University of Arkansas
Dale Bumpers College of Agricultural, Food and Life Sciences

CSES 5233 Plant Genetic Engineering

Prerequisite
Consult with the instructor

Instructor

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I. Catalog Description

CSES 5233: Plant Genetic Engineering

Topics will be covered in the field of in vitro plant biology, transgene genetics and crop genetic engineering. Concepts and applications of transgenic plant technology will be discussed, with the emphasis on the strategies for crop improvement and gene discovery. Lecture: 3 hours. Prerequisite: consult with the instructor. Spring semester, even year.

II. Method of Grading

Final grade for the course will be based on the following:

	Total Points	% of Final Grade
Three long examinations (15% each)	450	45
Three Quizzes (10% each)	300	30
Group discussion (5% each)	150	15
Final examination (10%)	100	10
Total	1000	100

The long examinations and quizzes will consist of the topics covered in the respective units. Quizzes will consist of multiple-choice questions or the questions that require very short answers. The long examination and final examination will include objective, essay and problem solving types of questions.

III. Attendance Policy

Full attendance is very important for the student to keep up with the course. Students who missed a quiz or long examination for valid reasons will be allowed to take a make-up test. No make-up final examination will be given except for extreme or special cases.

IV. Contribution to the Objectives of the Department/College

This course is designed for the graduate students majoring in plant sciences or related field. Transgenic crops have become an important component of crop improvement, disease and pest management programs. This course will help students develop concepts on transgene genetics and learn about emerging transgenic technologies. This course will provide advanced level training in genetic engineering and biotechnology. Students will learn about how transgenic plants are developed for industrial and research applications, how this technology is contributing to understanding gene function. Finally, students will learn about the advantages and disadvantages of this technology for human. This course will supplement other existing courses in the department and college such as Advanced Crop Science, Agricultural Biotechnology and Plant Genomics.

V. Course Outline

A. Broad Objectives

1) To provide in depth knowledge of the science behind transgenic plant (GMO) technology.
2) To introduce students with the developments in cutting edge crop biotechnology and the changing trend of plant genetics.

B. Teaching Units: the course is divided into 3 units.

1) Unit I. In Vitro Plant Biology and plant transformation

a) Unit Objectives

i) To introduce the students to the fundamental concepts of plant tissue culture.
ii) To familiarize the students with practical application of plant tissue culture and transformation.

b) Learning Techniques

Classroom lectures (chalk) will be given with supplemental power point and overhead presentations. Group discussion will be carried out on chosen journal articled. Lab tours and demonstration of some techniques will be arranged. The entire course will be posted on WebCT. Additional handouts and lecture notes will be provided for each topic in the classroom. Reading assignments will be given periodically. There will be an office hour for a help session once a week and a review session prior to the unit exam. However, students are encouraged to ask questions or seek for assistance at any time.

c) Topics/Specific Objectives

Period	Topic/Objective	Reading Assignment
1-2	Overview of plant tissue culture. History of in vitro plant biology, Culture media, plant hormones, Differentiation/ Regeneration.	
3-4	Plant Transformation: history of, protoplasts isolation, fusion; haploid technology.	
5-6	Agrobacterium biology: Virulence genes, T-DNA transfer mechanism.	Selected review articles
	Quiz	
7-8	Fate of foreign DNA in plant cell: mechanisms of DNA integration.	Selected review articles

9-10	Transgene expression and inheritance. Stability of the transgene, patterns of integration.	Research articles
11-13	Discussion on 2-3 selected articles on in vitro biology and plant transformation from scientific journals.	
14	Long Exam on topics covered in Unit I	

2) Unit II. Transgene genetics

a) Unit Objectives

i) To introduce the students to the fundamental concepts DNA recombination.
ii) To demonstrate how DNA recombination tools are utilized in crop biotechnology and functional genomics.

b) Learning Techniques

The instructor will give lecture on each topic. Students will be encouraged to ask questions during the lecture. Students will be required to read and comprehend the research and review articles selected by the instructor.

c) Topics/Specific Objectives

Period	Topic/Objective	Reading Assignment
15-16	Site-specific recombination systems Integrase, Cre-lox, FLP-*FRT*.	Research article
17-18	Molecular biology of transposons Ac-Ds, Mu, En-Spm systems.	book chapter
19-20	Homologous Recombination Mechanism, pathways, factors.	
21-22	Emerging technologies for improvement in plant transformation.	
	Quiz	
23-24	Gene Silencing: Transcriptional gene silencing Post-transcriptional gene silencing	Review articles
25-26	Molecular strategies to prevent gene silencing	

27-28	Transgenic approaches functional genomics: Gene tagging, Insertional mutagenesis, Activation mutagenesis
29--31	Discussion on selected articles.
32	Long exam on unit II

2) Unit III. Crop Biotechnology

a) Unit Objectives

i) To make the students aware of the key biotechnology programs being carried out in public and private laboratories.
ii) To demonstrate how DNA recombination tools are utilized in crop biotechnology.

b) Learning Techniques

The instructor will give a lecture on each topic. Students will be encouraged to ask questions during the lecture. Research and review articles from journals will serve as reference material.

c) Topics/Specific Objectives

Period	Topic/ Objective	Assignment
33-35	Thrust areas in biotechnology Metabolic manipulations Fatty acid genetic engineering Tree biotechnology, Plastics in plant cell	Book chapter
36-37	Environmental Impact of crop biotechnology Discussion on risks of biotechnology	
38-39	Transgene containment strategies: Agronomic and molecular approaches.	
40-42	Discussion on selected journal articles.	
43	Long Exam on Unit III.	
44-45	Recap of the course.	