndsu.edu
Call: 701-231-8685 (option 1)

BULLETIN DESCRIPTION

The course is designed to introduce students to current technologies being used for crop production, and how to use the data collected by them to make more informed crop management decisions. The course is offered as two 50-minute lectures and three 50-minute lab (one meeting) per week.

PREREQUISITES

PAG 215 – Mapping of Precision Ag Data

RECOMMENDED STUDENT RESOURCES

- D. Kent Shannon, David E. Clay, Newell R. Kitchen. *Precision Agriculture Basics.* American Society of Agronomy, Incorporated, 2018. ISBN: 978-1-4200-9270-7. (Recommended)
- David E. Clay and John F. Shanahan (Editors). *GIS applications in precision agriculture - Volume Two. CRC Press, 2011.* ISBN: 978-1-4200-9270-7. (Recommended)
- *R. Kerry and A. Escola (Editors). Sensing Approaches for Precision Agriculture. Springer, 2021, ISBN-13: 978-3030784300, ISBN-10: 3030784304. (Recommended)*

- *K. Green, R.G. Congalton, M. Tukman. Imagery and GIS – Best practices for extracting information from imagery. ESRI Press, 2017. ISBN 9781589484542 (Recommended).*
- Paul A. Zandbergen. *Python Scripting for ArcGIS. ESRI Press, 2015.* ISBN-10: 1589483715, ISBN-13: 978-1589483712. (Recommended for graduate students, ArcGIS 10.X versions)
- Paul A. Zandbergen. *Python Scripting for ArcGIS Pro. ESRI Press, 2020.* ISBN-10: 1589484991, ISBN-13: 978-1589484993. (Recommended for graduate students)
- Joel Lawhead. *Learning Geospatial Analysis with Python. Second Edition, PACKT Publishing, 2015.* ISBN 978-1-78355-242-9. (Recommended for graduate students)

COURSE OBJECTIVES

Objectives

The course objective is to introduce students to tools/software, hardware, and techniques that will allow them to integrate different sources of information collected during planting activities, crop growing season, and harvest to make more informed crop management decisions using precision agriculture principles.

In addition to the objectives listed above, graduate students will be introduced to the use of GIS software and basics of Python to automate, to some degree, the tasks listed above.

Outcomes

Students will:
- Retrieve, create visualization, and analyze information collected by agricultural machinery.
- Plan drone missions to assess crop health and to map weeds.
- Apply basic principles of image analysis to extract useful information from drone imagery.
- Integrate machinery data and remote sensing data to make crop management decisions.
- Create field management zones.
- Create fertilizer and weed control prescription maps.

In addition to the above, graduate students will learn how to use GIS software and basics of Python programming language to integrate data from different sources and to automatize some steps of that process.

MODES OF PRESENTATION

Lecture with PowerPoint – classroom and Zoom (recording purposes)
Guest Speakers
Problem solving/demonstrations

BLACKBOARD

Blackboard will be used for announcements, class presentations, submission of assignments, taking both quizzes and exams, and posting grades (information purposes only).

A NOTICE ABOUT COPYRIGHT OF COURSE MATERIALS

Refer to NDSU Policy 190 on Intellectual property.
- In this course recording the lectures with your own personal devices is prohibited without prior approval from the instructor.
- In this course recording the lectures for anything other than personal use is prohibited.

EVALUATION PROCEDURES AND GRADING CRITERIA

PAG 454/654 – APPLICATIONS OF PRECISION AGRICULTURE

Spring 2024

Students will have 6 categories in which they will be evaluated in the course. Those categories are as follows.

Category	Undergraduate, 454	Graduate, 654
	-------------- % of the final grade* --------------	
1. Homework (up to 12)	15	10
2. Quizzes (unannounced, up to 6 quizzes)	10	-
3. Labs (projects)	20	20
4. GIS – Python script projects	-	15
5. Exam 1	15	15
6. Exam 2	15	15
7. Final exam (comprehensive)	25	25
Total	100	100

*Letter grades will be assigned using the following scale: A= 90-100%; B= 80-89.9%, C= 70-79.9%; D= 60-69.9%, and F= less than 60%.

Homework, quizzes, labs, and test scores will be posted on Blackboard for informational purposes only.

Quizzes can be unannounced and <u>will be no makeup for missed quizzes</u>.

