American University of Beirut
Department of Electrical and Computer Engineering
Course Syllabus
Spring Semester 2018-2019

Course Number and Title

EECE 290: Analog Signal Processing

Credit hours

3 credit hours

Catalogue Description

A course on selected topics in circuit analysis; operational amplifiers; frequency responses; Butterworth and active filters; responses to periodic inputs; real, reactive, and complex power; maximum power transfer; responses to step, impulse, and switching operations; convolution; Laplace transform and its use in circuit analysis; Fourier transform; two-port circuits; and circuit simulation using SPICE.

Required or Elective:

Required of CCE and ECE students

Prerequisites

By course: EECE 210-Electric Circuits

By topic: understanding of electric circuit analysis including KCL, KVL, mesh-current, node-voltage, superposition, source transformation, Thevenin's and Norton's equivalent circuits, simple differential equations and complex numbers

Textbooks

- Reference 1: Nilsson/ Riedel, Electric Circuits, 10th Edition, Pearson, 2015
- Reference 2: Prof. Nassir Sabah, Electric Circuits and Signals, CRC Press, Selected Topics in Circuit Analysis, 2015

Course Objectives

The objectives of the course are to enable students to understand:	*Correlates to program objectives*
Ideal operational amplifiers and analyze simple op amp circuits	1,2,3
Real, reactive and complex power and applications	1,2,3
Laplace transform and its applications in circuit analysis	1,2,3
Laplace transform and its applications in circuit analysis	1,2,3
Impulse responses and convolution	1,2,3
Passive and active filters, their transfer functions, graphical representations, and implementations	1,2,3,4
Fourier series and transform and its application in circuit analysis	1,2,3

Course Topics

Chapter 5: Ideal operational amplifier: basic properties, Feedback, Noninverting configuration, Inverting configuration and applications.

Chapter 10: Sinusoidal Steady-State Power Calculations: Instantaneous Power, Average and Reactive Power, The rms value and Power Calculations, Complex Power, Power Calculations and

Maximum Power Transfer.

Chapter 12: Introduction to the Laplace Transform: Definition of the Laplace Transform, The Step Function, The Impulse Function, Operational Transforms, Applying Laplace Transforms, Inverse Laplace Transform, Poles and Zeros of F(s), and Initial and Final Value Theorems.

Chapter 13: The Laplace Transform in Circuit Analysis**:** Circuit Elements in the S-domain, Circuit Analysis in the S-domain, Applications, the Transfer Function, Convolution integral, Transfer function and steady state response

Chapter 14: Introduction to Frequency Selective Circuits, Low pass, band-pass, band-reject, and High-pass filters

Chapter 15: Active Filter Circuits, First-Order Low-Pass and High-Pass filters, Scaling, OP-Amp band-pass and band-reject filters, high-order OP-Amp filters, Narrow-band pass and band-reject filters.

Chapter 16: Fourier series: Fourier Series analysis, Fourier coefficients, effect of symmetry on the Fourier Coefficients, Average power calculations, the rms value of a periodic function, the exponential form of the Fourier Series.

Chapter 17: The Fourier Transform: Derivation of the Fourier transform, Fourier transforms and limits, mathematical properties, Operational transforms, circuit applications, Parseval's Theorem.

Course Learning Outcomes

At the end of the course, students should be able to:

1. Solve and analyze simple circuits containing op amps that include inverting amplifiers, noninverting amplifiers, summing amplifiers, and difference amplifiers.
2. Compute the different forms of ac power (real, reactive, complex) in ac circuits and apply the condition for maximum real power to a load.
3. Compute the Laplace transform of a function using the definition and/or a table of operational transforms, and calculate the inverse Laplace transform using partial fraction expansion and the Laplace transform table.
4. Transform a circuit into the s-domain and determine its response and transform back the solution into the time domain.
5. Explain the significance of a transfer function and calculate the transfer function of a circuit using s-domain techniques.)
6. Explain the relation between impulse response, transfer function, and convolution integral.
7. Analyze different RLC frequency selective circuits and identify their cutoff frequencies, center frequency and bandwidth.
8. Analyze and design active filters circuits starting from a prototype to achieve a desired frequency response.
9. Calculate the trigonometric form of the Fourier coefficients of a periodic waveform and identify the simplifications possible for different types of symmetry.
10. Determine the response of a circuit to a periodic input using the Fourier coefficients and superposition.
11. Compute the Fourier Transform of a function and explain how it can be applied in circuit analysis.

Resources

Textbook or reference material, Moodle, and PSPICE

Evaluation Methods

Final exam: 40%, Quiz 1 and 2 45%, Problem Solving Sessions 15%, and attendance

Professional Components

Engineering topics: 75%
General education: 0%
Mathematics and basic sciences: 25%