CMP2102 Electric Circuits and Signals

Period per Week			Contact Hour per Semester	Weighted Total Mark	Weighted Exam Mark	Weighted Continuous Assessment Mark	Credit Units
LH	PH	TH	CH	WTM	WEM	WCM	CU
45	30	00	60	100	40	100	4

Rationale

Circuits and signals are foundational material for computer engineering. These areas provide the basic knowledge for the design of the circuits used to implement computers. Knowledge of the electrical circuits used to implement digital circuits and computers is crucial to the computer engineer.

Objective

The course aims to provide the student with:

- An introduction of circuit analysis concepts and theorems used in DC and AC analysis, alongside laboratory work in order to enable one appreciate the practicality of theoretical aspects.
- Skills for the analysis of electrical circuits of continuous current. Different methods and techniques for the analysis and simplification of electric circuits are studied in detail, making the student able to identify the most adequate technique in each case. Circuits are analyzed and simulated using PSPICE and then constructed in laboratory to compare calculated and measured results.
- The ability to formulate and solve the differential equations describing time behavior of circuits containing energy storage elements.
- The capability to design and construct circuits, take measurements of circuit behavior and performance, compare with predicted circuit models and explain discrepancies.

Course Content

1. History and Overview

- Indicate some reasons for studying circuits and systems
- Highlight some people that influenced or contributed to the area of circuits and systems

- Indicate some important topic areas such as electrical quantities, resistance, reactance, frequency response, sinusoids, convolution, discrete-time signals, Fourier representation, filters, and transforms
- Contrast between current and voltage
- Describe Ohm's Law
- Explain reactive elements such as inductance and capacitance
- Indicate that frequency affects reactive elements, but not resistance elements ; Mention phase and the meaning of being "out of phase "
- Distinguish how signal sampling can produce aliasing and quantizing
- Illustrate the design of a "square wave" from a trigonometric Fourier series
- Explore some additional resources associated with circuits and systems
- Explain the purpose and role of circuits and systems in computer engineering

2. ***Electrical Quantities***
   - Charge
   - Current
   - Voltage
   - Energy
   - Power
3. ***Resistive Circuits and Networks***
   - Ohm's Law
   - Kirchoff's laws
   - Independent and dependent sources
   - Series and parallel elements
   - Voltage and Current measurement
   - Mesh and Nodal analysis
   - Superposition
   - Thevenin's and Norton's theorems
   - Maximum power transfer
4. ***Reactive Circuits and Networks***
   - Inductance
   - Capacitance
   - Mutual inductance
   - Time constants for RL and RC circuits
   - Transient response of RL, RC, and RLC circuits
   - Damping
   - Transformers
5. ***Frequency Response***
   - Response of RL, RC, and RLC circuits
   - Transfer functions
   - Two-port circuits
   - Parallel and series resonance.
6. ***Sinusoidal Analysis***
   - Phasor representation of voltage and current
   - Forced response to sinusoidal functions
   - Impedance and Admittance
   - Nodal and Mesh analysis
   - Thevenin's and Norton's theorems

- Phasor diagrams
- Superposition
- Source transformations

7. Convolution

- Impulse response
- Convolution integral
- Physically realizable systems
- Graphical methods

Learning Outcomes

On completion of this course the students will:

- Appreciate new concepts in AC and DC Circuit analysis and on completion of this course unit a student will be firmly convinced that the theorems and concepts hold practically;
- Become adept at using various methods of circuit analysis, including simplified methods such as series-parallel reductions, voltage and current dividers, and the node method;
- Appreciate the consequences of linearity, in particular the principle of superposition and Thevenin-Norton equivalent circuits.

Recommended and Reference Books

[1] Dorf and Svoboda, *Electrical circuits: Introduction*

[2] D. R. Cunningham and S. A. Stuller, *Basic Circuit Analysis*, Jaico, 2005

[3] W. H. Hayt, J. E. Kemmerly and S. M. Durbin, *Engineering Circuit Analysis*, 6th ed., Tata McGraw-Hill, New Delhi, 2006