ELECTRONICS II

Computer/Telecommunications and Engineering Technologies Sector

Course Number:
ELN 8232

Applicable Program(s):
Electronic Engineering Technology

Course Hours:
Delivered: 80

Normative: 80

Contribution to Program:
Vocational/Core

AAL:
03

Prerequisites:
Electronics I (ELN 8221)
Passive Circuits (ELN8222)
Mathematics II (MAT8301)

Corequisites:
Electric Circuits (ELN 8230)

Educator(s):
C. Sauriol

Approval Date:
August 2002

Approved By:

Mike Mcneil

Title: Academic Manager

Approved for Academic Year:
2002 - 2003

COURSE DESCRIPTION

This course introduces students to the study of linear integrated circuits and provides the basic concepts and building blocks necessary to analog signal processing. The material covers a wide range of operational amplifier circuits used in common applications. Amplification, level detection, amplitude clipping, peak detection, precision rectification, frequency response, filtering and transient time response constitute the main subjects of this course. Analog to digital converters and interfacing to ADCs is also covered.

RELATIONSHIP TO PROGRAM LEARNING OUTCOMES

This a vocational course that supports the following vocational program standards:	This course contributes to your program by helping you to achieve the following provincial generic standards:
To be provided	To be provided

COURSE CURRICULUM

1. Course Learning Requirements/Embedded Knowledge and Skills

Course Learning Requirements	Knowledge and Skills
When you have earned credit for this course you will have demonstrated an ability to:	
1a) Read and search for pertinent information in device data sheets. b) Understand and explain basic negative feedback concepts. c) Understand, explain and use ideal analysis rules.	1. **Introduction to op amps** Op amp datasheets, input and output features. Introduction to negative feedback: open and closed loop gains, ideal and actual closed loop gains, % error, differential voltage, ideal analysis of op amp circuits.
2a) Understand and state most common functions that can be implemented with op amps. b) analyse basic operational amplifier circuits. Design, build and test simple op amp circuits to meet design specifications.	2. **Basic op amp applications** Buffer, inverting and non-inverting amplifiers, adder, subtractor, instrumentation amplifier, integrator, differentiator, current sources, phaseshifters, voltage clippers,. etc.
3a) Understand and state most common waveforms that can be generated. b) Analyse, design, build and test various types of waveform oscillators and timers.	3. **Waveform oscillators** RC op amp oscillators, op amp VCO, function generator, IC timers.
4a) Understand practical difficulties encountered in DC signal processing. b) Optimise op amp circuit DC performance. c) Determine appropriate op amp DC parameters to meet design constraints.	4. **DC offsets in op amps** Balancing the I/P's, calculation of maximum O/P offset voltage, DC offsets in ideal and practical integrators, balancing networks, search appropriate op amps.
5a) Understand frequency limitations of electronic devices and be able to select appropriate devices to meet given system requirements. b) Analyse, design, build and test or simulate basic active filters.	5. **Frequency response** Op amp response: resistive feedback circuit response, first order low-pass and high-pass filters, overdamped second-order band-pass filter, etc. AC coupling effects
6a) Understand the effects of system frequency response on pulse transmission. b) Calculate required bandwidth and select appropriate components.	6. **Transient response** Effect of bandwidth on rise and fall times of square wave response, tilt or exponential decay caused by AC coupling, slew rate effect on various waveforms, ringing in unstable circuits or in higher-order circuits.

7a)	Design simple analog subsystems that meet specifications to interface with other system components.	7. **Basic Design Applications** Design of analog subsystems involving buffering, amplification, switching, level shifting, filtering, interfacing to transducers and A/D converters to meet given specifications in concrete applications.
b)	Understand and use basic transducers, and provide proper signal conditioning.	
8a)	Understand and explain DAC internal circuit and DAC operation as a whole.	8. **Digital to Analog Converters (DAC's)** Weighted resistors DAC, R-2R ladder network DAC, integrated DAC-08. DAC application as digital control of AC amplitude DC offset of function generator O/P, programmable voltage and current limit power supply using DAC's
b)	Analyse and design DAC circuits in unipolar and bipolar DC and AC applications.	
	If time permits	**If time permits**
9a)	Understand instability problem when using fast voltage comparators or op amps in threshold detection.	9. **Level Detectors and Schmitt Triggers** Design level detectors with DC and AC hysteresis with desired accuracy and speed. Select proper threshold levels and design Schmitt triggers in pratical applications.
b)	Design stable and reliable level detectors in order to overcome stray feedback, noise or ripple present on top of signal.	

