SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: MEASUREMENTS

Code No.: ELR 101

Program: ELECTRICAL/ELECTRONIC TECHNOLOGY

Semester: TWO

Date: NOVEMBER, 1986

Author: NORM BARKER

New: _____ Revision: X

APPROVED: L P Orazetti 86-12-08

Chairperson Date

CALENDAR DESCRIPTION

MEASUREMENTS	ELR 101
Course Name	Course Number

PHILOSOPHY/GOALS:

To provide a sound understanding of the operating principles, characteristics and limitations of commonly used electrical measuring devices. Approximately fifty percent of class time will be spent in laboratory exercises to develop skills in the use of those instruments, together with familiarization with the appropriate manufacturers' manuals.

The graduate will also be capable of developing and conducting calibration procedures and equipment performance test.

METHOD OF ASSESSMENT (GRADING METHOD):

1. Written tests will be held at the end of one or more blocks of work, at least one week's noticce will be given. Test questions may cover work from previous blocks.

2. Short quizzes may be given without notice.

3. Laboratory log books are to be maintained and must be ready for assessment one week after scheduled completion of the laboratory session.

4. Each student will be subject to continuous evaluation in the laboratory, with emphasis on skill in the use of tools, test equipment, work habits, effort, participation and attitude.

5. Students are reminded that all laboratory exercises are mandatory.

6. COURSE WEIGHTING:

Theory	60%
Practical	40%

ASSIGNED GRADES ARE:

"A" - 80 to 100%
"B" - 66 to 79%
"C" - 55 to 65%
"R" - Less than 55%

In the case of final marks less than 55%, consideration will be given to a supplemental examination covering the whole course. The maximum mark that can be obtained on the supplemental is 55%.

REFERENCES:

Manufacturers' Manuals
Electronic Instrumentation and Measurement Techniques (Cooper)
Electronic Instrumentation and Measurement (Bell)

COURSE OUTLINE

1. INTRODUCTION:

   Historical development
   Measurement and error; accuracy, precision, significant figures and types of errors
   Units of measurement: fundamental and derived, SI units
   Measurement standards: National Research Council, National Bureau of Standards

2. BASIC DEFLECTION INSTRUMENTS:

   Controlling, deflecting and damping forces
   Permanent Magnet Moving Coil (PMMC) instruments
   Moving iron instruments
   Electrodynamic or dynamometer instruments
   Sources of errors and limitations

3. VOLTMETERS, AMMETERS AND OHMMETERS:

   Multipliers
   Shunts
   Current and potential transformers
   Series and shunt ohmmeters
   VOM (Simpson 260)
   Loading effect
   Component testing

4. OSCILLOSCOPE:

   The Electrostatic Cathode Ray Tube
   Block diagram
   Deflection diagram
   Internal and external triggering
   Delayed triggering
   Oscilloscope specifications
   Storage oscilloscopes
   Adjustments and use of probes

5. DIGITAL INSTRUMENTS:

   Principles, Block Diagrams, and use of:
      Multimeters
      Frequency counters

6. SIGNAL GENERATORS:

7. RL AND C MEASUREMENT:

Volt-ammeter method
Wheatstone bridge
Kelvin bridge
Universal bridge
Sencore Z meter
Capacitor tester

8. POWER MEASUREMENT:

Wattmeters
1 phase power measurement
Tong-test ammeters and voltmeters
Bridge megger
Wee megger

9. PRINTED CIRCUIT BOARD:

Testing
Repair

10. CALIBRATION:

Calibration of an analogue instrument (VOM)
Calibration of an oscilloscope
Preparation, calibration/error charts
Performance testing

11. ADVANCED MEASUREMENT TECHNIQUES:

True RMS measurement technique
Microprocessors in test equipment
The "Josephson volt"
Introduction to nanovolt measurement and the 8 1/2 digit DMM
Frequency standards

SPECIFIC OBJECTIVES

BLOCK 1 - INTRODUCTION TO MEASUREMENTS

1. Student shall be familiar with the historical development of the science of measurement and the development of general units and standards.

2. To become familiar with the six basic units of measurements as outlined by the International System of Units (SI):
   a) length - meter (m)
   b) time - second (s)
   c) mass - kilogram (kg)
   d) temperature - kelvin (k)
   e) Electric current - ampere (A)
   f) Luminous intensity - candela (cd)

3. Recall that the above basic units of measurements are a modernized version of the metric system and that all other SI units are derived from these six basic units.

4. Recall that the National Bureau of Standards (NBS) in the USA and the National Research Council (NRC) in Canada are responsbile for the establishment and maintenance of the SI standards in the USA and Canada respectively.

5. Recall the characteristics of good measurement.

6. Recall that in measurements, precision is a necessary prerequisite to accuracy, but precision does not guarantee accuracy.

7. Become familiar with the 3 main types of errors and how these errors may be reduced.

BLOCKS 2 & 3 - BASIC DEFLECTION INSTRUMENTS

instruments in this block. He shall be able to use manufacturer's manuals for the various instruments and be able to determine their applications, ranges, accuracy, specifications, limitations, precautions and operating procedures and any other pertinent data.

The student shall be able to:

1. Recall 5 requirements of a good meter.

2. Recall that a moving coil meter movement responds to DC current only.

3. Explain the operation of a basic moving coil meter movement with the aid of a fully labelled diagram.

4. Recall that the sensitivity of a meter movement is the amount of current (Im) required to produce full-scale deflection (fsd).

5. Recall that the internal resistance (Rm) of a meter movement is the DC resistance of the coil.

6. Recall that the ohms-per-volt rating is related to meter sensitivity.

7. Determine experimentally the sensitivity (Im) of a meter movement.

8. Determine experimentally the internal resistance (Rm) of a meter movement.

9. Determine the amount of error in reading any instrument when the accuaracy is known.

10. Design a voltmeter using a meter movement and multiplier resistors.

11. To determine the percent error between the calculated (true) and measured (apparent) readings.

12. Recall the precautions that must be observed in using voltmeters.

13. To determine the ohms-per-volt rating of a voltmeter.

14. Explain how the loading effect of a voltmeter causes errors in meter readings.

15. Recall the precautions to be observed when measuring current with an ammeter.

16. Calculate the percent error between measured and calculated current

readings.

17. Design an ammeter using a basic meter movement and a shunt resistor.

18. Design a multi-range ammeter using an Ayrton shunt.

19. To determine the insertion effects of an ammeter in an actual circuit.

20. Recall the precautions that must be observed when using an ohmmeter.

21. Design a series type ohmmeter from a basic meter movement.

22. To design a multi-range ohmmeter.

23. Using the schematic diagram of a Simpson 260 VOM to draw out the circuit applicable to the DC voltage ranges, DC current ranges, AC voltage.

BLOCK 4 - OSCILLOSCOPE

1. With the aid of a diagram explain the operation of an electrostatic cathode ray tube.

2. Explain with the aid of a block diagram, the operation of an oscilloscope.

3. Measure the frequency, phase angle, voltage, rise time, fall time, pulse width, tilt overshoot and ringing.

4. Use the oscilloscope in the delay mode and external triggering.

BLOCK 5 - DIGITAL INSTRUMENTS

The student shall be able to:

1. Explain with the aid of a block diagram the basic operation of digital multimeter and discuss its advantages as compared to a VOM, eg: Simpson Model 260.

2. Correctly use a digital multimeter to measure resistance, voltage, and current.

3. Correctly use a frequency counter to measure frequency.