SACRAMENTO STATE

Course Change Proposal
Form A

Academic Group (*College*): **Engineering**	Academic Organization (*Department*): **Electrical and Electronic Engineering**	Date: September 27th 2006
Type of Course Proposal: New ___ Change _X__ Deletion ___	Department Chair: Dr. Suresh Vadhva	Submitted by: Dr. Milica Markovic
Does this course fulfill a requirement for single-subject or multiple subject credential students? Yes ___ No _x_	For Catalog Copy: Yes _x_ No ___ CCE: Yes ___ No ___	Semester Effective: Fall ___ Spring _x__, 2007___

This course replaces experimental course Subject Area *(prefix)* and Catalog Number *(course number)*:EEE161	EEE161
This Catalog Number *(course number)* is being replaced:EEE161	EEE161

Change from:

Subject Area *(prefix)* & Catalog No. *(course no.)*:	Title: Transmission Line and Fields	Units: 4

Change to:

Subject Area *(prefix)* & Catalog No. *(course no.)*:	Title: Applied Electromagnetics	Units: 4

JUSTIFICATION:

1. The title of the course is changed. A better description of the content is applied electromagnetics.

2. Currently EEE161 is a 4 unit class. It is proposed that the course become a 3 unit lecture class with a 1 unit laboratory. The laboratory will be held at AIRC building computer lab. There are enough computers available for all students in one lecture section to attend one lab.

3. The reason for the proposed change is twofold. One is that the students struggle to understand difficult concepts in this class. Addition of a lab will present further opportunities to visualize the fields and see further applications of electromagnetic fields. The second is that we already introduced visualization with MATLAB in electromagnetics. A small part of Matlab instruction is conducted during the class, see item 4. Students are required to complete most of the visualization exercises assigned on their own time outside the class. The lab will provide instructor supervised time to help students with visualization methods. Some class content, such as numerous examples, will be transferred to the lab.

4. Alarge number of concepts are currently taught in EEE161. Most of the concepts that relate to visualization of the fields are left to students to work on during their own time as projects. Currently two lectures (3hrs 20min) are spent in the laboratory to introduce Matlab, and two lectures (another 3hrs and 20min) are used to present projects at the end of the semester. Throughout the semester significant amount of time is used to present examples that students work out in small groups. This time can be transferred to lab as part of pre-Matlab exercises. The lecture content will decrease from 4 to 3 units, however a 1 unit lab will be added to the course in which different examples will be solved using hand calculations and visualized using MATLAB.

See the detailed old and new syllabus and the detailed future laboratory syllabus attached.

NEW COURSE DESCRIPTION: (Not to exceed 80 words, and language should conform to catalog copy. See http://www.csus.edu/acaf/univmanual/crspsl.htm - Guidelines for Catalog Course Description

Review of vector calculus. Electrostatic fields from lines, surface and volume charges by Coulomb's law, Gauss' law, Laplace's and Poisson's equations. Capacitance. Magnetostatic field calculations using Biot-Savart's law and Ampere's law. Inductance. Forces on moving charges. Magnetic materials. Electric and magnetic energy in fields. Faraday's law. Ideal transformer. Moving conductor in time-varying magnetic field. Displacement current. Charge-current continuity relation. Transmission line analysis, characteristic impedance, reflection coefficient and standing wave concepts. Introduction to Smith Chart solutions to matching problems.	
Note:	
Prerequisite: MATH032, MATH045, PHYS011C, ENGR017 and CSC025	
Corequisite:	
CAN (California Articulation Number):	
Graded: Letter __X___ Credit/No Credit____	**Instructor Approval Required? Yes___ No_X__**
Course Classification *(e.g., lecture, lab, seminar, discussion)*: **C4/C16**	**Title for SIS+/CMS (not more than 30 characters) Applied Electromagnetics**
Cross Listed? Yes ___ No__X__	**If yes, do they meet together and fulfill the same requirement, and what is the other course.**
How Many Times Can This Course be Taken for Credit? __Once____ **Can the course be taken for Credit more than once during the same term? Yes ___ No _x__**	

FOR NEW COURSE PROPOSALS OR SUBSTANTIVE CHANGES ONLY:

Description of the Expected Learning Outcomes: Describe outcomes using the following format: "Students will be able to: 1), 2), etc." See the example at http://www.csus.edu/acaf/example.htm

Students will be able to:

1. **Calculate the capacitance and inductance of different transmission lines.**
2. **Calculate magnetic force and torque in simple systems**
3. **Describe and perform analysis of a simple transformer and generator.**
4. **Describe in your own words the meaning of Maxwell's equations**
5. **Explain a concept of a wave.**
6. **Name and recognize transmission lines used in professional practice.**
7. **Calculate impedance of standard transmission lines.**
8. **Perform impedance matching of a load to a transmission line.**

**Attach a list of the required/recommended course readings and activities [Note: it is understood that these are updated and modified as needed by the instructor(s).] This attachment should be forwarded only to your Dean's office, not Academic Affairs.

