Course Outline for Electronic Systems Technology 54
ANALOG CIRCUITS AND SEMICONDUCTOR DEVICES

Catalog Description:

ESYS 54 - Analog Circuits and Semiconductor Devices 2.00 units
Analog circuits, including amplifiers, oscillators, and filters, using single-chip analog devices, operational amplifiers, field-effect transistors, bipolar transistors.
Strongly Recommended: ESYS 52

Grading Option: Letter Grade

Discipline:

<table>
<thead>
<tr>
<th>Units</th>
<th>Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Week</td>
</tr>
<tr>
<td>Lecture</td>
<td>1</td>
</tr>
<tr>
<td>Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>Clinical</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>2.00</td>
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Prerequisite Skills:
None

Measurable Objectives:
Upon completion of this course, the student should be able to:
1. explain the concept of a 3-terminal device called a transistor and show how current is controlled between two of the terminals by a signal on the third terminal;
2. explain the composition of a MOSFET and how it works as an amplifier;
3. identify basic methods for biasing MOSFETs as amplifiers;
4. explain the composition of a bipolar junction transistor (BJT) and how it works;
5. identify the basic methods for biasing a BJT as an amplifier and a switch;
6. identify basic transistor amplifier circuits such as common emitter/source, common base/gate, common collector/drain;
7. draw the circuit of an emitter/source follower, explain its characteristics, purpose and operation;
8. identify a differential amplifier by its schematic, state its purpose, explain its operation and benefits;
9. define op amp and draw the basic circuits for an op amp inverter, non-inverting amplifier, differential amplifier, follower, instrumentation amplifier and active filter;
10. state the basic specifications of an op amp and explain the importance of each;
11. describe the purpose, operation, specifications and applications of the following IC amplifiers: programmable gain, power amplifier, video amplifier, RF amplifier;
12. explain the operation of an amplifier connected as an oscillator and calculate oscillation frequency;
13. name three common types of oscillators, identify their circuits from schematics and state the primary applications;
14. draw the equivalent circuits of a quartz crystal used as a frequency determining element in an oscillator. State the major benefits of crystal oscillators over all other types;
15. explain the operation of a switching amplifier and state its benefits;
16. name the basic classes of amplifiers, state the approximate efficiency of each and indicate where each type is generally used;
17. state the concept of a push pull amplifier;
18. identify a complementary symmetry class AB amplifier and explain its operation;
19. show how BJTs and MOSFETs are used in power amplifiers;
20. troubleshoot transistor and IC amplifiers using common test equipment;
21. install, connect, test, explain the operation of and operate at least one complete analog/linear electronic system. Examples: Audio PA system, music/instruments system, consumer stereo/surround sound system, home solar power system, autosound system.

Course Content:
1. Course Content, Lecture
   A. Integrated amplifier, oscillator, and filter devices
   B. Op-amps and closed-loop amplifier configurations
   C. Op-amp filters
   D. Op-amp oscillators
   E. MOSFET amplifiers and biasing
   F. Source followers and push-pull configuration
   G. Amplifier classes, including class AB and class D
   H. Bipolar amplifiers and biasing

2. Course Content, Laboratory
   A. Integrated amplifier, oscillator, and filter devices
   B. Op-amps and closed-loop amplifier configurations
   C. Op-amp filters
   D. Op-amp oscillators
   E. MOSFET amplifiers and biasing
F. Source followers and push-pull configuration
G. Amplifier classes, including class AB and class D

Methods of Presentation
1. Lecture/Discussion
2. Laboratory
3. Online learning objects

Assignments and Methods of Evaluating Student Progress
1. Typical Assignments
   A. Measure and compare the performance of a class AB and class D amplifier, including gain, bandwidth, noise, and efficiency.
   B. Develop and execute a troubleshooting plan for a MOSFET oscillator circuit.
2. Methods of Evaluating Student Progress
   A. Exams/Tests
   B. Quizzes
   C. Papers
   D. Class Participation
   E. Homework
   F. Lab Activities
   G. Observation and critique of laboratory exercises
   H. Final Examination

3. Student Learning Outcomes
   Upon the completion of this course, the student should be able to:
   A. The student will identify op-amp circuit configurations and calculate gain and impedances for the circuit.
   B. The student will identify the terminals and basic internal construction of MOSFET transistors, and describe the operation of MOSFET switching and amplifier circuits.

Textbook (Typical):
1. Lessons in Electric Circuits, Vol. 1 & 2, 2015, Kuphaldt, T., open source, hosted on ibiblio.org

Special Student Materials
1. Computer with Internet access.

Abbreviated Class Schedule Description:
Analog circuits, including amplifiers, oscillators, and filters, using single-chip analog devices, operational amplifiers, field-effect transistors, bipolar transistors.

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