COURSE OUTLINE

ELEC 416 – Microelectronics Circuit Design

Prepared By: Robert Jennings
A. **TITLE**: Microelectronics Circuit Design

B. **COURSE NUMBER**: ELEC 416

C. **CREDIT HOURS**: 3

D. **WRITING INTENSIVE COURSE**: NO

E. **WEEKS PER SEMESTER**: 15

F. **SEMESTER OFFERED**: FALL and SPRING

G. **HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY**: 2- hours lecture and 2- hours laboratory per week


I. **PRE-REQUISITES/COCOURSES**:

Pre-Requisites: Industrial Power Electronics (ELEC 332) and Electronic Circuits (ELEC 231), or permission of instructor.

J. **GOALS (STUDENT LEARNING OUTCOMES)**

By the end of this course, seventy percent of the students will be able to:

<table>
<thead>
<tr>
<th>Course Objectives (STUDENT LEARNING OUTCOMES)</th>
<th>*Institutional SLO</th>
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<tbody>
<tr>
<td>1. Determine the value of the four currents present in a two transistor current source circuit containing a reference resistor.</td>
<td>2. Critical Thinking 3. Professional Competence</td>
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<tr>
<td>2. Determine the transcondutance (g_m) and the output resistance (r_0) for a MOSFET amplifier with an active load and load resistor.</td>
<td>2. Critical Thinking 3. Professional Competence</td>
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<tr>
<td>3. For a Shunt-Series feedback amplifier, determine the open-loop gain (A_i), the feedback current transfer function (B_f) and the closed loop current transfer function (A_if).</td>
<td>2. Critical Thinking 3. Professional Competence</td>
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<td>4. For a single pole feedback amplifier, determine the closed loop low frequency gain, given the open loop response function and a value for Beta of 0.03.</td>
<td>2. Critical Thinking 3. Professional Competence</td>
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*Institutional Student Learning Objectives (SLO)*

(1) Communication, (2) Critical Thinking, (3) Professional Competence, (4) Inter-Intrapersonal Skills

K. TEXTS:

L. REFERENCES:

M. EQUIPMENT: As determined by the instructor

N. GRADING METHOD: A-F

O. MEASUREMENT CRITERIA/METHODS
   - Hourly exams,
   - Quizzes
   - Homework assignments
   - Written laboratory reports

P. DETAILED TOPICAL OUTLINE:

I. Integrated Circuit Biasing and Active Loads
   A. Bipolar Transistor Current Sources
   B. FET Current Sources
   C. Circuits with Active Loads
   D. Small signal Analysis
   E. Op-Amp Applications
   F. Operational Transconductance Amplifiers
   G. Op-Amp Circuit Design

II. Differential and Multistage Amplifiers
   A. The Differential Amplifier
   B. BJT Differential Pair
   C. FET Differential Pair
   D. Differential Amplifier with Active Load
   E. Design Application

III. Feedback and Stability
   A. Introduction to Feedback
   B. Ideal Feedback Topologies
   C. Voltage (Series-Shunt) Amplifiers
D. Current (Shunt-Series) Amplifiers  
E. Transconductance (Series-Series) Amplifiers  
F. Transresistance (Shunt-Shunt) Amplifiers  
G. Loop Gain  
H. Bode Plots  
I. Nyquist Plots  
J. Gain and Phase Margins  
K. Stability of the Feedback Circuit  

IV. Operational Amplifier Circuits  
A. General Op-Amp Circuit Design  
B. A Bipolar Operational Amplifier Circuit  
C. CMOS Operational Amplifier Circuits  
D. JFET Operational Amplifier Circuits  
E. Design Application  

Q. LABORATORY OUTLINE  
A. Diode Thermometer with a Bipolar Transistor  
B. An Output Stage Amplifier Using MOSFET  
C. Electronic Thermometer with an Instrumentation Amplifier  
D. An NMOS Current Source  
E. A MOSFET Feedback Circuit  
F. A Two-Stage CMOS Op-Amp to Match a Given Output Stage  
G. An Offset Voltage Compensation Network  
H. An Active Bandpass Filter  
I. A Static CMOS Logic Gate  
J. A Static Emitter-Coupled Logic (ECL) Gate