SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE: ELECTRICAL SYSTEMS

CODE NO.: ELR 108-3

PROGRAM: PRE-ENGINEERING

SEMESTER: ONE

DATE: SEPTEMBER 1986

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NEW: X REVISION: _____

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Date

Order	Periods		Topic Description	Reference
	Theory	Lab		
	3		**Introduction to Electricity** a) Matter and Structure b) Current, resistance, potential difference c) Units d) Ohm's Law, Power and Efficiency	
2	6		DC Circuits a) Series circuits b) Parallel Circuits c) Series-parallel circuits	
3	9		Magnetism, Inductance and Capacitance a) Magnetic fields b) Electromagnets c) Induced voltage d) Inductors, inductance, R.L. Circuit e) Self and Mutual Inductance f) Inductors in series and parallel g) Capacitors, capacitance and R.C. Circuit h) Capacitors in series and parallel	
4	6		Introduction to Alternating Current a) Production of a sine wave voltage b) Cycle, maximum, instantaneous, average and rms value c) Phasors d) Effects of ac with R, L and C e) Power, Phase angle, power factor f) Transformers and auto transformers	
5	6		Generators and Motors a) Induced voltages b) Construction of ac and dc generators c) voltage and frequency control d) Paralleling requirements e) Characteristics and operation of dc motors and generators f) Polyphase induction motors g) automatic voltage regulators h) three-phase systems	
6	6		Solid State Electronics a) Basic semiconductor theory b) Function diodes c) transistors d) silicon controlled rectifiers e) inverters and cycloconverters	
7	6	6	Aircraft Electrical Systems a) Cessna 152 and 172 b) Twin Otter c) Challenger d) Gulfstream II e) Gates Lear jet	

INTRODUCTION TO ELECTRICITY

UNIT 1 - Introduction to Electricity

Specific Objectives

1. Recall the nature of matter and the structure of the atom.

2. Recall that electric current is the movement of electric charges along a conductor.

3. Recall that the ampere is the unit of measurement of current and is the rate of flow of one coulomb of electricity per second.

4. Recall that resistance is the opposition to the flow of an electric current, and that the ohm is the unit of resistance.

5. Recall that resistance depends upon the material, cross-sectional area, length and temperature of the conductor.

6. Recall that potential difference is that which causes current to flow and its unit of measurement is the volt.

7. Recall that electromotive force, or emf, is required to maintain a potential difference between two points when a current flows between the two points. An emf may be produced, chemically, mechanically or by heat.

UNIT 2 - DC Circuits

Specific Objectives

1. Recall that in a series circuit:
   a) there is only one current path
   b) the same current flows through each resistor
   c) the total resistance of a series circuit is the sum of the individual resistances, ie:

$$R_T = R_1 + R_2 + R_3 + \ldots$$

   d) the sum of the voltage drops across each resistor is equal to the applied voltage. Kirchoff's Voltage Law.

2. Recall that in a parallel circuit:
   a) the voltages across the branches in parallel are equal
   b) the total resistance of a parallel circuit is:

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

   c) the total current entering a junction is equal to the sum of the currents leaving the junction. Kirchoff's Current Law.

3. To be able to solve simple series, parallel and series-parallel circuits with one source of emf.

4. Recall that voltage is a common term used to specify the measurement of potentia difference or emf.

5. **Recall and be able to use:**

$$I = \frac{V}{R}, \quad R = \frac{V}{I}, \quad V = IR$$

$$P = VI = \frac{V^2}{R} = I^2R$$

6. Be able to define a) Work, b) Energy, c) Power, d) Efficiency, and know their interrelationships.

UNIT 3

Magnetism, Inductance and Capacitance

Specific Objectives

1. Recall that magnets may be permanent or temporary depending upon their ability to retain magnetism.

2. Recall that materials that are attracted by a magnet are called magnetic materials

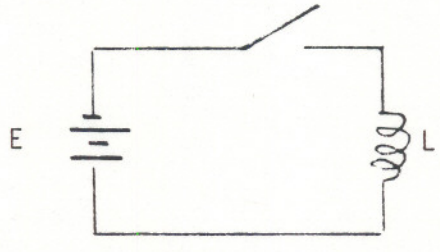
3. Recall the following properties of magnets:

   a) like poles repel, unlike poles attract
   b) the N pole is a north-seeking pole and the S pole is a south-seeking pole.
   c) lines of force form closed loops, and leave from the N pole and enter at the S pole.
   d) Lines of force travel most easily through ferromagnetic materials.
   e) Lines of force repel each other and cannot intersect.

