ECE 302
ELECTRONIC CIRCUITS
FALL 2012

COURSE: M W Th 5:40 - 6:30 pm Room 1345 EB

CO & PREREQ: ECE 303 & ECE 202

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:

Schubert & Kim, Active and Non-Linear Electronics, Wiley, 2004

M. Rashid, Intro. To PSpice Using Orcad for Circuits and Electronics, Pearson Prentice Hall, 2004

GRADING:
Three one-hour exams (9/24, 10/22, 11/19) 200 pts
Final exam* (Mon., Dec 10, 8 - 10 pm) 200 pts
Homework * (normalized) 50 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 work with other students (list all names below yours) but the work you submit must be done by you. Assignments which are identical will all receive a grade of zero. You must type and run all of your own computer work. Copying of old assignments or computer files will be dealt with severely.

OTHER:
Only simple scientific calculators are allowed for exams. Exam questions have little or no partial credit. There are NO MAKE UP EXAMS. One 1-hour exam 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 2: Diode Characteristics and Circuits

2.1 Basic Functional Requirements of an Ideal Diode
   Piecewise Linear Model, Transition Point, Assumed States for Analysis, Strategy for Guessing States

2.2 Semiconductor Diode V-I Relationship
   Physics of the P-N Junction, Shockley Equation, Approximations, Dynamic Resistance

2.3 Diode as a Circuit Element
   Transcendental Equation, SPICE Model Parameters, Software Curve Tracer, Effects of Temperature

2.4 Load Lines
   Graphical Solutions to Static Circuits, Inspection Short Cut, Graphical Solutions of Circuits with Time-Varying Sources

2.5 Simplified Piecewise Linear Model

2.6 Diode Applications

2.7 Zener Diode and Applications
   Piecewise Linear Model, Shunt Regulator, Design - Cigarette Lighter Adapter for a CD Player, SPICE Evaluation

Chapter 3: Bipolar Junction Transistor (BJT) Characteristics

3.1 BJT V-I Relationships

3.4 Modeling of the BJT in its Regions of Operation
   Active, Saturation, Cut-Off, Inverse-Active, Inverse-Saturated, Inverse Cut-Off, Edge-of-Saturation, Edge-of-Cut-Off, Edge-of-Saturation Reverse, Edge-of-Cut-Off-Reverse

3.2 The BJT as a Circuit Element
   Assumed States Analysis, Strategies for Guessing the State of an NPN (PNP) BJT, Load-Line Approach, Ebers-Moll Approach

3.6 Biasing the BJT
   Fixed Bias Circuit, Emitter Bias Circuit with Two Supplies, Emitter Bias Circuit with One Supply, Emitter Bias Circuit Design, Biasing PNP Transistors

3.5 Digital Electronic Applications
Chapter 5: Single Transistor Amplifiers

5.2 BJT Low-Frequency Models
   Definition of Small Signal, Small-Signal Analysis Algorithm Small-Signal Model for an NPN, PNP BJT and a diode

5.3 Common-Emitter Amplifier
   Voltage Gain, Input Impedance, Current Gain, Power Gain, Output Impedance, SPICE Verification

5.4 Common-Collector (Emitter Follower) Amplifier
   Voltage Gain, Input Impedance, Current Gain, Power Gain, Output Impedance

5.5 Common-Base Amplifier
   Voltage Gain, Input Impedance, Current Gain, Power Gain, Output Impedance

Chapter 6: Multiple-Transistor Amplifiers

6.1 Using Simple Stages Cascaded
   Common-Emitter Common-Emitter Amplifier

Chapter 10: Frequency Response of Transistor Amplifiers

10.X Departure from Ideal Diode Performance
   Depletion Capacitance, Diffusion Capacitance, SPICE Parameters of a Diode, AC Model of a Diode, SPICE Testing of V-I Characteristics

10.Y Departure from Ideal Transistor Performance
   SPICE Parameters of a BJT, AC Model of a BJT, SPICE Testing of V-I Characteristics, Measuring Low Frequency AC Parameters, AC Model for a BJT (Giaucoleto Model)

10.6 High-Frequency Amplifiers
   Wideband Common-Emitter Amplifier, SPICE Evaluation, Short Circuit Time Constants, Open Circuit Time Constants, Loading Effects on Bandwidth

Chapter 4: Field-Effect Transistor Characteristics

4.1 Junction Field-Effect Transistors (JFETs)
   N-Channel JFET, Physical Operation in Cut-Off and Ohmic Region, Physical Operation in Saturation, Character Curves and Equations, P-Channel JFET

4.2 Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFETs)
   Enhancement N-Channel MOSFET, Physical Operation in Cut-Off and Ohmic Region, Physical Operation in Saturation, Character Curves and Equations, Enhancement P-Channel MOSFET, FET - BJT Analogy

4.3 FET as a Circuit Element
   JFET SPICE Model Parameters, Software Curve Tracer, MOSFET SPICE Model Parameters, Software Curve Tracer, The JFET as a Voltage-Controlled Resistance with SPICE Verification, The JFET as a Current Source with SPICE Verification

4.6 Biasing the FET
   Fixed-Bias Circuit, Self-Bias Circuit, Fixed-Plus Self-Bias Circuit
4.3 FET as a Circuit Element
  NMOS Inverter with a Pull-Up Resistor, NMOS Inverter with Capacitive Loads, CMOS Inverter, SPICE Transfer Curves, CMOS NOR-Gate, CMOS NAND-Gate, CMOS Transmission-Gate, Bulk-Pin Potential

5.7 FET Low-Frequency Models
  Definition of Small Signal, Small-Signal Analysis Algorithm, Small-Signal Model for an N- and P-Channel JFET, Small-Signal Model for an N- and P-Channel MOSFET

5.8 The Common-Source Amplifier
  Voltage Gain, Input Impedance, Current Gain, Power Gain, Output Impedance, Comparison of a Common-Source Amplifier and a Common-Emitter Amplifier

6.1 Using Simple Stages Cascaded
  Broadband Amplifier: Common-Source Common-Base Amplifier

Chapter 7: Power Amplifiers and Output Stages

7.1 Power Amplifier Classification
  Class A, Total Harmonic Distortion, SPICE Measurement, Efficiency

7.3 Complementary Pair Power Booster (Class B Amplifier)
  Efficiency, Distortion, SPICE Verification

7.4 Class AB Power Amplifiers
  15-Watt Power Amplifier

7.6 Thermal Considerations