ESCUELA SUPERIOR POLITÉCNICA DEL LITORAL
Faculty of Electrical and Computer Engineering
COURSE SYLLABUS
Electrical Network Analysis II

1. CODE AND NUMBER OF CREDITS

CODE	FIEC01784	
NUMBER OF CREDITS : 5	**Theoretical:** 5	**Practical: 0**

2. COURSE DESCRIPTION

The course covers in the first part, the analysis of electrical networks using transient techniques in the time domain. In the second part deals with techniques in the frequency domain using the Laplace Transform as a tool of analysis.
During the development of the course, students apply the techniques imparted to the analysis of electrical circuits interactively with the teacher and their peers in class. This is complemented with guides of exercises and periodical evaluations assigned as short lessons.
The course is a theoretical type training material and therefore applied in all technical signatures of engineering in electricity. The course requires that the students handle the techniques learned in the field of electrical network analysis I and also a basic knowledge of differential equations solutions and of the Laplace Transform.

3. PRE-REQUISITES AND CO-REQUISITES

PRE-REQUISITES	FIEC01735 ELECTRICAL NETWORK ANALYSIS I ICM01974 DIFFERENTIAL EQUATIONS
CO-REQUISITES	

4. CORE TEXT AND OTHER REQUIRED REFERENCES FOR THE TEACHING OF THE COURSE

CORE TEXT	1. William H. Hayt - Jack E. Kemmerly - Steven M. Durbin, "Análisis de Circuitos en Ingeniería", 7ma. edición 2007 o superior, McGraw-Hill.
REFERENCES	1. M. E. Van Valkenburg, "Análisis de Redes", 3era. edición, reimpresión 1999, Editorial Limusa. 2. David E. Johnson – John L. Hilburn – Johnny R. Johnson – Peter D. Scott, "Análisis Básico de Circuitos Eléctricos", 5ta. Edición 1996 o superior, Prentice Hall 3. James W. Nilsson, "Electric Circuits", Third edition 1990, Addison Wesley Publishing Company

5. COURSE LEARNING OUTCOMES

At the end of the course, the student will be able to:

1. Analyze and solve linear electrical networks to determine their dynamic response: transient components and steady state techniques using both time-domain and in the frequency domain (Laplace Transform).
2. Analyze the natural behavior of the ideal inductor and the ideal capacitor from the equations that describes its operation.
3. Analyze circuits of first and second order, using techniques in the time domain.
4. Calculate the total response (natural and forced) of circuits of first and second order.
5. Apply the technique of Laplace transform to solve linear circuits.
6. Calculate and interpret the features of one and two ports networks.
7. Determine the poles and zeros of network functions, its relationship to the stability of active networks and their effects on the response in time.
8. Draw and interpret the graphs of frequency response of functions networks.
9. Calculate the different types of parameters of two-port networks and their interconnections.

6. COURSE PROGRAM

I. INDUCTANCE AND CAPACITANCE. (3 sessions - 7.5 hours).

- Behavior with continuous excitations.
- Energy considerations.
- Abrupt variations of current on the ideal inductor.
- Abrupt variations of voltage on the ideal capacitor.
- Reduction of inductors and capacitors in series and parallel.

II. TRANSIENT BEHAVIOR FOR FIRST ORDER CIRCUITS WITHOUT SOURCES. (3 sessions- 7.5 hours)

- Simple RL circuit.
- Exponential response properties
- More general RL Circuit.
- Simple RC circuit. Duality.
- More general RC circuit.

III. TRANSIENT BEHAVIOR FOR FIRST ORDER CIRCUITS WITH SOURCES. (3 sessions- 7.5 hours)

- Application of the unit step function excitation.
- Natural response of RL and RC circuits.
- Forced or steady state response
- Total response.
- Integration Factor Method.

IV. SECOND ORDER TRANSIENT OR RLC CIRCUITS (5 sessions - 12.5 hours).

- Parallel RLC circuit without sources; cases: Overdamped, Critically damped and Underdamped.
- Series RLC circuit without sources; cases: Overdamped, Critically damped and Underdamped. Duality.
- Complete response of RLC circuits.
- Determination of initial conditions in networks with degeneration.
- Degenerate or loops circuits. Principle of Conservation of charge.
- Degenerate or node cut sets. Principle of Continuity of Flow linkages.

V. APPLICATION OF THE LAPLACE TRANSFORM IN SOLVING CIRCUITS (3 sessions - 7.5 hours).

- Definition of the Laplace Transform.
- Laplace Transform of simple time functions.
- Fundamental theorems for the Laplace Transform. Initial Value and Final Value Theorems.
- Partial Fraction Expansion.
- Application of the Laplace Transform to the solution of first and second order circuits.
- Transformed of other waveforms signals. Signal synthesis.

