ECE 404
RADIO FREQUENCY ELECTRONIC CIRCUITS
FALL 2019

COURSE: M W F 9:10 - 10:00 am Room 2243 EB

PREREQ: ECE 302, 303 & 305

INSTRUCTOR: G.M. Wierzba Room 3215 EB 355-5225; wierzba@msu.edu

WEB SITE: www.egr.msu.edu/~wierzba

OFFICE HRS: M W Th 4:10 - 5:00 pm or by appointment

TEXTS: G.M. Wierzba, ECE 404 Class e-Notes and Lab Manual, Fall 2019 Edition, (free for all registered students)

GRADING: Three one-hour exams (9/16, 10/14 and 11/11) 200 pts
Final exam* (Th., Dec. 12 @ 7:45 - 9:45 am) 200 pts
Homework* (normalized) 50 pts
Lab Grade* 150 pts

*You must obtain a passing grade to pass the course.

POLICIES: You are expected to arrive for class on time. No electronic devices or laptops are allowed during class. No student can wear earphones during class.

HOMEWORK: Homework is to be done on 8.5" x 11" paper using only one side. It must be stapled and ragged edges must be trimmed. Whenever possible, the correct answer is to be circled or boxed. You may NOT work with other students. The work you submit must be done by you. Assignments which are identical to any other student will all receive a grade of zero. You must type and run all of your own computer work.

OTHER: Only simple scientific calculators are allowed for exams. Exam questions may have little or no partial credit. There are NO MAKE UP EXAMS. Your lowest hourly exam grade will be dropped in computing your grade. Late homework WILL NOT be accepted. Your lowest homework grade will be dropped in computing your normalized homework grade.

An 85% attendance rate is required to pass the course, that is, you can miss 7 classes. Please keep your own record of absences.
Chapter 1: Resonant Circuits

1.1 Review of Phasors

1.2 Review of Bode Diagrams

1.3 Series Resonance
   Lossless Components.

1.4 Parallel Resonance

1.5 Components

1.6 Series-to-Parallel Transformations
   Series-to-Parallel Inspection Formulas.

1.7 Insertion Loss
   Definition of Insertion Loss, Maximum Power Transfer.

1.8 Impedance Transformations
   Ideal Transformer, Tapped Capacitor Circuit, Performance Analysis with Pspice, Goal Functions, Tapped Inductor Circuit, Mutual Inductance, Coefficient of Coupling, Reflected Impedance.

Chapter 2: Impedance Matching

2.1 Introduction
   Complex Maximum Power Transfer, Impedance Matching.

2.2 The L Network
   Low-Pass Configurations, High-Pass Configurations, Design Equations, Parasitic Effects.

2.3 Three-Element Matching
   Pi-Network, Four Filter Configurations, T-Network, Four Filter Configurations.

2.4 Smith Chart
   Impedance Properties, Plotting Impedance Values, Impedance Scaling, Impedance Manipulation, Admittance Properties, Admittance Manipulation, Conversion of Impedance to Admittance.

2.5 Impedance Matching on the Smith Chart
   Two-Element Matching, Three-Element Matching, T-Networks, Pi-Networks.
Chapter 3: Small-Signal RF Amplifiers

3.1 BJT Equivalent Circuits
   Giacoletto Model, Gain-Bandwidth-Product, SPICE, DC Results, AC - Mid-Band Results, AC - High Frequency Results, Miller Effect.

3.2 Two-Port Parameters
   Y-Parameters, H-Parameters, Chain Parameters, Interconnection of Two-Ports, Parallel Input - Parallel Output, Chain-Connection.

3.3 Transmission Line Concepts

3.4 Characteristics of Microwave Transistors
   Scattering Parameter Analysis.

3.5 The Smith Chart
   Derivation of the Smith Chart, Transmission Line Input Impedance, Load Reflection Coefficient and VSWR, Transistor Scattering Parameters with Ansoft Designer.

Chapter 4: Small-Signal RF Amplifier Design

4.1 Designing with Y-Parameters
   Linvill Stability Factor, Stern Stability Test, Maximum Available Gain, Transducer Gain, Simultaneous Conjugate Matching, Designing with Potentially Unstable Transistors, Generating Two-Port Parameters with Ansoft Designer.

Chapter 5: Oscillator Circuits

5.1 Introduction to Sinusoidal Oscillators
5.2 Phase Shift Oscillator
   Conditions for Oscillation
5.3 Wien Bridge Oscillator
   Conditions for Oscillation, Stablizer
5.4 Colpitts Oscillator
   Conditions for Oscillation, Biasing, Design