Assessment Strategies: A description of the assessment strategies (e.g., portfolios, examinations, performances, pre-and post-tests, conferences with students, student papers) which will be used by the instructor to determine the extent to which students have achieved the learning outcomes noted above:

Lecture Assessment

Homework - 5 %
Quizzes - 10 %
Midterms (Each) - 30 %
Assessment Exam - 5%
Final - 30 %

Laboratory Assessment

Lab Reports (5) :10%
Lab Exams: 20 %
Final Project: 20 % (comprehensive)
Homework: 10%

For whom is this course being developed?
Majors in the Dept _X__ Majors of other Depts ___ Minors in the Dept ___ General Education ___ Other ___
Is this course required in a degree program (major, minor, graduate degree, certificate? Yes _X_ No ___
If yes, identify program(s): Majors in EEE

Does the proposed change or addition cause a significant increase in the use of College or University resources (lab room, computer facilities, faculty, etc.)? Yes ___ No __X__
If yes, attach a description of resources needed and verify that resources are available.

Indicate which department or programs will be affected by the proposed course (if any). Electrical and Electronic Engineering Department.

The Department Chair's signature below indicates that affected programs have been sent a copy of this proposal form.

Approvals: If proposed change, new course or deletion is approved, sign and date below. If not approved, forward without signing to the next reviewing authority, and attach an explanatory memorandum to the original copy.

Signatures:	**Date**
Department Chair: Suresh Vadhva	11/21/2006
College Dean or Associate Dean:	11/21/06
CPSP ***(for school personnel courses ONLY)***	
Associate Vice President and Dean for Academic Programs	

Distribution: Academic Affairs (original), Department Chair and College Dean. Dean's office to send original after approval to Academic Affairs, at mail zip 6016. An electronic copy must also be sent.

EEE 161

This is the syllabus for the new, proposed course.

Applied Electromagnetics, Spring 2007.

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Required Course

Future Catalog Description

Review of vector calculus. Electrostatic fields from line, surface and volume charges by Coulomb's law, Gauss' law, Laplace's and Poisson's equations. Capacitance. Magnetostatic field calculations using Biot-Savart's law and Ampere's law. Inductance. Forces on moving charges. Magnetic materials. Electric and magnetic energy in fields. Faraday's law. Ideal transformer. Moving conductor in time-varying magnetic field. Displacement current. Charge-current continuity relation. Transmission line analysis. Characteristic impedance, reflection coefficient and standing wave concepts. Introduction to Smith Chart solutions to matching problems. **Prerequisites:** MATH032, MATH045, PHYS011C, ENGR017 and CSC025.

Text: Fundamentals of Applied Electromagnetics, by Ulaby, F.T. Prentice Hall, 2005 ISBN0-13-185089-X

Support Software: *Matlab Student Version, MATLAB 7*, The Math Works, Inc., (ISBN 0-9755787-4-X).
Note: Any release of MATLAB software above MATLAB 4 is acceptable. Wolfram's Mathematica is also acceptable, any recent release.

Course objectives:
EEE161 is designed for electrical engineering majors as an introductory electromagnetics and high-frequency electronics class. This course builds upon the basic electronic circuits courses by introducing the analysis of distributed circuit elements. Introduction to Maxwell's equations provides the fundamental insight into design and analysis of lumped circuit elements such as capacitors, inductors and resistors. Visualization of difficult concepts, such as waves, is facilitated through high-level programming languages such as Matlab or Mathematica.
By the end of this course, students should be able to do the following:

1. Calculate the capacitance and inductance of different transmission lines.
2. Calculate magnetic force and torque in simple systems
3. Describe and perform analysis of a simple transformer and generator.
4. Describe in your own words the meaning of Maxwell's equations
5. Explain a concept of a wave.
6. Name and recognize transmission lines used in professional practice.
7. Calculate impedance of standard transmission lines.
8. Perform impedance matching of a load to a transmission line.

Prerequisites by Topic:
1. Knowledge of a programming language and algorithm development
2. Vector calculus, partial differentiation, multiple integration, differential equations with constant coefficients.
3. Basic concepts in electricity and magnetism.

4. Basic circuit concepts and procedures.

Evaluation:

Total Applied Electromagnetics grade consists of 75% class and 25% laboratory grade.

Lecture Evaluation:

Course class grades are based on a weighted sum of problem set scores and midterm and final examination scores, with the following weights:
Homework - 5 %
Quizzes - 10 %
Midterms (Each) - 30 %
Assessment Exam - 5%
Final - 30 %

Laboratory Evaluation

Lab Reports (5) :10%
Lab Exams: 20 %
Final Project: 20 % (comprehensive)
Homework: 10%

Contribution of Course to the Professional Education Component:

1. Homework assignments include practical transmission line and electromagnetic device design and anlysis problems with real-life constraints such as frequency, material, geometry and circuit size.
2. Matlab Laboratory design and analysis applications introduce student to a major professional engineering software tool.
3. Science and Design Content Distribution: Science – 3 units or 75% ; Design - 1 unit or 25%.

