STATE UNIVERSITY OF NEW YORK
COLLEGE OF TECHNOLOGY
CANTON, NEW YORK

MASTER SYLLABUS

ELEC 416 – Microelectronics Circuit Design

Prepared By: Stephen Frempong

CANINO SCHOOL OF ENGINEERING TECHNOLOGY
ELECTRICAL ENGINEERING TECHNOLOGY & ENGINEERING SCIENCE DEPARTMENT
FALL 2018

A. TITLE : Microelectronics Circuit Design

B. COURSE NUMBER: ELEC 416

C. CREDIT HOURS: (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)
Credit Hours: 3
Lecture Hours: 2 per week
Lab Hours: 2 per week
Other: per week

Course Length: 15 Weeks

D. WRITING INTENSIVE COURSE: NO

E. GER CATEGORY: NONE

F. SEMESTER OFFERED: FALL and SPRING

G. COURSE DESCRIPTION: Analyzing and designing analog electronic circuits, digital electronic circuits, and the foundations of electronic circuit design. Topics covered include : Operational amplifier circuit design, Integrated circuit biasing and active loads, Analysis of differential and multistage amplifiers, Feedback and Stability, and Operational Amplifier Integrated Circuits.

H. PRE-REQUISITES: Industrial Power Electronics (ELEC 332) and Electronic Circuits (ELEC 231), or permission of instructor.

CO-REQUISITE: NONE

I. STUDENT LEARNING OUTCOMES:

Institutional Student Learning Outcome (ISLO's)

(1) Communication Skills (2) Critical Thinking (3) Foundational Skills (4) Social Responsibility (5) Industry, Professional, Discipline-Specific Knowledge and Skills.

Accreditation Board for Engineering and Technology ABET- Student Outcomes (a-k)

Course Objectives	ABET-Students Outcomes (a-k)	Institutional SLO's
1. Determine the value of the four currents present in a two transistor current source circuit containing a reference resistor.	(b) An ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering	2. Critical Thinking 5. Industry, Professional, Discipline-Specific Knowledge and Skills.

	technology problems that require the application of principles and applied procedures or methodologies.	
2. Determine the transcondutance (g_m) and the output resistance (r_0) for a MOSFET amplifier with an active load and load resistor.	(b) An ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies.	2. Critical Thinking 5. Industry, Professional, Discipline-Specific Knowledge and Skills.
3. For a Shunt-Series feedback amplifier, determine the open-loop gain (A_i), the feedback current transfer function (B_i) and the closed loop current transfer function (A_{if}).	(b) An ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies.	2. Critical Thinking 5. Industry, Professional, Discipline-Specific Knowledge and Skills.
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.	(b) an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies.	2. Critical Thinking 5. Industry, Professional, Discipline-Specific Knowledge and Skills.

J. <u>APPLIED LEARNING COMPONENT:</u> CLASSROOM/LAB

K. <u>TEXTS</u>:

Neamen, Donald A. (2010)., *Microelectronics Circuits Analysis and Design*, *4th Ed*, New York: McGraw-Hill

L. REFERENCES:

Richard R. Spencer and Mohammed S. Ghausi, Introduction to Electronic Circuit Design, 1st Edition, Upper Saddle River, New Jersey 07458: Prentice Hall, 2003.

M. EQUIPMENT: As determined by the instructor

N. GRADING METHOD: A-F

O. SUGGESTED MEASUREMENT CRITERIA/METHODS

- Hourly exams,
- Quizzes
- Homework assignments
- Written laboratory reports

P. DETAILED COURSE 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. <u>LABORATORY OUTLINE</u>

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