Due dates for homework and lab reports will be provided with the assignments, and they will be due at 4:30 pm on the day of submission. Late assignments will be accepted with a 10% penalty per NDSU class day, but they will not be accepted after solutions are posted/handed out/discussed or 2 NDSU class days after the original due date. The instructor will provide flexibility for those students affected by illness or other challenges on a case-by-case basis at his own discretion.

Students are encouraged to work in virtual groups to complete their homework and lab assignments, which allow for students to learn from each other. Although virtual working groups are encouraged, students are required to turn in individual versions of their assignments. In the case when homework, lab reports, or missed homework and lab report seem to be a "copy" from another individual's assignment, all students involved will receive 0 points for that assignment.

ASSIGNMENT SUBMISSION

In this course Blackboard will be used as much as possible for assignment submissions (and grading) for all students.
If you are sick, please do not come to class or campus to turn in work. Instead notify the course instructor as soon as practical, so that accommodation can be made.

A NOTE ABOUT THE EXAMS

Students will have the flexibility to take exams posted on Blackboard either in the classroom or any other location with an internet connection. A student taking an exam via Blackboard in a location other than the classroom will be required to have his/her webcam and microphone on during the entire duration of the exam.

ATTENDANCE STATEMENT

According to NDSU Policy 333 (www.ndsu.edu/fileadmin/policy/333.pdf), attendance in classes is expected.

Attendance in classes is expected and important. (The term "class" includes class, online class, laboratory, field trips, group exercises, or other activities related to the course). However, there are instances in which students are unable to attend class, and if those are described in policy 333, then those absences will be excused. Absences not covered under policy 333 are excusable at the discretion of the instructor. However, class policies regarding class absence are provided below.

If a student will be missing class for an event related to university clubs or teams, or other excusable reason to be determined by the instructor, the student must let the instructor know before he/she misses the class. Consideration will be given to those students who have a valid excusable reason when deciding regarding making up assignments or tests.

- **Students that cannot attend the class in-person due to medical condition or other reasons may seek an accommodation through the Disability Services (701-231-8463; https://www.ndsu.edu/disabilityservices).**
- Please protect your health and the health of others by staying at home if you are sick.

DEAD WEEK POLICY

The NDSU Dead Week policy is available at http://www.ndsu.edu/registrar/dates/deadweek/.

VETERANS AND MILITARY PERSONNEL

Veterans or military personnel with special circumstances or who are activated are encouraged to notify the instructor as early as possible and are encouraged to provide Activation Orders.

FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT (FERPA)

Your personally identifiable information and educational records as they relate to this course are subject to FERPA.

STUDENTS WITH SPECIAL REQUIREMENTS

Any students with disabilities who need accommodations in this course are invited to share these concerns or requests with the instructor and contact the Center for Accessibility and Disability Resources as soon as possible.

ACADEMIC HONESTY STATEMENT

The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at www.ndsu.edu/academichonesty.

USE OF CELL PHONES AND OTHER ELECTRONIC DEVICES:

All participants in this class are subject to NDSU University Senate Policy 158: Acceptable use of Electronic Communications Devices (http://www.ndsu.edu/fileadmin/policy/158.pdf).

As a courtesy to other students and the instructor, all cell phones, iPods, MP3 players, and other electronic devices, except handheld calculators, should be turned off or placed in a vibrate-only mode during class time. Initiating phone calls, text message, or other types of messages during class time -including those to friends, family, classmates, coworkers, or

supervisors—is unacceptable unless there is a genuine emergency. Examples of emergencies include weather-related school closing announcements; fire, bomb, or other threats to public safety and well-being; and other incidents in which the NDSU system is or could be activated to provide broadcast messages to the NDSU community.

Use of cell phones or other portable electronic devices for communication, transmission, retrieval, or storage of information during the administration of a test or quiz may be considered an incident of **academic dishonesty**. One exception to this policy is the use of handheld calculators for computational purposes. Use of cell phones or similar devices as a calculator during tests and quizzes will not be allowed because it is difficult to distinguish such activity from sending and receiving text messages, which could obviously be interpreted as a form of academic dishonesty.

