SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title:	Communication Systems I
Code No.:	ELN 237-8
Program:	Electronic Technician
Semester:	Three
Date:	1990 September 1
Author:	Peter Szilagyi

New: _____ Revision: #4

Approved: W. Filipowich
Coordinator

Sep 4/90
Date

Approved: J.P. Arsenault
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Date

Communication Systems I ELN 237-8

PHILOSOPHY/GOALS

A first course in Analog Electronic Communications intended for the through-way Electronic Technician-Technology program. The level of treatment presupposes previous knowledge of basic electric circuits, electronics and mathematics.

The course covers in considerable detail passive and active communications circuits, modulation, transmission and reception systems.

METHOD OF ASSESSMENT:

- 5 written tests
- lab reports and testing of specific lab activity.

TEXTBOOKS:

1) Study Material, by Les Harvey.
2) Modern Electronic communication, by Gary M. Miller

REFERENCE BOOKS:

1) Electronic Communications, by Dennis Roddy and John Coolen.
2) Electronic Communication Techniques, by Paul H. Young

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GENERAL OBJECTIVES:

The study, analysis and design of the building blocks, then the block diagrams and schematic diagrams of AM, SSB and FM short wave and broadcast band radio receivers and transmitters.

The emphasis is on the communications systems operating in the 100 kHz to 300 MHz band of frequencies.

Laboratory experiments and projects develop the practical skills of operating sophisticated test equipment.(Sweep-Marker generator, Spectrum Analyser, Programmable RF Generator, RF Oscilloscope, etc)

A variety of communications circuits and systems will be built and tested.(Rezonant circuits, Filters, RF amplifiers, Superheterodine radio, PLL, RF oscillators, etc.)

The course is organized in 4 blocks:

Block 1: Passive RF circuits.....25 hours
Block 2: RF Amplifiers and Oscillators.....15 hours
Block 3: Amplitude Modulation.....20 hours
Block 4: Frequency Modulation.....20 hours

Total theory, including tests.....80 hours
Total laboratory.....48 hours

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COURSE OBJECTIVES:

BLOCK 1: PASSIVE RF CIRCUITS.

1) RESONANT CIRCUITS
   - series LCR circuits.
   - parallel LCR circuits.
   - quality factor, impedance, selectivity and bandwidth.

2) RF FILTERS
   - constant "k" filters.
   - derived "m" filters.
   - hi pass, lo pass, band pass and band stop filters.

3) COUPLING
   - introduction to coupling.
   - broad band rf coupling.
   - narrow band rf coupling.
   - tuned rf transformers.

4) IMPEDANCE MATCHING
   - introduction to impedance matching.
   - matching a high impedance generator to a low impedance load.
   - matching a low impedance generator to a high impedance load.
   - tuned-coupled matching circuits.
   - parallel to series transformations.
   - matching with rf filters.
   - L, T and PI matching networks.

BLOCK 2: RF AMPLIFIERS and OSCILLATORS

1) SMALL SIGNAL CLASS "A" RF AMPLIFIERS
   - FET amplifiers.
   - BJT amplifiers.
   - IC amplifiers.
   - coupling and decoupling.
   - impedance matching in rf amplifiers.
   - gain control and stability.
   - narrow band and broad band amplifiers.

2) LARGE SIGNAL RF (POWER) AMPLIFIERS
   - definition of terms: P_{IN}, P_{OUT}, P_D, efficiency, R_{LOAD}.
   - class "C" biasing and flow angle.
   - input and output impedance matching.
   - load impedance for a given power.
   - push-pull amplifiers.
   - frequency multipliers.

3) RF OSCILLATORS
- positive feedback.
- Barkhausen conditions.
- ac equivalent circuits.
- interelement capacitance of active components.
- frequency stability of oscillators.
- represzentative oscillators (Hartley, Colpits, Clapp, Armstrong, Ultra-Audion).
- crystal oscillators (Pierce, Miller, Overtone).

BLOCK 3: AMPLITUDE MODULATION

1) AM FUNDAMENTALS
- linear addition of sine waves.
- nonlinear mixing.
- AM waveform in time domain.
- AM signal in frequency domain.
- modulation index.
- AM analysis.
- circuits for AM generation (base modulator, collector modulator, linear IC modulator).
- high level and low level modulation.

