



## COURSE OUTLINE: ELR232 - ELECTRIC MACHINES

Prepared: Jon Pasiak

Approved: Corey Meunier, Chair, Technology and Skilled Trades

<b>Course Code: Title</b>	ELR232: ELECTRICAL MACHINES
<b>Program Number: Name</b>	4026: ELECTRICAL TN-PROC 4029: ELECTRICAL TY-PROCES 4127: ELECTRICAL TN-TRADES
<b>Department:</b>	ELECT./INSTRUMENTATION PS
<b>Semesters/Terms:</b>	19F
<b>Course Description:</b>	This course is an analytical study of the characteristics, performance and control of D.C. generators and motors, single and polyphase induction motors, polyphase synchronous machines and transformers, supported by an integrated laboratory program.
<b>Total Credits:</b>	7
<b>Hours/Week:</b>	5
<b>Total Hours:</b>	75
<b>Prerequisites:</b>	ELR109
<b>Corequisites:</b>	ELR216
<b>Substitutes:</b>	ELR208
<b>This course is a pre-requisite for:</b>	ELR223, ELR236, ELR311, ELR330
<b>Vocational Learning Outcomes (VLO's) addressed in this course:</b>	<b>4026 - ELECTRICAL TN-PROC</b>
<b>Please refer to program web page for a complete listing of program outcomes where applicable.</b>	VLO 1 Interpret and produce electrical and electronics drawings including other related documents and graphics.
	VLO 2 Analyze and solve routine technical problems related to electrical systems by applying mathematics and science principles.
	VLO 4 Assemble, test, modify and maintain electrical circuits and equipment to fulfill requirements and specifications under the supervision of a qualified person.
	VLO 5 Install and troubleshoot static and rotating electrical machines and associated control systems under the supervision of a qualified person.
	VLO 6 Verify acceptable functionality and apply troubleshooting techniques for electrical and electronic circuits, components, equipment, and systems under the supervision of a qualified person.
	VLO 7 Analyze, assemble and troubleshoot control systems under the supervision of a qualified person.
	VLO 8 Use computer skills and tools to solve routine electrical related problems.
	VLO 9 Assist in creating and conducting quality assurance procedures under the supervision of a qualified person.
	VLO 12 Apply health and safety standards and best practices to workplaces.
	VLO 13 Perform tasks in accordance with relevant legislation, policies, procedures, standards, regulations, and ethical principles.



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VLO 14 Configure installation and apply electrical cabling requirements and system grounding and bonding requirements for a variety of applications under the supervision of a qualified person.

#### **4029 - ELECTRICAL TY-PROCES**

VLO 1 Analyze, interpret, and produce electrical and electronics drawings, technical reports including other related documents and graphics.

VLO 2 Analyze and solve complex technical problems related to electrical systems by applying mathematics and science principles.

VLO 4 Design, assemble, test, modify, maintain and commission electrical equipment and systems to fulfill requirements and specifications under the supervision of a qualified person.

VLO 5 Commission and troubleshoot static and rotating electrical machines and associated control systems under the supervision of a qualified person.

VLO 6 Design, assemble, analyze, and troubleshoot electrical and electronic circuits, components, equipment and systems under the supervision of a qualified person.

VLO 7 Design, install, analyze, assemble and troubleshoot control systems under the supervision of a qualified person.

VLO 10 Prepare reports and maintain records and documentation systems.

VLO 12 Apply and monitor health and safety standards and best practices to workplaces.

VLO 13 Perform and monitor tasks in accordance with relevant legislation, policies, procedures, standards, regulations, and ethical principles.

VLO 16 Select and recommend electrical equipment, systems and components to fulfill the requirements and specifications under the supervision of a qualified person.

#### **4127 - ELECTRICAL TN-TRADES**

VLO 1 Interpret and produce electrical and electronic drawings including other related documents and graphics.

VLO 2 Analyze and solve routine technical problems related to electrical systems by applying mathematics and science principles.

VLO 4 Assemble, test, modify and maintain electrical circuits and equipment to fulfill requirements and specifications under the supervision of a qualified person.

VLO 5 Install and troubleshoot static and rotating electrical machines and associated control systems under the supervision of a qualified person.

VLO 6 Verify acceptable functionality and apply troubleshooting techniques for electrical and electronic circuits, components, equipment, and systems under the supervision of a qualified person.

VLO 7 Analyze, assemble and troubleshoot control systems under the supervision of a qualified person.

VLO 8 Use computer skills and tools to solve routine electrical related problems.

VLO 9 Assist in creating and conducting quality assurance procedures under the supervision of a qualified person.

VLO 12 Apply health and safety standards and best practices to workplaces.

VLO 13 Perform tasks in accordance with relevant legislation, policies, procedures, standards, regulations, and ethical principles.

VLO 14 Configure installation and apply electrical cabling requirements and system grounding and bonding requirements for a variety of applications under the



