SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE OUTLINE:	NETWORK ANALYSIS
CODE NO.:	ELR 309-8
PROGRAM:	ELECTRICAL/ELECTRONIC TECHNOLOGY
SEMESTER:	FIVE
DATE:	SEPTEMBER 1988
PREVIOUS OUTLINE DATED:	SEPTEMBER 1985
AUTHOR:	BOB HEATH

NEW:______ REV.:____X____

APPROVED: ______________ CHAIRPERSON   90/08/15 DATE

NETWORK ANALYSIS
COURSE NAME

ELR 3Ø9 - 8
CODE NUMBER

TOTAL CREDIT HOURS: 1Ø5

PREREQUISITE(S): MTH 577

PHILOSOPHY/GOALS:

THE STUDENT WILL STUDY AC & DC CIRCUITS IN-DEPTH USING NETWORK THEORMS, DIFFERENTIAL EQUATIONS, LAPLACE TRANSFORMS, FOURIER ANALYSIS USING TRADTIONAL SOLUTION TECHNIQUES AS WELL AS THE APPLICATION OF COMPUTER SOLUTION TECHNIQUES .

STUDENT PERFORMANCE OBJECTIVES:

UPON SUCCESSFUL COMPLETION OF THIS COURSE, THE STUDENT WILL BE ABLE TO:

1) DEFINE AND DISCUSS BASIC CIRCUIT LAWS AND ANALYSIS METHODS.
2) SOLVE INITIAL, FINAL AND FIRST-ORDER CAPACITIVE AND INDUCTIVE CIRCUITS.
3) ANALYZE CIRCUITS WITH LAPLACE TRANSFORMS.
4) PERFORM WAVEFORM ANALYSIS USING MATHCAD.

NETWORK ANALYSIS
COURSE NAME

ELR309 - 8
CODE NUMBER

TOPICS TO BE COVERED:

1) OVERVIEW OF BASIC CIRCUIT LAWS.

2) INTODUCTION TO CIRCUIT ANALYSIS METHODS.

3) APPLICATION OF CIRCUIT ANALYSIS TO CAPACITIVE AND INDUCTIVE CIRCUITS.

4) SOLVING FIRST ORDER DIFFERENTIAL CIRCUITS.

5) CIRCUIT ANALYSIS WITH LAPLACE TRANSFORMS.

6) INTRODUCTION TO TRANSFER FUNCTIONS.

7) INTRODUCTION TO SINUSOIDAL STEADY-STATE ANALYSIS.

8) INTRODUCITON TO FREQUENCY RESPONSE ANALYSIS

9) INTRODCUTION TO WAVEFORM ANALYSIS.

REQUIRED STUDENT RESOURCES
(INCLUDING TEXTBOOKS & WORKBOOKS)

1) L.P. HUELSOMAN, BASIC CIRCUIT THEORY
TORONTO, PRENTICE-HALL, 1984

2) R.B. ANDERSON, THE STUDENT EDITION OF MATHCAD, VER.2.0
TORONTO, ADDIOSN WESLEY, 1989

Sep 1/87

ONA-1

ELR309 - NETWORK ANALYSIS

COURSE OBJECTIVES

Upon completion of each block and upon completion of the course, the student shall be able to perform each stated objective.

BLOCK 1 - BASIC CIRCUIT LAWS

1. Define the basic circuit quantities and state the symbols and units used to represent them.
2. Define the basic active and passive models and sketch their schematic forms.
3. Explain power conventions and determine when power is absorbed or delivered.
4. State and apply Ohm´s Law.
5. State and apply Kirchhoff´s voltage and current laws.
6. Determine the equivalent resistance of complex resistive networks.
7. State and apply the voltage and current divider rules to complex resistive networks.
8. Define the form types of controlled (or dependent) sources and discuss their significance in circuit modelling.

BLOCK 2 - CIRCUIT ANALYSIS METHODS

1. Determine the current, voltages and power in a single loop circuit.
2. Determine the voltage, currents and power in a single node-pair circuit.
3. Apply source transformations to simplify source models.
4. Determine appropriate models for realistic voltage and/or current sources.
5. Apply mesh current analysis to determine all voltages, currents and power in a circuit containing several meshes.
6. Apply node voltage analysis to determine all voltages, currents and power in a circuit containing several nodes.
7. Determine the Thevenin and Norton equivalent circuits for a given circuit.