2) AM TRANSMITTER SYSTEMS
- CB transmitter (Motorola).
- transmitter measurements.

3) AM RECEPTION
- receiver characteristics (selectivity and sensitivity).
- diode square-law detectors.
- synchronous detectors.

4) SUPERHETERODINE RECEIVERS
- frequency conversion.
- receiver block diagram (rf amp, mixer, local oscillator, IF, detector and audio amp.)
- tuning and alignment.
- automatic gain control (AGC).
- image frequency.
- AM broadcast superheterodine.
- linear IC AM receiver.

5) SINGLE-SIDE-BAND COMMUNICATIONS
- basic SSB concepts, advantages and disadvantages.
- time domain, frequency domain and phasor representation of SSB signals.
- balanced modulators (push-pull, ring, LIC).
- SSB filters (LC, crystal, ceramic and mechanical).
- filter method and phase method of SSB generation.
- SSB demodulation: second mixer and BFO.
- SSB receivers.

BLOCK 4: FREQUENCY MODULATION

1) FM PRINCIPLES
   - angle modulation.
   - the amount and rate of deviation.
   - FM mathematical analysis.
   - side frequencies from Bessel functions.
   - broadcast and narrow-band FM standards.
   - FM noise analysis and capture effect.
   - preemphasis and deemphasis. (Dolby system).

2) FM GENERATION
   - direct method (capacitance microphone, varactor diode, reactance modulator, VCO, Crosby modulator).
   - indirect method (Armstrong modulator).
   - PLL FM transmitter.

3) FM RECEIVERS
   - composite modulating signals.
   - block diagram of FM receivers.
   - limiting and sensitivity.
   - rf amplifiers and limiters.
   - discriminators (slope detector, Foster-Seely, ratio detector, quadrature detector, coincidence detector, PLL).

4) STEREOPHONIC BROADCASTING
   - block diagram of transmitter.
   - block diagram of receiver.
   - composite modulating signals.
   - stereo demodulation (decoding).
   - LIC stereo decoders.
   - SCA signal and SCA PLL decoder.

ADMINISTRATIVE AND EVALUATION PROCEDURES

TESTING

a) Written tests based upon theory objectives will occur following the completion of each theory block and with about a week of advance notice. Short written quizzes may occur at any time without advance notice

b) Testing of lab objectives will occur concurrent with the specific lab activity.

GRADING

a) Grading is done using the following definitions:
- Consistently autstanding performance.....A+ (90-100)%
- Autstanding performance.....A (80- 90)%
- Above average performance.....B (65- 80)%
- Satisfactory performance.....C (55- 65)%
- Unsatisfactory performance.....R (0- 55)%

b) The grading of laboratory type objectives will be in two parts: The demonstrated ability to perform a skill function, e.g. use an instrument in a specified role or trouble shoot a circuit, will be graded "C". Failure to demonstrate the skill function will be graded "R". Subjective evaluation of lab reports, supporting theory, deportment, housekeeping etc., will be used to modify the skill function grade upward, where applicable.

c) Lab reports are due one week after the experiment was scheduled to be completed. Late reports are penalized 5% per day.

d) The grading weight will be 30% for the lab and 70% for the theory.

e) A final overall accumulated mark of 55% is the minimum requirement for course credit with the added restriction that neither the theory or the lab part of the course can be less then 55%. e) A failing grade on more then half of the theory tests during the semester leads directly to an "R" grade, regardless of the theory average.

f) Failing one third of the semesters theory tests excludes a final "A" grade, regardless the theory average.

UPGRADING

a) No upgrading tests will take place during the semester.

b) The method of upgrading is at the teachers discretion. It may consist of the rewriting of block tests, the writing of comprehensive examination, repeating laboratory experiments or repeating the course.

c) The highest mark obtainable in any make-up test is "Sufficient".

ATTENDANCE

a) Attendance for laboratory classes is compulsory.

b) Attendance at all theory classes will be recorded. Attendance is highly recommended but not mandatory.

c) Anyone with an accumulated attendance record of less then 80% at the end of the semester, and who is also in a failing condition, can expect to have to repeat the course, with no right to write a make-up test.

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