SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

COURSE OUTLINE

COURSE TITLE : COMMUNICATIONS SYSTEMS I

CODE NO : ELN 239-?

PROGRAM : ELECTRONIC ENGINEERING TECHNOLOGY

SEMESTER : 3RD, 16 WEEKS

AUTHOR : P. SZILAGYI

NEW _____ REVISION ____X____

DATE: MAY 29, 1985

APPROVED _____ _____
CHAIRPERSON DATE

Communications Systems I ELN 239-7

Goals: A first course in analog electronic communications at a technology level.
The principles of resonance, impedance matching, coupling and filtering are first studied, then RF amplifiers and oscillators.
The generation and electronic processing of CW, AM, and SSB are studied as well.

Method of Assessment
4 written tests
lab reports and practical test

Textbooks
Study Material: Communications Circuits
Modern Electronic Communication by Garry M. Miller

Topic Description

		Hours
Block 1: Resonance, Coupling and Filtering		
1.1	Resonant Circuits	8
1.2	RF Transformers and Coupling	4
1.3	Decibells	1
1.4	RF Filters	2
	Block Test	1
Total Block 1		16
Block 2: Impedance Matching, RF Generation and Implification		
2.1	Impedance Matching	4
2.2	RF Amplifiers	4
2.3	RF Power Amplifiers	4
2.4	RF Oscillators	3
	Block Test	1
Total Block 2		16
Block 3: AM and SSB		
3.1	Noise and Distortion	2
3.2	Amplitude Modulation	8
3.3	Single Side Band Communications	8
	Block Test	1
Total Block 3		19

Block 4: Communications Techniques		
4.1	FM Principles	2
4.2	Communication Techniques	6
4.3	Facsimile	1
4.4	Mobile Communications	1
4.5	Communications Transcievers	2
	Block Test	1
Total Block 4		13
Total Hours		64

Course Objectives

Communications Systems ELN 239-7

General Objectives When the student successfully completed this course he will have gained a knowledge of basic analog communications circuits and principles, as applied to amplitude modulated radio communication equipment.

Related laboratory work will develop a facility in tuning, loading, trouble-shooting, aligning and specification testing of such equipment.

ELN 239 is a pre-requesite for ELN 245.

Specific Objectives To analyze, study and understand the following topics:

Block 1: Resonance, Coupling and Filtering

1.1 Resonant Circuits

- series resonant circuits
- parallel resonant circuits
- Thompsons formula
- phasor representation of circuit conditions
- resonance curves
- selectivity, bandwidth and Q factor
- circuit impedance
- losses in a resonant circuits
- applications, examples

1.2 RF Transformers and Coupling

- coupled circuits
- common inductance coupling
- impedance coupling
- link coupling
- transformer coupling
- broad band RF transformer
- transmission line transformers
- narrow band coupling
- reflected impedance
- mutual inductance
- single and double tuned transformer coupling
- critical, optimum, over and under coupling

1.3 Decibels
- loss and gain
- absolute level
- relative level
- zero levels
- converting decibels to power or voltage
- attenuators

1.4 RF Filters
- constant K filters
- derived filters
- low pass filter
- high pass filter
- band pass filter
- band stop filter
- L, and T networks
- voltage versus frequency characteristics
- attenvation versus frequency characteristics
- LC filter design
- characteristic impedance of filters

Block 2: Impedance Matching, RF Generation and Amplification

2.1 Impedance Matching
- impedance matching by coupler circuits
- inductive coupled, series tuned loads
- inductive coupled, shunt tuned loads
- series to parallel transformation
- two element networks (L)
- three element networks (T and u)

2.2 RF Amplifiers
- RF voltage amplifiers
- MOSFET, JFET and BJT RF amplifiers
- multistage response
- stagger tuning
- neutralization
- cascode amplifier
- integrated circuits
- VHF and UHF amplifiers

2.3 RF Power Amplifiers
- the RF power transistor
- voltage and current relations in a class "C" power amplifier
- input and output power . dissipated power and efficiency
- transistor class "C" biasing
- parallel and push-pull operation
- frequency multipliers
- linear and broadbend power amplifiers
- design considerations

2.4 RF Oscillators
- positive and negative feedback
- the Barkhausen criterion
- AC equivalent circuits
- frequency stability of oscilator
- representative oscillator circuits: Hartley, Colpitts, Clapp, Armstrong, Ultraaudion
- shunt and series connected power supply
- crystal oscillators
- crystal cuts
- electrical characteristics of crystals
- Pierce, Miller and Overtone oscillators
- logic gate oscillators
- voltage controlled oscillators

Block 3: AM and SSB

3.1 Noise and Distortion
- external and internal noise
- thermal noise
- noise resistor and equivalent noise resistance
- equivalent noise temperature
- shot noise
- flicker noise
- white noise
- harmonic distortion
- frequency domain representation
- fundamental and harmonic components

3.2 Amplitude Modulation

3.2.1 AM Principles
- carrier and intelligence
- combining two signals in a linear network
- AM waveforms
- percentage modulation
- overmodulation
- mathematical analysis of AM
- upper and lower sideband
- power spectral distribution

3.2.2 AM Generation
- discrete and integrated circuit modulators
- high and low level modulators
- AM transmitters
- trapezoid patterns

3.2.3 AM Reception
- the tuned radio frequency receiver
- selectivity and sensitivity
- linear IC TRF receiver

3.2.3 Continued
- AM detection
- square law detection
- synchronous detection

3.2.4 Supermeterodine Receivers
- frequency conversion and intermediate frequency
- tuning and tracking
- image frequency
- automatic gain control
- receiver circuit diagram analysis

3.3 Single Side Band Communications

3.3.1 SSB Principles
- advantages of SSB
- mathematical and phasorial analysis of SSB
- the balanced modulator (PUSH PULL, RING AND LIC) and the DSB signal
- SSB filters: LC, crystal, mechanic and ceramic

3.3.2 SSB Transmitters
- filter method
- phase method
- third method
- time domain and frequency domain analysis
- ISB transmitters

3.3.3 Single Side Band Receivers
- SSB demodulation
- the beat frequency oscillator
- SSB receiver block diagram
- SSB receiver frequency conversion diagram
- the independent sideband receiver
- ISB receiver frequency conversion diagram
- channelized SSB equipment
- frequency synthesised SSB equipment

Block 4: Communication Techniques

4.1 FM Principles
- angle modulation, phase modulation and frequency modulation
- the rate and amount of frequency change
- capacitor microphone FM generator
- FM mathematical analysis
- modulation index for PM and FM
- deviation and bandwidth
- FM side frequencies from bessel functions
- narrow band FM
- power spectral distribution of the FM signal

4.2 Communications Techniques
- double conversion
- UP conversion
- image frequency rejection
- delayed AGC
- auxiliary AGC
- variable sensitivity
- variable selectivity
- bandspread
- noise limiter
- metering
- squelch (muting)

4.3 Facsimile
- cylindrical scanning
- dynamic range
- sender system layout
- facsimile receiver systems
- photographic reception
- direct recording

4.4 Mobile Communications
- mobile telephone
- FCC allocations for mobile radio services
- terminal unit
- radio base station
- system block diagram

4.5 Communications Transcievers
- block diagrams
- general specifications
- circuit analysis