332:222 Principles of Electrical Engineering II– Spring 1999

Text: Electric Circuits by James W. Nilsson and Susan A. Riedel, Fifth Edition, Addison Wesley. Class notes on *Magnetic Circuits and Electromechanics* will be distributed to all students.

Syllabus: Chapters 7, 8, 11, 12, 13, 14, 15, 16, and 19 of the above text by Nilsson and Riedel + Class Notes on Magnetic Circuits and Electromechanics.

The following is the approximate time-schedule covering 28 class periods. The first topic constitutes Part 1 of the course and covers frequency selective networks or filters. Topics 2 to 6 constitutes Part 2 of the course and covers time-domain analysis of circuits. The last five topics constitutes Part 3 of the course and covers three phase circuits, magnetic circuits, and electromechanics.

Subject Material	**Subject Source**	**# of class periods**
1. Filter Circuits	Chapters 15 and 16	7 class periods
2. First-order circuits	Chapter 7	2.5 class periods
3. Second-order circuits	Chapter 8	3.0 class periods
4. Intro. to Laplace Transforms	Chapter 13	2 class periods
5. Transform methods in Circuits	Chapter 14	2.5 class periods
6. Two-Port Circuits	Chapter 19	1 class period
7. Three Phase Circuits	Chapter 11	2 class periods
8. Review of Physics	Notes	1 class period
9. Magnetic Circuits	Notes	1 class period
10. Transformers & Mutual Inductance	Notes & Chapter 12	1.5 class periods
11. Electromechanics	Notes	4.5 class periods

Exams: There will be six to eight unannounced short (ten minute) quizes, two hourly exams, and a final exam. All the exams will be closed book and closed notes. **No make up exams will be given**. If you have a medical excuse, talk to your instructor.

Grading: Assigned Home-work is worth 10%. Short quizes all together are worth 18%. Each hourly is worth 18%. Final exam is worth 36%.

First hourly exam: The first exam is scheduled to take place on Thursday February 18th from 6:10PM to 7:30PM in Hill 114.

Second hourly exam: The second exam is scheduled to take place on Thursday March 25th from 6:10PM to 7:30PM in Hill 114.

Final Exam: The final exam is cumulative and is **tentatively** scheduled to take place on May 3rd from 4:00 to 7:00 PM. The location of the exam will be announced later on. It is known that certain students in Chemistry (Group G) courses might have conflicts. If so, let us know right away.

Labs: Lab manuals will be distributed in the lab. There are no labs during the first two weeks. Labs start on Monday February 1, 1999.

Data of faculty members:

Professor P. Sannuti; Room - CORE 525, Phone # 445-3127, e-mail: sannuti@ece
Office hours: Monday 1:30 PM – 4:00 PM, Wednesday 1:30 PM – 4:00 PM.

Professor R. Yates; Room - Win-Lab 123, Phone # 445-5249, e-mail: ryates@ece
Office hours: Monday 1:30 PM – 2:30 PM, Wednesday 10:30AM – 12:30 PM.

Office hours of TA's will be announced soon.

Frequency Selective Networks – Chapters15 & 16
Organization of Class Lectures

The first topic discussed is the one on Frequency Selective Networks comprising Chapters15 & 16.

We study here essentially four types of frequency selective networks or commonly called *filters*, (1) Low Pass Filter (LPF), (2) High Pass Filter (HPF), (3) Band Pass Filter (BPF), and (4) Band Rejection Filter (BRF). By studying the frequency response of the transfer function of a given network, we could categorize it as one of these four types of filters. Let us look at our study as a design problem. We would like to design a filter with a given characteristics. Based on previous experience we select a transfer function for the filter and study its frequency response. Next, we look for either a passive or active network that gives the desired transfer function. We then select the parameters of the network appropriately to meet the given specifications. Although we can extend our study here to some higher order filter design, we basically concentrate on filters that can be viewed as interconnection of first and second-order networks. Our study is organized as follows:

1. Introduction – Section 15.1
2. Derivation of transfer functions of different networks

Certain networks scattered throughout chapters 15 and 16, in particular selected circuits among the ones shown in figures 15.6, 15.7, 15.12, 15.21, 15.22, 15.24, 16.1,16.4, 16.21, 16.25, 16.26.

