EEE 33 Electric Circuit Theory

Course Description: Analysis of Resistive Circuits. Equilibrium Equations for RLC Networks. Transient Analysis of First-Order and Higher-Order Networks. Sinusoidal Steady-State Analysis. Resonance and Electric Filters. Two-Port Networks.

Pre-requisites: Math 53 and EEE 31
Credits: 4 units (4 units lecture)
Schedule: 2 meetings/week for the lecture, 2.0 hours/meeting;

Course Goal: To learn the different methods, techniques and theorems used to determine, evaluate, analyze, assess and quantify the performance of linear electric circuits.

Course Objectives: The student who successfully completes the course will be able

1. To formulate and solve mathematical equations that describe resistive circuits and apply the theorems that are used to analyze resistive circuits;
2. To formulate mathematical equations that describe electric circuits with resistors, inductors and capacitors;
3. To determine the performance of first-order and higher-order networks under transient conditions;
4. To evaluate the steady-state performance of electric circuits with sinusoidal excitation;
5. To analyze and design electric filters and other electric circuits that exhibit a discriminatory behavior against certain frequency bands; and
6. To determine and apply the various two-port network parameters in evaluating the response of electric circuits.

Course Outline

Mtg No	Lecture Topic	Objective	Important dates
1-2	Course Outline. Class Policies and Grading. Series and Parallel Resistors.	To discuss the content of the course and approve the class policies. To be able to apply KVL and KCL in the analysis of simple resistive circuits.	HW 1 out: 16 Jun HW 1 due: 23 Jun HW 2 out: 28 Jun HW 2 due: 30 Jun PS 1 out: 23 Jun PS 1 due: 30 Jun Exam 1: 4 Jul
	Delta-Wye Transformation. Dependent Sources. The Operational Amplifier.	To be able to simplify more complex resistive circuits. To describe the different types of dependent sources. To discuss the Operational Amplifier as a practical application of resistive circuits.	
	Nodal Analysis. Loop Analysis.	To be able to solve resistive circuits using nodal analysis and loop (or mesh) analysis.	
3	Linearity and the Principle of Superposition.	To define a linear electric circuit and to be able to solve linear resistive circuits using the principle of superposition.	
4	Thevenin's Theorem and Norton's Theorem.	To be able to solve linear resistive circuits using Thevenin's and Norton's theorems. To discuss the condition for maximum power transfer.	
EXAM 1: July 4 (Mon) 8 – 10 AM			
5	Self and Mutual Inductances. Capacitance. Op Amp Integrator.	To describe the inductor, capacitor and Op Amp Integrator as circuit elements. To discuss the behavior of magnetically-coupled coils. To be able to simplify combinations of inductors and capacitors.	HW 1 out: 19 Jul HW 1 due: 26 Jul HW 2 out: 2 Aug HW 2 due: 4 Aug PS 2 out: 28 Jul PS 2 due: 4 Aug Exam 2: 8 Aug
6	Nodal Formulation and Loop Formulation for RLC Circuits.	To be able to formulate equilibrium equations describing electric circuits containing resistors, inductors and capacitors.	
7	Source-Free RL and RC Circuits.	To be able to solve a homogeneous first-order differential equation. To be able to determine the transient response of source-free RL and RC circuits (one L or one C but any number of resistors).	