4. Recall that a magnetic field is produced by a current carrying conductor and its direction can be established by the Right Hand Corkscrew Rule.

5. Recall that an emf is induced whenever there is relative motion between a closed coil and a magnetic field, and that the magnitude is proportional to the rate of cutting lines of force (Faraday's Law) and that its direction is such that it opposes the change causing it (Lenz's Law).

6. To be able to describe the current build up and decay of induced voltage in the following circuit:



7. To be able to explain self and mutual inductance.

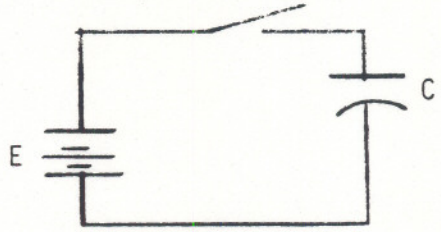
and for inductors in parallel is:

$$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \ldots$$

9. Recall that an inductance opposes the change of current, and that energy is stored in the magnetic field surrounding a current carrying conductor.

10. Recall the basic construction of a capacitor and that energy is stored in the electric field between the plates, and that a capacitor opposes changes in voltage.

11. To be able to explain the voltage build up and current decay in the following circuit:



12. Recall that the equivalent capacitance for capacitors in series is:

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots$$

and for capacitors in parallel is:

$$C_T = C_1 + C_2 + C_3 + \ldots$$

UNIT 4

Introduction to Alternating Current

Specific Objectives

1. Recall the production of an emf by the rotation of a coil in a magnetic field.

2. Recall that each cycle of alternating current represents one complete revolution of the coil in the magnetic field.

3. To be able to explain the following terms:

   a) cycle
   b) frequency
   c) Instantaneous value
   d) maximum value

e) average value
f) RMS value

4. Recall how alternating quantities may be represented by phasors.

5. Recall the phasor relationships between voltage and current in a pure resistive, a pure inductive and pure capacitive circuit.

6. Recall that the power consumed by a pure resistance is VI and by a pure inductance and capacitance is zero.

7. Recall the meaning of phase angle (lead or lag) and that true power is VI COS Q and apparent power is VI in a circuit containing resistance, inductance and/or capacitance.

8. Recall the basic construction and principle of operation of a single phase transformer and autotransformer.

UNIT 5

Generators & Motors

Specific Objectives

1. Recall that the magnitude of an induced voltage is dependent upon:
   a) the magnitude of the magnetic field
   b) the number of conductors cutting the magnetic field
   c) the rate of cutting lines of magnetic force by the conductors.

2. Recall the general construction of an ac generator and a dc generator.

3. Recall the principles of producing an emf in a generator.

4. Recall the principles of controlling the voltage of a dc, and the principles of controlling the voltage and speed of an ac generator.

5. Recall the requirements of paralleling dc and ac generators.

6. Recall the basic connections and characteristics of dc shunt, series and compound generators and motors.

7. Recall the basic construction of a polyphase induction motor.

8. Recall the principle of operation of a polyphase induction motor and its operating characteristics

9. Recall and explain the principle of operation of an automatic voltage regulator.

10. Recall and explain the benefits of three-phase generation and distribution using star and delta systems.

Solid State Electronics

Specific Objectives

e) N type and P type crystals

2. Recall and explain the principles of the P-N junction, and the effects of forward and reverse voltages.

3. Recall and explain the use of junction diodes for half and full-wave rectification of ac.

4. Recall and explain PNP and NPN transistors, explain common-base, common-emitter and common-collector configurations and their characteristics.

5. Recall and explain the basic construction, characteristics and applications of the SCR in phase controlled converters and static inverters.