	supervision of a qualified person.				
	VLO 15 Assist in commissioning, testing and troubleshooting electrical power systems under the supervision of a qualified person.				
	VLO 16 Select electrical equipment, systems and components to fulfill the requirements and specifications under the supervision of a qualified person.				
<b>Essential Employability Skills (EES) addressed in this course:</b>	<p>EES 1 Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.</p> <p>EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective communication.</p> <p>EES 3 Execute mathematical operations accurately.</p> <p>EES 4 Apply a systematic approach to solve problems.</p> <p>EES 5 Use a variety of thinking skills to anticipate and solve problems.</p> <p>EES 6 Locate, select, organize, and document information using appropriate technology and information systems.</p> <p>EES 7 Analyze, evaluate, and apply relevant information from a variety of sources.</p> <p>EES 8 Show respect for the diverse opinions, values, belief systems, and contributions of others.</p> <p>EES 9 Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals.</p> <p>EES 10 Manage the use of time and other resources to complete projects.</p> <p>EES 11 Take responsibility for ones own actions, decisions, and consequences.</p>				
<b>Course Evaluation:</b>	Passing Grade: 50%, D				
<b>Other Course Evaluation &amp; Assessment Requirements:</b>	<p>The student must maintain a minimum 50% average in both the theory portion and lab portion of the class in order to receive a passing grade.</p> <p>Grade Definition Grade Point Equivalent A+ 90 - 100% 4.00 A 80 - 89% B 70 - 79% 3.00 C 60 - 69% 2.00 D 50 - 59% 1.00 F (Fail)49% and below 0.00</p> <p>CR (Credit) Credit for diploma requirements has been awarded. S Satisfactory achievement in field /clinical placement or non-graded subject area. U Unsatisfactory achievement in field/clinical placement or non-graded subject area. X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course. NR Grade not reported to Registrar's office. W Student has withdrawn from the course without academic penalty.</p>				
<b>Books and Required Resources:</b>	Electrical Machines, Drives, And Power Systems by Theodore Wildi Publisher: Pearson Prentice Hall Edition: 6th ISBN: 0-13-177691-6				
<b>Course Outcomes and Learning Objectives:</b>	<table border="1"> <thead> <tr> <th>Course Outcome 1</th> <th>Learning Objectives for Course Outcome 1</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> </tr> </tbody> </table>	Course Outcome 1	Learning Objectives for Course Outcome 1		
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1. Analyze and test direct current (dc) motors and generators.	<p>1.1 Describe the construction of dc machines.</p> <p>1.2 Describe how a dc generator generates voltage.</p> <p>1.3 Describe how a dc motor develops torque.</p> <p>1.4 Perform calculations to determine electrical, mechanical and magnetic operating parameters of dc machines.</p> <p>1.5 Connect and test various configurations of dc machines.</p>
<b>Course Outcome 2</b>	<b>Learning Objectives for Course Outcome 2</b>
2. Analyze and test single and polyphase transformers.	<p>2.1 Describe the construction of various power, control and instrument transformers.</p> <p>2.2 Describe the principles of operation of ideal and real transformers.</p> <p>2.3 Utilize phasor diagrams to explain the characteristics of transformers operating at various power factors.</p> <p>2.4 Perform calculations involving power, voltage, current and flux.</p> <p>2.5 Connect and test various configurations of single and polyphase transformers.</p> <p>2.6 Describe safety issues regarding transformers.</p>
<b>Course Outcome 3</b>	<b>Learning Objectives for Course Outcome 3</b>
3. Analyze and test three phase alternating current (ac) generators.	<p>3.1 Describe the construction of ac synchronous generators.</p> <p>3.2 Perform calculations to determine electrical, mechanical and magnetic operating parameters of ac synchronous generators.</p> <p>3.3 Utilize phasor diagrams to explain the characteristics of ac synchronous generators operating at various power factors and under various load conditions.</p> <p>3.4 Connect and test ac synchronous generators.</p>
<b>Course Outcome 4</b>	<b>Learning Objectives for Course Outcome 4</b>
4. Analyze and test single and polyphase ac induction motors.	<p>4.1 Describe the construction of three phase ac induction motors.</p> <p>4.2 Describe how a rotating magnetic field is set up in a three phase ac motor.</p> <p>4.3 Describe how torque is developed by a three phase induction motor.</p> <p>4.4 Describe the construction of various types of single phase induction motors.</p> <p>4.5 Describe how torque is developed by single phase induction motors.</p> <p>4.6 Perform calculations to determine electrical and mechanical operating parameters of ac induction motors.</p> <p>4.7 Connect and test various types of ac induction motors.</p>
<b>Course Outcome 5</b>	<b>Learning Objectives for Course Outcome 5</b>
5. Analyze and test single and polyphase ac synchronous motors.	<p>5.1 Describe the construction of a three phase synchronous motor.</p> <p>5.2 Describe how a synchronous motor develops torque.</p> <p>5.3 Describe methods of starting synchronous motors.</p> <p>5.4 Perform calculations to determine electrical, mechanical and magnetic operating parameters of ac synchronous motors.</p> <p>5.5 Utilize phasor diagrams to explain the characteristics of ac synchronous motors operating at various power factors and under various load conditions.</p>



		5.6 Describe how synchronous motors are used for power factor correction and perform related calculations. 5.7 Describe the construction and operation of common fractional horsepower single phase synchronous motors.						
	<b>Course Outcome 6</b>	<b>Learning Objectives for Course Outcome 6</b>						
	6. Construct and test various motor control circuits.	6.1 Describe power and control components of typical ac and dc motor control schemes. 6.2 Define wiring diagram, schematic diagram, ladder logic, relay logic. 6.3 Draw and interpret wiring, schematic, ladder logic and relay logic diagrams. 6.4 Connect and test various motor control circuits. 6.5 Apply rules from the Canadian Electrical Code relating to motor installation.						
<b>Evaluation Process and Grading System:</b>	<table border="1"> <thead> <tr> <th>Evaluation Type</th> <th>Evaluation Weight</th> </tr> </thead> <tbody> <tr> <td>Lab Component</td> <td>30%</td> </tr> <tr> <td>Tests/Quizzes/Assignments</td> <td>70%</td> </tr> </tbody> </table>	Evaluation Type	Evaluation Weight	Lab Component	30%	Tests/Quizzes/Assignments	70%	
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<b>Date:</b>	August 27, 2019							
<b>Addendum:</b>	Please refer to the course outline addendum on the Learning Management System for further information.							