Rutgers University, Department of Electrical and Computer Engineering
ABET COURSE SYLLABUS
COURSE: 14:332:222

Course Catalog Description: 14:332:222 - Principles of Electrical Engineering II (3) Passive and active filter circuit design, Butterworth filter design, transient analysis by classical methods and by Laplace Transform analysis, step and impulse response, two-port networks, Introduction to Fourier Series, three phase circuits.

Pre-Requisite Courses: 01:332:221

Co-Requisite Courses: 01:640:244 and 14:332:224

Pre-Requisite by Topic:

1. The characteristics of the basic circuit elements, study of voltage and current, resistors, inductors, and capacitors.
2. Construction of circuit models and use of Kirchhoff's laws.
3. Use of the above in the steady state solution of DC and AC circuits.
4. Power calculations in DC and AC circuits.

Textbook & Materials: J. W. Nilsson and S. A. Riedel, *Electric Circuits*, 8th Ed., Prentice Hall, 2007, and class notes

References: *MatLab: Student Version*, Current Edition, The MathWorks, Inc..

Overall Educational Objective: To study passive and active filter circuit design, Transient analysis of circuits, Laplace Transforms, Two-port networks, Fourier Series, and Three Phase Circuits.

Course Learning Outcomes: A student who successfully fulfills the course requirements will have demonstrated:

1. an ability to calculate system responses by solving differential equations by classical methods
2. an ability to calculate system responses through the application of Laplace transforms
3. an ability to determine the mathematical model of linear time-invariant systems in s-domain
4. an ability to sketch the Bode diagrams for various transfer functions
5. an ability to design LPF, BPF, and HPF filters circuits (both passive and active) to meet the design specifications by utilizing a cascade of filter circuits or using Butterworth design concepts
6. an ability to understand and analyze different sets of two-port parameters
7. an ability to describe Fourier series analysis, and its uses

8. an ability to analyze three-phase circuits

How Course Outcomes are Assessed:
HW Problems (15 %)
Filter Design (15 %)
Two Mid-Term Exams (40 %)
Final Exam (30 %)

N = none S = Supportive H = highly related

Outcome	Level	Proficiency assessed by
(a) an ability to apply knowledge of Mathematics, science, and engineering	H	HW Problems, Filter design, Exams
(b) an ability to design and conduct experiments and interpret data	S	HW Filter design and construction
(c) an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	N	
(d) an ability to function as part of a multi-disciplinary team	N	
(e) an ability to identify, formulate, and solve ECE problems	H	HW Problems, Filter design, Exams
(f) an understanding of professional and ethical responsibility	N	
(g) an ability to communicate in written and oral form	S	HW Problems, Filter design report
(h) the broad education necessary to understand the impact of electrical and computer engineering solutions in a global, economic, environmental, and societal context	N	
(i) a recognition of the need for, and an ability to engage in life-long learning	S	Take-Home Filter design
(j) a knowledge of contemporary issues	N	
(k) an ability to use the techniques, skills, and modern engineering tools necessary for electrical and computer engineering practice	H	HW Problems, Filter design, Exams
Basic disciplines in Electrical Engineering	H	HW Problems, Filter design, Exams
Depth in Electrical Engineering	S	HW Problems, Filter design, Exams
Basic disciplines in Computer Engineering	S	P-Spice Simulations
Depth in Computer Engineering	N	
Laboratory equipment and software tools	S	HW Problems, Take-Home design
Variety of instruction formats	S	Lecture, office hour discussions

Topics covered week by week:

Week 1: Frequency selective circuits, Frequency response, Bode diagrams; phase angle plots.
Week 2: Parallel and series resonant circuits, filter circuits, frequency response of Op Amp circuits.
Week 3: Distortion in filter circuits, Active filter circuit design, design project.
Week 4: Butter-Worth filter design, Hourly Exam 1.
Week 5: Introduction to transient response of circuits, solution to 1rst order differential equations, RL and RC with independent and dependent sources; Sequential switching; examples; design problem.
Week 6: Differential equations for circuits with two energy storage elements, solution of the 2nd order differential equations, roots of characteristic equation in the complex plane, Complete response of RLC series and parallel circuits, state variable approach, frequency response.
Week 7: Unit Step and Impulse functions.
Week 8: Laplace Transforms and its properties.
Week 9: Inverse Laplace transforms, partial fraction expansions. Hourly Exam 2.
Week 10: Analysis of circuits in Laplace domain, step and impulse response.
Week 11: Analysis of two-port networks.
Week 12: Analysis of two-port networks (continued), introduction to Fourier series.
Week 13: Fourier series.
Week 14: Fourier series.
Weeks 15-16: Review and Final Examination

Computer Usage: Students use the computer circuit-simulation program P-*Spice* and Matlab to do Home-Work, to design filters, and in Laboratory.

Laboratory Experiences: It is a separate course 14:332:224 associated with this course.

Design Experiences: Design of Filters within realistic constraints such as economic, manufacturability, and sustainability (a take home project).

Independent Learning Experiences: 1. Home-Work problems are assigned weekly, collected and graded,

and 2. Take home filter design project as discussed above.

Contribution to the Professional Component:
(a) College-level mathematics and basic sciences: 0.25 credit hours
(b) Engineering Topics (Science and/or Design): 2.75 credit hours
(c) General Education: 0 credit hours
Total credits: 3
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