SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: ELECTRICAL MACHINES

Code No.: ELR 304-6

Program: ELECTRICAL ENGINEERING TECHNOLOGY

Semester: FIVE

Date: AUGUST, 1985

Author: R.A. PEARMAN

New: _____ **Revision:** X

APPROVED: L.P. Arsenault
Chairperson **Date**

Approved Jan 15/86

ELECTRICAL MACHINE DESIGN
Course Name

ELR 304-6
Course Number

PHILOSOPHY/GOALS:

The object of this course is to develop the analytic skills to thoroughly understand the operation and application of AC and DC rotating machines under steady-state and dynamic operating conditions.

METHOD OF ASSESSMENT (GRADING METHOD):

1. Written tests will be conducted at regular intervals.
2. Short quizzes may be given without notice.
3. Laboratory reports are due within one week of the completion of an experiment. Late reports will be penalized 10% per day.
4. Grading:

A - 80-100%
B - 66-79
C - 55-65%
X - 50-55%
R - Less than 50%

The grading weights are Theory-70% and Laboratory-30%.

TEXTBOOK(S):

ELECTRICAL MACHINERY by Fitzgerald, Kingsley and Umans
McGraw--Hill

ELECTRICAL MACHINE DESIGN

ELR 304-6

BLOCK I: Magnetic Circuits and Transformers

At the end of this block the student shall be able to:

1. Develop and utilize equations describing;

   a) series and parallel magnetic circuits
   b) flux linkage and equivalent flux
   c) energy stored in magnetic circuits, magnetic force, hysteresis and eddy currents, core losses
   d) inductance and self-inductance, force and torque, mutual inductance; energy, torque, and force in inductively coupled circuits
   e) The ideal transformer
   f) exciting current, core-loss current, and magnetizing current
   g) leakage impedance, coupled circuit equations, and equivalent circuit diagram
   h) open and short circuit tests, exciting admittance and equivalent impedance
   i) transformer losses, efficiency and voltage regulation
   j) auto transformers, instrument transformers
   k) three-phase transformer connections, per unit quantities
   l) multicircuit transformers
   m) transformer operation

BLOCK II: D-C Machines

At the end of this block the student shall be able to:

1. Describe the structural characteristics of d-c machines.

2. Develop and utilize equations and graphs describing:

   a) M.M.F. and flux components
   b) field excitation, armature reaction
   c) load characteristics and generators
   d) analyze steady-state performance of motors and generators
   e) commutation
   f) losses and efficiency
   g) motor torque, speed-torque characteristics
   h) transfer functions
   i) steady-state and dynamic behaviour of machines
   j) starting and speed-control including Ward-Leonard

BLOCK III: Synchronous Machines

At the end of this block the student shall be able to:

1. Describe the structural and operating characteristics of synchronous machines.

2. Develop and utilize equations, phasor diagrams and graphs describin

   a) a-c armature windings, induced armature voltage, armature MMF
   b) unsaturated inductances of cylindrical rotor machines and phasor diagrams.
   c) idealized three-phase generator, general relationships in terms of inductances, and balanced loads.
   d) short circuit and open circuit tests, voltage regulation and short circuit ratio
   e) parallel operation of synchronous generators
   f) real and reactive power versus power factor angle
   g) synchronous machine excitation systems
   h) direct and quadrature exis synchronous reactance of salient pole
   i) Zero-power factor characteristics and Potier triangle.
   j) torque angle characteristic of salient pole machines
   k) motor starting and applications
   l) transient performance and dynamic stability

BLOCK IV: Polyphase Induction Motors

At the end of this block the student shall be able to:

1. Describe the construction, operation, performance and applications of polyhase induction motors.

2. Develop and utilize equations, phasor diagrams and graphs describing

   a) magnetizing reactance and leakage reactance
   b) rotor current, rotor copper loss and slip
   c) The equivalent circuit diagram and phasor diagram
   d) slip-torque relationships
   e) squirrel cage and wound motor starting and speed-control techniques
   f) double squirrel cage and deep-bar motors
   g) no load and locked rotor tests.
   h) asynchronous generators
   i) solid-state drives for induction motors

BLOCK V: Single-Phase Motors

At the end of this block the student shall be able to:

1. Describe the construction, operation, characteristics and applications of single phase induction motors.

2. Develop and utilize equations, phasor diagrams and graphs describing:

   a) two revolving field theory
   b) No-load and locked rotor tests
   c) capacitor motor
   d) self-synchronous motors