SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title:	ELECTRONIC CIRCUITS
Code No.:	ELN 109-5
Program:	ELECTRICAL/ELECTRONIC COMMON
Semester:	II
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APPROVED: J.P. Arozietti Dec 17/85

Chairperson Date

ELECTRONIC FUNDAMENTALS II
Course Name

ELN 109-5
Course Number

PHILOSOPHY/GOALS:

This course is intended to provide a solid background in fundamentals that is necessary for the study of more specialized aspects of electronics. The student will expand his knowledge gained in Electronic Fundamentals 1 (ELN 110) with the continuation of amplifier analysis. Theoretical and practical analysis of voltage and power amplifiers, including eqivalant circuits, coupling methods, classes of operation, will be covered as well as BJT, JFET, MOSFET and OPAMP devices. Related lab work with emphasis on testing, troubleshooting and technical report writing.

METHOD OF ASSESSMENT (GRADING METHOD):

1. Testing in relation to the theory objectives will make up approximately 60% of the final mark and will consist of at least two major tests plus short quizzes.

2. Testing in relation to the practical (lab) objectives will make up approximately 40% of the final mark and will consist of a technical report, lab logbook reports and practical assessments, which will include lab attendance, participation, performance, attitude, etc.

TEXTBOOKS:

Electronic Principles - 3rd Edition - Malvino (McGraw-Hill)
Experiments for Electronic Principles - 3rd Edition - Malvino

REFERENCE TEXTS:

Transistor Circuit Approximations - 3rd Ed. - Malvino (McGraw-Hill)
Fundamentals of Electronics - 3rd Ed. - Luych
General Electronic Circuits - 2nd Ed. - DeFrance (Holt-Rinehart)
Electronic Devices and Circuits - 3rd Ed. - Boylestad, Nashelsky (Prentice-Hall)
Electronic Devices and Circuits - 2nd Ed. - Bell (Reston)

BLOCK	TOPIC DESCRIPTION	REFERENCE
I	CASCADED AND POWER AMPLIFIERS	Chapters 8, 9, 14

1. Amplifier coupling methods
2. Analysis of direct coupled amplifiers
3. Classes of operation
4. Power and efficiency calculations
5. AC analysis of Class A and Class B amplifiers
6. h Parameters
7. Decibels and power gain
8. Frequency effects

II	FIELD EFFECT TRANSISTORS	Chapters 12, 13

1. Principles of operation of JFET and MOSFET
2. Characteristic curves and parameters
3. Biasing techniques
4. Common-source and common-drain circuit analysis
5. FET applications

III	OPERATIONAL AMPLIFIERS	Chapters 15, 16, 17

1. Differential amplifier - operation and analysis
2. Operational amplifier
   - operation
   - characteristics
   - parameters
   - linear inverting and non-inverting amplifiers
   - band width
3. Feedback
4. Filter networks

Block 1: Cascaded and Power Amplifiers

Reference: Chapters 8, 9, 10, Malvino

Understanding of the following topics is required:

1. Advantages and disadvantages of the following coupling methods:

   - RC coupling
   - Impedance coupling
   - Transformer coupling
   - Direct coupling

2. Analysis of direct-coupled transistor amplifiers.

3. Definition of Class A, AB, B and C operation, and comparison of their performance based on efficiency and distortion.

4. Calculation of turns ratio for impedance matching in transformer coupled amplifiers.

5. AC load line construction for class A large signal amplifiers.

6. Optimum Q-point for class A amplifiers.

7. Calculation of maximum output power, Po(MAX); maximum power dissipation, Pd(MAX); and efficiency, %N for class A amplifiers.

8. Calculation of Ré, large signal AC emitter resistence, from transistor transconductance curves.

9. The cause of non-linear distortion in large-signal class A amplifiers.

10. Calculation of voltage gain, power gain and input impedance in class A amplifiers.

11. a - Definition of the following terms related to transistor power ratings $T_J(MAX)$, O_{JA}, T_J, O_{CA}, D

    b - Use of the above parameters to calculate PD(MAX) under different conditions.

12. AC load line construction for class B push-pull amplifiers.

13. Principles of operation and the function of components in large signal class B push-pull amplifiers.

14. Cause of crossover distortion and method of elimination in class B amplifiers.

15. Two functions of the diodes in diode-based class B push-pull amplifiers.

16. Calculation of ICQ and VCEQ in class B push-pull amplifiers.

17. Calculation of voltage gain, power gain and input impedance in class B amplifiers.

18. Calculation of Po(MAX), PD(MAX) and efficiency in class B amplifiers.

Block II: Field - Effect Transistors

Specific Objectives

1. Draw the symbol and structural diagram for the N-channel and P-channel JFET's and label the drain, source and gate.

2. List advantages and disadvantages of JFET's over vacuum tubes and transistors.

3. Explain the biasing method and operation of JFET's.
   Vp VGS(off)

4. Explain what is meant by "pinch-off", "cut-off", IDSS.

5. ExplainJFET operation using the drain curves and transconductance curves.

6. Recall that JFET amplification is

   $$Av = Gfs \times RL$$

   where Gfs - transconductance (mhos)
   RL - load resistance (ohms)

7. Explain operation of the basic Common-Source amplifier and draw the circuit and waveforms.

8. With the aid of circuit diagram and waveforms, explain the operation of the Common-Drain amplifier.

9. Draw the structural and symbol diagram for a MOSFET (IGFET).

10. Explain operation and application of a MOSFET.

11. Explain biasing methods for depletion type and enchancement type MOSFETs.

12. Explain the operation and application of CMOs and VMOS devices.

BLOCK III - Operational Amplifiers (OPAMPS)

The student shall be able to:

1. Draw a block diagram of a basic differential amplifier and state its characteristics.

2. With the aid of a basic circuit diagram of a differential amplifier, explain circuit operation.

3. Explain the operation and characteristics of the following differential amplifier configurations.

   (a) single-ended input
   (b) double-ended input (differential input) with in-phase and out-of-phase signals.

4. Draw a block diagram of an OPAMP and state the approximate values of each important amplifier characteristic typical of an OPAMP, such as:

   (a) Power rating
   (b) Open-loop voltage gain
   (c) Differential voltage gain
   (d) Input and output impedance
   (e) Common-mode rejection ratio (CMRR)

5. Describe the offset problem of OPAMPS and show how it can be corrected.

6. Explain the concept of "virtual ground".

7. For the following OPAMP circuits, draw the circuit diagram, explain its operation, recall the voltage gain formula and list its characteristics.

   (a) Constant-gain amplifier
   (b) Inverting Amplifier
   (c) Con-inverting Amplifier
   (d) Emitter-follower
   (e) Comparator
   (f) Adder (Summer)
   (g) Subtractor
   (h) Add/Substract
   (i) Integrator
   (j) Differentiator
   (k) Voltage-to-current converter

8. To extract data on operation, specifications, ratings, applications and electrical characteristics on OPAMPS from manufacturers data sheets.

9. To study the operation, characteristics and applications of the 555 Timer I.C.