3. Calculation of Frequency Response by Bode-diagrams, emphasis on the study of first and second order transfer functions and their frequency response – Sections 15.6 and 15.7
4. Magnitude and Frequency Scaling – Section 16.2
5. Detailed Study of First Order Filters:
   - Passive Filters and Effects of Loading – Sections 15.2 and 15.3
   - Active Filters – Section 16.1
   - Cascade of First Order Filters – Section 16.3 and a part of Section 16.4
6. Detailed Study of Second Order Filters:
   - Passive Filters and Effects of Loading – Sections 15.4 and 15.5 & Notes
   - Butterworth Filters – Remaining part of Section 16.4
   - Second Order Narrow-Band Band-Pass and Band-Reject Filters – Section 16.5

Home Work Problems in Chapters 15 and 16

15.30 Draw the Bode-plots of transfer functions given in Problem 14.49, namely (a) $H(s) = \frac{250}{s+250}$, (b) $H(s) = \frac{s}{s+250}$, (c) $H(s) = \frac{s}{s+20{,}000}$, (d) $H(s) = \frac{20{,}000}{s+20{,}000}$, (4) $H(s) = \frac{500}{s+625}$

15.31 Bode-plot of the transfer function given in Problem 14.50, namely $H(s) = -\frac{0.8(s-1000)}{s+4000}$

15.32 Deriving a network transfer function and drawing a Bode-plot of it.

15.33 Bode-plot of a transfer function given in Problem 9.62, namely $H(s) = 0.5\frac{p-s}{p+s}$ where $p = \frac{1}{R_x C}$ when R_x is varied from zero to infinity.

15.34 Some critical frequencies of second order transfer function

15.2 Low-pass *RL* network

15.5 Low-pass *RC* network

15.8 Effect of a source resistance on high -pass *RC* network

15.9 Design of a high -pass *RC* network

16.3 Derivation and the analysis of the transfer function of an active *RC* filter

16.4 Design of a low-pass active *RC* filter

16.5 Design of a high-pass active *RC* filter

16.13 Verification of an observation on frequency scaling

16.17 Effect of frequency scaling on a time function; note that before scaling i_o is given by $i_o = [1728 + 2880e^{-20t}\cos(15t - 233.13^0)]u(t)$ mA

16.18 Effect of frequency scaling on a time function; note that before scaling v_o is given by $v_o = [50 + 210e^{-0.5t} + 30e^{-t}]u(t)$ volts

15.13 Band-pass characteristics

15.14 Design of a *RLC* band-pass filter

15.16 Design of a *RLC* band-pass filter

15.19 Effect of source and load impedances on a *RLC* band-pass filter

15.23 A band-rejection filter circuit

15.25 Design of a band-rejection filter circuit

16.10 A proto type design of a *RLC* band-pass filter

15.35 Detailed analysis of a network

15.39 Discussion of problem 15.13 with certain practical perspectives

16.22 Design of a first order broad-band active filter

16.30 Design of a high-pass Butterworth filter

16.35 Design of an active narrowband band-pass filter

16.40 Design of an active narrowband band-reject filter

16.41 Detailed analysis and design of a filter circuit

16.42 Design of a third order low-pass Butterworth filter

16.43 Detailed analysis and design of a filter circuit

16.49 Design of *RC* filters – effects of replacing a *R* by a *C* and a *C* by a *R*.

The **home work problems** for the rest of the chapters are given below.

Chapter 7

7.2, 7.4, 7.10, 7.12, 7.14, 7.17, 7.22, 7.24, 7.27, 7.30, 7.32, 7.37, 7.38, 7.46, 7.58, 7.61, 7.69, 7.70, 7.71, 7.74, 7.78, 7.82, 7.84, 7.86.

Chapter 8

8.3, 8.4, 8.5, 8.21, 8.22, 8.23, 8.24, 8.30, 8.31, 8.32, 8.34, 8.36, 8.39, 8.42, 8.46, 8.47, 8.48, 8.51.

Chapter 13

13.1, 13.3, 13.8, 13.12 b and c, 13.16, 13.22, 13.23, 13.27, 13.29, 13.30.

Chapter 14

14.7, 14.9, 14.25, 14.27, 14.32, 14.36, 14.40, 14.42, 14.52, 14.56.

Chapter 19

19.10, 19.11, 19.12, 19.13, 19.19.

Chapter 11

11.1, 11.3, 11.5, 11.9, 11.11, 11.12, 11.14, 11.18, 11.23, 11.31, 11.33.

Chapter 12

12.3, 12.6, 12.8, 12.11, 12.12, 12.16, 12.24, 12.27, 12.28, 12.31, 12.36, 12.42.

Home work problems for *Magnetic Circuits and Electromechanics* are in the notes that will be distributed. The notes also contains the solutions of all the given problems, and hence home work on *Magnetic Circuits and Electromechanics* will not be collected.