#272

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: MEASUREMENTS

Code No.: ELR 115-2

Program: G.A.S. PRE-ENGINEERING

Semester: TWO

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Author: NORM BARKER

New: ___X___ Revision: _____

APPROVED: _____ _____

Chairperson Date

Delete as per N. Barker 87.12.15

CALENDAR DESCRIPTION

Course Name | Course Number

PHILOSOPHY/GOALS:

With the aid of manufacturers' manuals, successful students will be capable of measuring voltage, current, resistance, frequency, power and pulse parameters. Using common electrical and electronic test instruments, they will be able to describe the fundamental operating principles of the test equipment used.

METHOD OF ASSESSMENT (GRADING METHOD):

1. Written tests will be announced at least one week in advance.

2. Short quizzes may be given without notice.

3. Laboratory reports will be ready for assessment one week after scheduled completion of the lab exercise. All laboratory exercises must be completed satisfactorily.

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

COURSE WEIGHTING		ASSIGNED GRADES	
Theory	60%	"A"	80 to 100%
Practical	40%	"B"	66 to 79%
		"C"	55 to 65%
		"R	Less than 55%

In the case of final marks less than 55% and greater than 50%, consideration will be given to a supplemental examination covering the whole course, with a maximum mark of 55%.

REFERENCES:

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

COURSE OBJECTIVES

INTRODUCTION:

- Brief historical development
- Measurement and error: accuracy and precision
- Units of measurement: fundamental and derived
- SI units
- Introduction to measurement standards: National Research Council

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

VOLTMETERS, AMMETERS AND OHMMETERS:

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

DIGITAL INSTRUMENTS:

- Multimeters
- Frequency counters

SIGNAL GENERATORS:

- Audio
- Function
- Pulse
- Oscilloscope

LABORATORY POWER SUPPLIES:

- Connection of cells to meet voltage and current needs
- Basic power supply
- Use of laboratory power supplies

POWER MEASUREMENT & INSULATION MEASUREMENT:

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

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 measurement 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) Liminous 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 responsible 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:

The student shall become thoroughly familiar with the operation of the instruments in this block. He shall be able to use manufacturer's manuals for the varoius instruments and be able to determine their application, 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 curent (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 accuracy 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 currents 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. Verify experimentally the value of the shunt required to convert a meter movement into a milliameter of a specified range.

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

21. Recall the precautions that must be observred when using an ohmmeter.

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

23. To calibrate an ohms scale for the series-type ohmmeter.

24. To design a shunt ohmmeter circuit.

25. To design a multi-range ohmmeter.

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

BLOCK 4 - DIGITAL INSTRUMENTS:

The student shall be able to:

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

2. Correctly use a frequency counter to measure frequency.

BLOCK 5 - SIGNAL GENERATORS:

The student shall be able to:

1. With the aid of simplified block diagrams, describe in general terms the operation of:
   an audio generator
   pulse generator
   function generator

2. Use an oscilloscope to examine the output of these signal generators.

BLOCK 6 - LABORATORY POWER SUPPLIES:

The student shall be able to:

1. Determine battery hook-up circuits to provide specified voltage and current requirements.

2. Explain with the aid of achematic the operation of a simple full-wave power supply including capacitor and pi filters.

3. Correctly connect a voltage supply to provide:

    1. a positive potential with respect to common
    2. a negative potential with respect to common
    3. a dual polarity output

BLOCK 7 - POWER MEASUREMENT:

The student shall be able to:

1. Recall and explain the operation of a wattmeter, and be able to correctly connect and measure dc and single-phase ac power.

2. Correctly use tong-test ammeters and voltmeters.

3. Explain with the aid of a sketch the principle of a Wee Megger.

4. Measure insulation resistance and continuity using a Wee Megger.