8	RL and RC Circuits with Constant or Time Varying Source.	To be able to solve a first-order differential equation with a constant or time-varying forcing function. To be able to determine the complete response (steady-state, transient and initial conditions) of RL and RC circuits with constant sources.	
9	Source-Free Series RLC and Parallel RLC Circuits.	To be able to solve a homogeneous second-order differential equation. To be able to determine the transient response of a source-free series RLC or parallel RLC circuit. To discuss the significance of over-damped, under-damped and critically-damped electric circuits.	
10	Formulation of Higher-Order Differential Equations.	To be able to apply the method of operators to get the differential equation that describes any voltage or current in circuits containing R, L and C.	
11	Evaluation of Initial Conditions.	To be able to calculate the initial value and the initial derivative(s) of any current or voltage in a circuit with R, L and C.	
12	Solution of Higher-Order Differential Equations.	To be able to determine the complete solution (transient, steady-state, initial conditions and constants) of a second-order differential equation. To be able to determine the general solution of an n^{th}–order differential equation.	
EXAM 2: August 8 (Mon), 8 – 10 AM			
13	The Sinusoidal Forcing Function	To describe the characteristics of the sinusoidal function and to derive its effective (or RMS) value. To discuss algebra of complex numbers.	HW 1 out: 18 Aug HW 1 due: 25 Aug HW 2 out: 30 Aug HW 2 due: 1 Sep PS 3 out: 25 Aug PS 3 due: 1 Sep Exam 3: 5 Sep
14	The Phasor Method. Nodal Analysis and Loop Analysis.	To discuss the phasor transformation for circuits with sinusoidal excitation. To be able to solve the transformed network using nodal analysis and loop analysis.	
15	The Phasor Method. Superposition and Thevenin's Theorem.	To be able to solve the transformed network using Thevenin's theorem and the principle of superposition.	
16	Power Equations	To derive the equations for instantaneous and average power. To define real power, reactive power, apparent power and complex power.	
17	Power Calculations.	To be able to apply the power equations in the analysis of the transformed network.	
18	Introduction to Balanced Three-Phase System. The Ideal Two-Winding Transformer.	To define the balanced three-phase system and to be able to determine the single-phase equivalent of a balanced three-phase circuit. To discuss the theory and derive the equations of an ideal two-winding transformer.	
EXAM 3: Sept 5 (Mon) 8 – 10 AM			
19	Series RLC Resonance. Parallel RLC Resonance.	To describe the series RLC and parallel RLC resonant circuits and to derive the equations describing their performance as frequency-selective circuits.	HW 1 out: 13 Sep HW 1 due: 20 Sep HW 2 out: 27 Sep HW 2 due: 29 Sep PS 4 out: 22 Sep PS 4 due: 29 Sep Exam 4: 3 Oct
20	Other Resonant Circuits. Low-Pass and High-Pass Filters.	To describe other resonant circuits and to discuss the theory of operation of simple low-pass and	

		high-pass filters. To be able to design simple filters.	
21	Op-Amp Filters	To be able to analyze and design Op Amp filters for practical applications.	
22	Impedance and Admittance Parameters	To derive and apply the z and y parameters in the analysis of a given electric circuit.	
23	Hybrid and Transmission Parameters	To derive and apply the G, H and ABCD parameters in the analysis of a given electric circuit.	
24	Interconnected Two-Port Networks.	To derive and apply the overall two-port parameters for electric circuits in series, parallel, hybrid or cascade connection.	
EXAM 4: October 3 (Mon) 8 – 10 AM			

Course Requirements and Class Policies

1. The final grade will be computed using the following distribution:

Long exams	70%
Problem sets	10%
Homeworks	10%
Attendance	5%
Board work	5%

2. One percentage point (1%) will be deducted from the attendance component of the grade (5%) for every absence in the large class OR discussion class. A student incurring more than 6 absences will be advised to drop the class or will be given a grade of 5.0.

3. There will be four (4) long exams. All exams are departmental and the topics covered of each exam are defined in the course outline.

4. Re-grade of exams will be entertained only up to a week after the results of the exam are handed out.

5. The homeworks and problem set questions will be posted at http://server1.eee.upd.edu.ph/manuel on the dates specified in the course outlines. They are due in the beginning of class on the due dates specified in the outline. Late papers will not be entertained.

6. Cheating is punishable with a grade of 5 plus the filing of a disciplinary case. Copying of homeworks and problem sets is considered as cheating.

7. The following grading scale will be applied:

92 – 100	1.0	72 – 75+	2.25	Below 55	5.0
88 – 91+	1.25	68 – 71+	2.5		
84 – 87+	1.5	64 – 67+	2.75		
80 – 83+	1.75	60 – 63+	3.0		
76 – 79+	2.0	55 – 59+	4.0		

8. A removal exam will be given during the final exam period.

9. If a student fails to take any of the scheduled long exams, he or she must notify his or her instructor as soon as possible. The student must secure an official excuse slip from the College Secretary and submit the same to his or her DC instructor within one week after he or she officially reports for class. If the absence is due to a valid reason, the student should take the removal exam, and the score in this exam will take the place of the missed exam. The removal exam can replace the missed exam at most once. A succeeding missed exam will be given a grade of zero.

10. All lecture materials, including the course outline and the class policies and grading system, will be uploaded at http://server1.eee.upd.edu.ph/manuel

Reference:

W. H. Hayt,J. E. Kemmerly, and S. M. Durbin, *Engineering Circuit Analysis, 7th ed.*, Mc-Graw Hill © 2007.