TO: The Engineering Faculty

FROM: The Faculty of the School of Agricultural and Biological Engineering

RE: New graduate course – ABE 53000 Plant Phenotyping Technologies (3 Credit Hours)

The Faculty of the School of Agricultural and Biological Engineering has approved the following new graduate course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM:

ABE 59100 Plant Phenotyping Technologies Sem. 1, Class 2, Lab 1, Cr. 3. Classification: 4 or higher

Temporary course number. Course was taught Fall 2017 (7), Fall 2018 (10), and Fall 2019 (5).

TO:

ABE 53000 Plant Phenotyping Technologies Sem. 1, Class 2, Lab 1, Cr. 3. Restrictions/Prerequisites: Instructor Permission or Graduate Standing

Introducing concepts, models, algorithms, and tools in plant phenotyping development and application projects. Class topics include high-throughput phenotyping in greenhouse, field phenotyping platforms, Ag remote sensing, plant sensors (hyperspectral, 3D thermal, fluorescent, X-ray, etc.), plant image processing technologies, statistical modeling, big data, database requirement, artificial intelligence algorithms, and hybridizations of the above techniques applied in plant phenotyping. Typically offered Fall. Credits: 3.000

REASON: This course has been taught successfully as a temporary course and it is now being submitted for a permanent course number
ABE 53000 Plant Phenotyping Technologies

3 Credits Grad Class Each Fall
Instructor: Jian Jin (jinjian@purdue.edu)
Office: ABE 315
Telephone: 49-41182 (office)
Office Hours: Before/after each lecture and by appointment

Class Schedule
9:30 am - 10:20 am MW
1:30 pm – 3:20 pm M (Lab)

Catalog Description
Introducing concepts, models, algorithms, and tools in plant phenotyping development and application projects. Class topics include high-throughput phenotyping in greenhouse, field phenotyping platforms, Ag remote sensing, plant sensors (hyperspectral, 3D thermal, florescent, X-ray, etc.), plant image processing technologies, statistical modeling, big data, database requirement, artificial intelligence algorithms, and hybridizations of the above techniques applied in plant phenotyping.

Restrictions/Prerequisites
Graduate Standing or Instructor Permission

Student Learning Outcomes
On the completion of this course, the student will have:
- The concept of digital agriculture and plant sensors’ applications
- An understanding of plant phenotyping technologies, in both software and hardware
- The skills of designing a professional phenotyping imaging system and collecting data
- The understanding of the current phenotyping activities in academia and industry
- The knowledge of major plant sensors and their applications
- The capability of choosing or designing the most feasible sensor system for specific phenotyping projects
- The understanding of the role of the plant sensors in a precision agriculture system
- Basic image processing skills
- The capability of applying computational intelligence and machine learning techniques to classification, prediction, pattern recognition, and optimization problems.

Grading
There are no exams. Grading will be based on 50% assignments/labs and 50% Final Project.

Final Project
The student can choose one of the assigned projects to practice the phenotyping technologies. The Final Project should be submitted as a technical report and presented in class. The project will be graded as follows: 60% implementation quality, 20% report quality, and 20% presentation quality. The report document should contain: problem description, benchmarking, and discussion. The presentation should
be made with 10-15 slides, in about 15 minutes, including questions and answers.

**Prerequisite Knowledge and Skills**
The ability to program in MATLAB is required to complete the course.

**Textbook**
Digital Image Processing Using MATLAB
by Rafael C. Gonzalez (Author), Richard E. Woods (Author), Steven L. Eddins (Author)
ISBN-10: 0130085197

**Course Schedule**

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<th>Date</th>
<th>Topics</th>
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<td>Week 1</td>
<td>Introduction, Syllabus</td>
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<tr>
<td>Week 2</td>
<td>Overview of Plant Phenotyping in Industry and Academia</td>
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<td>Week 3</td>
<td>Introduction to Phenotyping Sensors 1</td>
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<td>Week 4</td>
<td>Introduction to Phenotyping Sensors 2</td>
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<td>Week 5</td>
<td>Image Processing for Plant Features 1</td>
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<td>Week 6</td>
<td>Image Processing for Plant Features 2</td>
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<td>Week 7</td>
<td>Designing a phenotyping imaging system 1 – lighting, cameras, imaging box and automatons</td>
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<td>Week 8</td>
<td>Designing a phenotyping imaging system 2 – Environmental conditions, data storage and processing protocols, noise removal</td>
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<td>Week 9</td>
<td>Statistics Basics in Plant Phenotyping 1– Training, Testing, Validation, Data Pre-Processing, Regression, Classification</td>
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<td>Week 10</td>
<td>Statistics Basics in Plant Phenotyping 2– PCA, PLS Modeling, SVM, SOM and Neural Network</td>
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<td>Week 11</td>
<td>Ag Remote Sensing Applications 1</td>
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<td>Week 17</td>
<td>Final Project Presentations</td>
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Actual course schedule will be adjusted along the semester based on the students’ interests and performance.