

# EPIC Educational Program Innovations Center

## 98-Elec-A6 - Electromagnetic Energy Conversion

Course Instructor: Dr. R. El-Shatshat,

Email: [raelshatshat@uwaterloo.ca](mailto:raelshatshat@uwaterloo.ca)

Tel: 519-576-4563

### Course Description

- 1. Basics of Electric Circuits — A Review:** Voltage, Current, and Power. Sign notation. Resistors, Inductors and Capacitors. Ohms Law, Kirchhoff's voltage and current Laws (KVL and KCL) (week 1).
- 2. Single-phase AC circuits — A Review:** Complex numbers, Phasors, Impedances, Frequency Domain Analysis, Instantaneous Power, Average (Active) Power, Reactive Power, Apparent Power, and Complex Power (week 1).
- 3. Three-phase AC circuits:** Power in three-phase circuits, Wye and Delta connections, measurement of power in three-phase circuits Power factor correction, (week 2).
- 4. Electromagnetism:** Magnetic field concepts; Magnetic circuits; Laws of electromagnetism — Faraday's Law, Hysteresis and Eddy currents (week 3).
- 5. DC Generators and Motors:** Construction, field excitation and armature reaction. Classification, shunt, series and compound dc motors. Speed - torque characteristics, motor starters, Speed control and power flow diagrams (week 4 and 5).
- 6. Transformers:**  
Ideal transformers; Induced voltages and currents, Practical transformers; Open and Short circuit tests; equivalent circuits, voltage regulation; efficiency; concepts of three-phase transformers (week 6).
- 7. Synchronous Generators:** Construction, equivalent circuits, phasor diagrams, voltage regulation.  
**Synchronous Motors:** Principles of motor operation, starting of synchronous motors, power, losses and efficiency calculations. V-curves, phasor diagrams, power factor correction (week 7, 8).
- 8. Induction Motors:** Three-phase Induction Motors: Rotating magnetic field, slip and rotor speed, equivalent circuits and phasor diagrams, speed control and speed regulation (week 9, 10).