Relationship of Course to Student Learning Outcomes:

1. #3. Problem solving: This course applies multi-variable vector calculus and differential equations to solve problems in electromagnetic circuit design.
2. #4. Knowledge of core EEE topics: This course adds advanced analysis and design applications to fundamental concepts of electricity, magnetism, circuit analysis, and computer programming. This course covers core topics in high-frequency electronics.
3. #7. Use of contemporary tools for analysis and design. Illustrations and practice problems involve contemporary technology. In the laboratory, visualization techniques are demonstrated and practiced.
4. #9. Integration of knowledge to solve design problems: This course provides depth of knowledge in electronics. In this course, transmission line circuits are introduced. Practical considerations that affect circuit design are analyzed.
5. #10. Teamwork: Teamwork is practiced in the lecture and laboratory part of the course as students work in groups.
6. #11 Written Communication: Laboratory reports require a written record of procedure and results.

Topics Covered, Lecture Schedule:

Table 1. Lecture Schedule

Lec	Date	Topic	Reading	HW	Quiz
1	Sept 5	Syllabus, Vector Algebra, Coordinate Systems.	Ch.3.1-3.2		
2	Sept 7	Gradient, Divergence, Curl.	Ch.3.4-3.6		
3	Sept 12	Coulomb's Law. Charge Distributions. Total Charge. Electric Field Due to Multiple Charges.	Ch1.2-1.3 4.1-4.4		
4	Sept 14	Electric Field due to Charge Distributions. Coulomb's Law. Gauss' Law.	Ch.4.3.2-4.5		
5	Sept 19	Electric Scalar Potential. Fields and Dielectrics.	Ch 4.5-4.9		
6	Sept 21	Capacitance. Resistance and Conductance. Electric Field Boundary Conditions.	Ch.4.9-4.10		
7	Sept 26	Current Distributions. Magnetic Forces. Torque. Bio-Savart's Law. Ampere's Law.	Ch.4.2-2, 5.1.		
8	Sept 28	Examples Bio-Savart's Law. Boundary Conditions. Inductance. Mutual Inductance.	Ch 5.2		
9	Oct 3	Inductance of a coaxial line. Faraday's Law. Transformer EMF. Motional EMF.	Ch 5.3-5.9		
10	Oct 5	Lenz's Law. Generators. The Ideal Transformer. Moving Conductor in a Static Magnetic Field.	Ch.6.		
11	Oct 10	Displacement Current. Integral Form of Maxewell's Equations. Differential Form of Maxwell's Equations.	CH6, 3.		
12	Oct 12	Review			

13	Oct 17	MIDTERM I			
14	Oct 19	Complex Numbers, Review of Phasors. Introduction to Transmission Lines.	Ch. 2.1-2.3		
15	Oct 24	Transmission Lines, Telegrapher's Equations. Wave Equation, Reflection Coefficient.	Ch. 2.4-2.5		1
16	Oct 26	Reflection Coefficient, Input Impedance.	Ch. 2-5		
17	Oct 31	Special Cases: Shorted Transmission Line, Open Transmission Line, Quarter-Wave Line, Half-Wave Line, Matched Line.			
18	Nov 2	Standing Waves.			
19	Nov 7	Power Flow.			
20	Nov 9	Smith Chart Intro, SWR	Ch.2.8		
21	Nov 14	Impedance Transformations Using Smith Chart.	2.9		
22	Nov 16	Lumped Elements and Transmission Lines. Impedance Matching with Lumped Elements.	2.10		
23	Nov 21	Impedance Matching with Transmission Lines, Shunt Stub.	Handout		
24	Nov 28	Impedance Matching Transmission Lines, Series Stub, Mixed Matching Networks.			
25	Nov 30	Review Midterm II			
26	Dec 5	MIDTERM II			
27	Dec 7	Applications of Impedance Matching. Design Requirements.			
28	Dec 12	Final Review			
29	Dec	Assessment Exam			

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Table 2. Laboratory Schedule

Week	Topic	Lab. Exercise / Text Reading
1	Introduction to Visualization, Vectors, Gradient, Contour, Quiver, Matrices, Plot Functions.	Lab 1/CH3
2	Visualization of Electric Field for Arbitrary Distribution of Charges.	Lab 2/CH4
3	Visualization of Electric Scalar Potential and Equipotential Lines. Relation to KVL. Capacitance.	Lab 3/CH4
4	Visualization of Magnetic Field for Arbitrary Surface and Volume Current Distributions.	Lab 4/CH5
5	Lab Exam 1.	
6	Magnetic Flux, Self-Inductance, Mutual Inductance.	Lab 5/CH5
7	Transformer EMF, Motional EMF.	Lab 6/CH6
8	Charge-Current Continuity Relation. Derivation of KCL.	Lab 7/CH1-CH2
9	Visualization of Wave Propagation on Transmission Lines.	Lab 8/CH2
10	Visualization of Standing Waves.	Lab 9/CH2
11	Lab Exam 2.	
12	Impedance Matching Examples.	Lab 10/CH2
13	Project Lab.	Handouts

14	Project Presentations.	
15	Final Exam.	

Course Coordinator: Milica Markovic **Date: October 10, 2006**