VI. TRANSFORMED CIRCUITS. NETWORK THEOREMS. (2 sessions - 5 hours).

- Transformed impedance and Transformed circuits.
- Solution of transformed circuits. Obtaining the complete response.
- Thevenin and Norton Theorems in transformed circuits.

VII. NETWORK FUNCTIONS: POLES AND ZEROS. (4 sessions - 10 hours).

- Definition of network functions and network transfer functions for one port and two ports circuits.
- Calculation of network functions for one and two network ports.
- Function pole and zero point and transfer driving.
- Restrictions on the location of poles and zeros for driving point and transfer functions.
- Relationship between the s-plane and time domain: Locus of the poles in the s-plane, behavior on time from pole-zero diagram.
- Graphical method for the determination of residues.
- Active networks Stability: Routh-Hurwitz criterion

VIII. FREQUENCY RESPONSE AND GRAPHICS. (3 sessions - 7.5 hours).

- Parts of the network functions.
- Graphs of magnitude and phase. Polar diagrams.
- Bode diagrams

IX. PARAMETERS OF TWO PORT NETWORKS. (2 sessions - 5 hours)

- Relation of variables for two-port networks.
- Open circuit Impedance parameters.
- Short circuit Admittance parameters.
- Direct and Invert Transmission Parameters.
- Direct and Invert Hybrid Parameters.
- Relations between sets of parameters
- Interconnection of two port networks: Series, Parallel and Cascade.

7. WORKLOAD: THEORY/PRACTICE

Number of sessions per week: 2
Number of hours per session: 2.5
Total number of hours of classes per week: 5

8. CONTRIBUTION OF THE COURSE TO THE EDUCATION OF THE STUDENT

THe course contributes to the formation of an engineer providing it with the techniques of analyzing the dynamic behavior of circuits on the basis of knowledge of the principles, laws and fundamentals of electrical network theory.

BASIC TRAINING	PROFESSIONAL TRAINING	SOCIAL SKILLS DEVELOPMENT
	X	

9. THE RELATIONSHIP BETWEEN THE LEARNING OUTCOMES OF THE COURSE AND THE LEARNING OUTCOMES OF THE DEGREE PROGRAM

LEARNING OUTCOMES OF THE DEGREE PROGRAM*	CONTRIBUTION (High, Medium, Low)	LEARNING OUTCOMES OF THE COURSE**	THE STUDENT MUST:
a) An ability to apply knowledge of mathematics, science and engineering.	High	1,2,3,4,5,6,7,8,9	Solve differential equations and / or algebraic model grids using different techniques. Plot the frequency response of a network. Interpreting and using graphs to understand the operation of the network. Determine the parameters of two-port networks to simplify analysis
b) An ability to design and conduct experiments, and to analyze and interpret data			
c) An ability to design a system, component or process to satisfy realistic constraints.			
d) An ability to function on multidisciplinary teams.	Low	1	Working in groups to solve electrical network analysis.
e) An ability to identify, formulate and solve engineering problems.	Medium	1,7	Apply the knowledge acquired in the course to understand how other types of physical systems work. Study the problem of the stability of active networks and apply a method for determining it.
f) An understanding of ethical and professional responsibility.			
g) An ability to communicate effectively.	Low	1	Express orally or written the appropriate procedure to analyze and solve an

			electrical circuit.
h) A broad education necessary to understand the impact of engineering solutions in a social, environmental, economic and global context.			
i) A recognition of the need for, and an ability to engage in life-long learning.	Low	1	Find and read updated information sources.
j) A knowledge of contemporary issues.			
k) An ability to use the techniques, skills, and modern tools necessary for engineering practice.	Medium	1,3,4,5	Simulation tools use electrical circuitry to verify the solution obtained through conventional methods.
l) Capacity to lead, manage and undertake projects.			

10. EVALUATION IN THE COURSE

Evaluation activities	
Exams	X
Tests	X
Homework/tasks	
Projects	
Laboratory/Experiments	
Class participation	
Visits	
Other	

11. PERSON RESPONSIBLE FOR THE CREATION OF THE SYLLABUS AND THE DATE OF ITS CREATION

Created by	Ing. Carlos Villafuerte P.
Date	05 SEPT 2013

12. APPROVAL

ACADEMIC SECRETARY OF THE ACADEMIC DEPARTMENT	DIRECTOR OF TECHNICAL ACADEMIC SECRETARY
NAME: Mrs. Leonor Cai...	NAME: Ing. Marcos Mendoza
SIGNATURE:	SIGNATURE: ESCUELA SUPERIOR POLITÉCNICA DEL LITORAL
Date of approval by the Directive Council: 2013-537 2013-10-7	Ing. Marcos Mendoza V. DIRECTOR DE LA SECRETARIA TÉCNICA ACADÉMICA

13. VALIDITY OF THE SYLLABUS

RESOLUTION OF THE POLYTECHNIC BOARD:	13-12-343
DATE:	2013-12-12