8. Apply various circuit analysis methods to circuits containing dependent (or controlled) sources.

9. Apply the principle of superposition in the analysis of linear circuits.

BLOCK 3 - CAPACITIVE AND INDUCTIVE TRANSIENTS AND EQUIVALENT CIRCUITS

1. Apply graphical differentiation to piecewise linear continuous functions.

2. Apply graphical integration to piecewise linear functions.

3. State and apply the instantaneous voltage-current relations for a capacitance.

4. State and apply the instantaneous voltage-current relationships for an inductance.

5. Obtain the equivalent capacitance of a complex network of capacitors.

6. Obtain the equivalent inductance of a complex network of inductors.

7. State and apply the voltage-current relationships for mutual inductance.

8. State and apply the relationships for ideal transformers.

BLOCK 4 - INITIAL, FINAL AND FIRST-ORDER CIRCUITS

1. Determine the equivalent circuits and predict the voltages and currents in a circuit immediately after an excitation is first applied.

2. Determine equivalent circuits and predict the voltages and currents in a circuit after DC steady-state conditions have been reached.

3. State the mathematical properties for and sketch the exponential function.

4. Recognize the form of a first-order circuit with DC excitation.

5. Determine the mathematical equation for and sketch the voltage and current responses in a first-order circuit with DC excitations.

6. Determine the time required for an exponential response to reach any value.

BLOCK 5 - LAPLACE TRANSFORMS

1. Define and explain the purposes of the Laplace transforms as applied to circuit analysis.

2. State the Laplace transforms for the most common functions encountered in circuit analysis.

3. State the forms of the most common Laplace transform operations.

4. Determine the Laplace transform of a given time function.

5. Determine the inverse transform of a given s-domain function.

BLOCK 6 - CIRCUIT ANALYSIS WITH LAPLACE TRANSFORMS

1. Define transform impedance and admittance and determine these quantities for any given circuit element.

2. Represent initial conditions for capacitors and inductors in terms of s-domain Thevenin and Norton models.

3. Determine the complete s-domain model for a given circuit.

4. Apply various circuit analysis methods to s-domain circuit models.

5. Identify the natural and forced responses and determine when these represent transient and steady-state responses.

6. Apply Laplace transform methods to obtain complete solutions for first-order circuits with artitrary excitations.

7. Apply Laplace transform methods to obtain complete solutions for second-order circuits.

BLOCK 7 - TRANSFER FUNCTIONS

1. State the conditions for a system to be linear, lumped and time-invariant.

2. Define the transfer function and the input-output relationship for a linear system.

3. Determine the transfer function for a given circuit.

4. Determine the output of a given system from a knowledge of the transfer function and the input.

5. Determine the poles and zeros from a given transfer function.

6. Construct an s-plane pole-zero diagram and show its relationship to the transfer function.

7. Define a stable system, a marginally stable system, and an unstable system, and discuss the relationship to the poles and zeros of the transfer function.

8. Apply block diagram algebra to simplify interconnections of transfer functions.

9. Discuss the form of the step response of a second-order system.

BLOCK 8 - SINUSOIDAL STEADY-STATE ANALYSIS

1. Represent a sinusoidal voltage or current as a complex phasor.

2. Obtain a single sinusoid equivalent to the sum of several sinusoids of the same frequency using phasor analysis.

3. Define the following terms based on the sinusoidal steady-state: impedance, resistance, reactance, admittance, conductance and susceptance.

4. Determine inductive reactance and susceptance for a given inductance.

5. Determine capacitive reactance and susceptance for a given capacitance.

6. Transform a complete circuit to the steady-state phasor form.

7. Apply basic circuit analysis methods to phasor circuit models to determine complete solutions.

8. Compute average power in a sinusoidal steady-state circuit.

BLOCK 9 - FREQUENCY RESPONSE ANALYSIS AND BODE PLOTS

1. Discuss and show the mathematical relationship between the s-domain and the phasor domain.

2. Define the steady-state transfer function, and show how it relates to the s-domain transfer function.

3. Determine the steady-state transfer function for a given circuit.

4. Define the linear amplitude response, the decibel amplitude response, and the phase response, and determine these functions from the steady-state transfer function.

5. Discuss the form of a Bode plot, and explain its significance.

6. Construct a Bode plot decibel amplitude response from a given transfer function or circuit.

7. Same as (6) for a Bode plot phase response.

BLOCK 10 - WAVEFORM ANALYSIS

1. Determine the DC value of a periodic waveform and explain its significance.

2. Determine the rms value of a periodic waveform and explain its significance.

3. Determine the average power dissipated in a resistor by a periodic waveform or current.

4. Define and sketch the step and ramp functions.

5. Express the mathematical equation for and sketch the form of a delayed function.

6. Express various peicewise linear waveforms in terms of step and ramp functions starting at appropriate times.

7. Apply superposition to determine the response of a circuit excited by a waveform composed of various step and ramp components as in (6).

8. Define the unit impulse function and explain its relationship to the unit step function.

9. Define the form of a Fourier series and discuss the practical significance in spectral analysis.

10. Determine the Fourier series for certain "standard" waveforms.

11. Apply symmetrical conditions to simplify the computation in (10).

REH 1987 September