IMPORTANT DATES (FULL NDSU DATES/DEADLINES CAN BE FOUND HERE)

Jan 1	Mon	HOLIDAY — New Year's Day (offices closed)
Jan 8	Mon	Classes begin at 4:00 p.m.
Jan 9	Tue	First full day of classes
Jan 15	Mon	HOLIDAY — Martin Luther King, Jr. Day (no classes, offices closed)
Jan 16	Tue	Last day to be added to Campus Connection Wait Lists
Jan 18	Thu	Last day to Add classes via Campus Connection* Permit needed after this date.
Jan 18	Thu	Last day for no-record Drop of classes @ 100% refund*(full semester classes only)
Jan 18	Thu	Last day to Withdraw to Zero Credits @ 100% refund*(full semester classes only)
Jan 24	Wed	Payments due for NDSU account balances
Jan 29	Mon	Last day to submit requests to Audit, Pass/Fail
Feb 19	Mon	HOLIDAY — Presidents' Day (no classes, offices closed)
Feb 19	Mon	Last day to Withdraw to Zero Credits @ 75% refund*full semester classes only)
Mar 4-8	Mon-Fri	Spring Break Week (no classes, offices open)
Mar 15	Fri	Late fee applied to unpaid account balances (11:59 p.m.)
Mar 21	Thu	Last day to Withdraw to Zero Credits @ 50% refund*(full semester classes only). No refunds issued for withdraw to zero credits after this date.
Mar 29-Apr 1	Fri-Mon	HOLIDAY -- Spring Recess (no classes, offices closed Friday, offices open Monday)
Apr 5	Fri	Last day to Drop classes with 'W' record*
Apr 5	Fri	Last day to Withdraw to Zero Credits for Spring
Apr 15	Mon	Late fees applied to unpaid account balances (11:59 p.m.)
Apr 29-May 3	Mon-Fri	Dead Week
May 6-10	Mon-Fri	Final Examinations
May 11	Sat	Commencement ceremony

PAG 454/654 – APPLICATIONS OF PRECISION AGRICULTURE

Spring 2024

<u>COURSE SCHEDULE/OUTLINE</u>

Tentative lectures schedule. Schedule can change due to unforeseen circumstances.

Week	Date	Topics
1	Jan 9	Class introduction
1	Jan 11	GIS Brief Review
2	Jan 16	Mapping soil data
2	Jan 18	Mapping soil data
3	Jan 23	NRCS Web Soil Survey
3	Jan 25	Variable rate technology
4	Jan 30	Variable rate technology
4	Feb 1	Planters/seeders technology
5	Feb 6	Planters/seeders technology
5	Feb 8	Planning UASs missions with specific goals in mind
6	Feb 13	Imagery applications early in the growing season
6	**Feb 15**	**Exam 1**
7	Feb 20	Basics of UAS imagery analysis
7	Feb 22	UAS chemical application
8	Feb 27	Sprayers technology
8	Feb 29	Sprayers technology
	Mar 5	**Spring break – no class**
	Mar 7	**Spring break – no class**
9	Mar 12	The future of weed control
9	Mar 14	Weed control and nozzles selection
10	Mar 19	The future of weed control
10	Mar 21	Economics of precision ag technologies
11	Mar 26	Economics of precision ag technologies
11	**Mar 28**	**Exam 2**
12	Apr 2	Combines technology
12	Apr 4	Yield monitor - calibration and data cleaning
13	Apr 9	Combines technology - protein sensors
13	Apr 11	Protein Sensor on combines
14	Apr 16	Integrating field data from different sources to support management decisions
14	Apr 18	Integrating data layers to aid decision making process

15	Apr 23	Creating management zones
15	Apr 25	Creating prescription maps
16	Apr 30	Technologies for grain storage and moisture management (Guest lecture)
16	May 2	Dead Week - content review
17	**May 8**	**Final Exam – 8:00–10:00 AM**

Tentative labs schedule. Schedule can change due to unforeseen circumstances.

Week	Date	Topics
1	Jan 11	GIS Overview – Introduction of GIS software
2	Jan 18	Creating soil fertility maps
3	Jan 25	Creating soil fertility maps
4	Feb 1	Planter components
5	Feb 8	Drones + sensors lab
6	Feb 15	Precision Ag cloud platform 1
7	Feb 22	Working with raster – VIs calculation and thresholding
8	Feb 29	Sprayer tour
	Mar 14	**Spring break – no lab**
9	Mar 7	Chemicals application and Nozzles
10	Mar 21	Precision Ag cloud platform 2
11	Mar 28	Combine tour
12	Apr 4	Data layers integration
13	Apr 11	Visualization, cleaning, and interpretation of yield monitor data
14	Apr 18	Creating management zones
15	Apr 25	Creating management Zones
16	May 2	Precision Ag cloud platform 3