2. Learning Resources

1. *ELECTRONICS II THEORY NOTES AND EXERCISES* (ELN8232), 08/2001, C. Sauriol, Algonquin. Compulsory, available at First Class bookstore

2. Supplementary material will be provided form my web site at http://www.algonquincollege.com/staff/saurioc/

3. *Microcap VII demo* sofware is a useful tool for this course and can be downloaded from the internet site http://www.spectrum-soft.com/index.shtm The instruction manual can also be downloaded from the same site.

4. A calculator that handles functions of complex variables and complex polynomial roots is also desirable for this course - it is essential later in the Linear Circuits course. Suggested models: TI-85, TI-86and most HP scientific models. TI-83plus calculators will do as bare minimum but have to be programmed for polynomial roots – see me for program.

REFERENCES

1. Op Amp Circuit Design Guide from Texas Instruments – go to http://www.algonquincollege.com/staff/saurioc/ for soft copy of manual.

2. Analog Integrated Circuit Applications, J. Michael Jacob, Pentice Hall
You can buy it at Amazon.com and get it real fast.

3. Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin and Frederick F. Driscoll, 5th edition, Prentice Hall. You can buy it at Amazon.com and get it real fast.

4. References also available at library – look in linear or analog circuits section.

3. Teaching/Learning Methods

- Formal lectures will be held three hours a week.
-Some lectures and lab sessions may be used for tutorials and problem solving.
-Lab experiments will be held weekly in two-hour blocks.
-Consultation is offered as shown on instructor's timetable posted on office door T211.

4. Learning Activities and Assessment

1) Attendance of lectures and lab sessions are essential to learn course material.
2) Each student is expected to review class theory at home on a daily basis.
3 Exercises will be provided regularly in class and should be done on a regular basis to reinforce and verify understanding of the theory.
4) Tutorials and problem solving sessions will be used to provide feedback and answers to difficulties encountered in course material.
5) Pre-labs are used to verify understanding of theory and provide ongoing feedback to students.
6) Lab experiments provide practical hands-on experience where circuits are built and tested or simulated using computer software.
7) Computer simulations are used for analysis and also to learn and reinforce some theoretical concepts.

5. Evaluation/Earning Credit

Theory	Weekly Quizzes	16%
	2 Term Tests	36%
	Final Exam	18%
Labs	Pre-labs	8%
	Lab work	12%
	Lab reports	10%
Total		100%

* The final exam is actually **term test #3** that covers the third section of the course. Laboratory material is also covered in theory tests.
A supplemental exam may be offered in marginal cases. A supplemental exam will be a privilege not an automatic right.
The student must pass both the theory and lab portions of the course **separately** in order to pass the entire course: failing one or the other will result in a failure of the entire course. Unjustified absence to **more than four hours of lab sessions** will result in **automatic failure of the entire course**.
All lab experiments, must be done satisfactorily in order to pass the course: that is pre-labs and lab reports must be submitted in time and performance in the normally scheduled lab time must be satisfactory - you must demonstrate circuit functionality to the instructor whenever required.

GRADING SYSTEM

PERCENTAGE CONVERSION

GRADING SYSTEM		
	LETTER GRADE	% GRADE
Course learning outcomes are met in a consistently outstanding manner	A+ A A-	90 – 100 85 – 89 80 – 84
Course learning outcomes are met in a consistently thorough manner	B+ B B-	77 – 79 73 – 76 70 – 72
Course learning outcomes are met satisfactory	C+ C C-	67 – 69 63 – 66 60 – 62
Course learning outcome objectives are met at a minimal level of achievement	D+ D D-	57 – 59 53 – 56 50 - 52
Course requirements are not met	F	

1. A pass in each course is (50) per cent. In some courses, students may be required to achieve more than a minimal level of achievement in order to proceed in their program. For those courses, the course outline will stipulate the progression requirements, as will the supplementary program regulations.

2. PASS (P)/FAIL (F) designation can be used in certain courses, with the approval of the program academic manager.

I. Prior Learning Assessment

PLA candidates may challenge this course, provided they complete the following assessment with a minimum mark of 60% in (a) (b) and (c).

a) A supervised written exam, of no longer than 2 1/2 hours, containing questions selected to assess the understanding of the course requirements.
b) An oral exam of no longer than one hour containing questions selected to assess the understanding of the course requirements.
c) A performance test consisting of at least 2 laboratory exercises requiring practical "hands-on" demonstrations of needed practical skills.

RELATED INFORMATION

Students, it is your responsibility to retain course outlines for possible future use to support applications for transfer of credit to other educational institutions.