

## **ELEC5405**

# **Advanced Linear and Nonlinear Circuit Theory and Applications**

*The objective of this course is to provide in-depth understanding of the fundamental basis and advanced concepts of linear and nonlinear circuit theory. The course covers both the analysis and synthesis areas with the objective of making the mathematical foundations more accessible. The focus will be on establishing the link between the fundamental basis and applied circuit techniques.*

### **Schedule:**

**Lectures:** Tuesday and Thursday 1:00-2:30pm (**starting September 10**)

### **Classroom:**

For the virtual classroom and Labs, we will be using **BigBlueButton** within CuLearn.

*(BigBlueButton is a web conferencing tool that facilitates online and real-time teaching and communication)*

For more info on BBB, please check the following site:

<https://carleton.ca/culearnsupport/students/bigbluebutton/>

# Course Outline

## State-Space:

- Concept of states
- Time-invariant and time-variant circuits
- Dynamical equations
- State-transition matrix
- Periodic circuits

## Circuit Properties:

- Frequency, time and Laplace-domains
- BIBO and Asymptotic stability
- Lyapunov equations
- Multiport network
- Passivity
- Causality
- Nonlinearity

## Formulation of the State-Space Equations:

- Graph theory
- Oriented graphs
- Incidence and cutset matrices
- Topological constraints
- Tellegen's theorem.

## Synthesis:

- Realizability conditions
- Synthesis of passive circuits
- Synthesis of active circuits

## Nonlinear Circuits:

- Properties
- Stability conditions

## References

### Computer Methods for Circuit Analysis & Design

*J. Vlach and K. Singhal, Van Nostrand Reinhold 1983/ 1994*

### Linear and Nonlinear Circuits

L. Chua, C. Desoer, McGraw-Hill, 1987

### Linear System Theory

W. Rugh, Prentice Hall, 1996

+ HANDOUTS + [Your Class Notes](#)

## Instructor:

Prof. Michel Nakhla

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<http://www.doe.carleton.ca/~msn/>

***Background Pre-requisite:***

*Analytical skills and strong theoretical background in Linear Algebra, Math, Numerical techniques and Circuit Theory*

**Course Grading**

**55% Final Exam (*open book*)**

**45% Midterm Exams and Assignments**

***Passing the final exam is necessary condition for passing the course***

Equity Services Accommodation:

<http://www.carleton.ca/equity/accommodation/outlines.htm>