



## COURSE OUTLINE: ELR236 - POWER ELECTRONICS

Prepared: R. Allen

Approved: Corey Meunier, Chair, Technology and Skilled Trades

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| <b>Course Code: Title</b>                                                                                                                                                  | ELR236: POWER ELECTRONICS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Program Number: Name</b>                                                                                                                                                | 4026: ELECTRICAL TN-PROC<br>4029: ELECTRICAL TY-PROCES<br>4127: ELECTRICAL TN-TRADES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Department:</b>                                                                                                                                                         | ELECT./INSTRUMENTATION PS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Semesters/Terms:</b>                                                                                                                                                    | 21W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Course Description:</b>                                                                                                                                                 | This course is an introductory analytical study of A.C. and D.C. motor control utilizing solid-state techniques. The topics include D.C. motor speed control utilizing phase-controlled and chopper converters, and polyphase A.C. motor speed control utilizing six-step and pulse-width modulated inverters and phase-controlled cycloconverters. This course is supported by a well equipped laboratory program.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Total Credits:</b>                                                                                                                                                      | 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Hours/Week:</b>                                                                                                                                                         | 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Total Hours:</b>                                                                                                                                                        | 105                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Prerequisites:</b>                                                                                                                                                      | ELN213, ELR232                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Corequisites:</b>                                                                                                                                                       | There are no co-requisites for this course.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>This course is a pre-requisite for:</b>                                                                                                                                 | ELR320                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Vocational Learning Outcomes (VLO's) addressed in this course:</b><br><br>Please refer to program web page for a complete listing of program outcomes where applicable. | <b>4026 - ELECTRICAL TN-PROC</b><br>VLO 1 Interpret and produce electrical and electronics drawings including other related documents and graphics.<br>VLO 2 Analyze and solve routine technical problems related to electrical systems by applying mathematics and science principles.<br>VLO 4 Assemble, test, modify and maintain electrical circuits and equipment to fulfill requirements and specifications under the supervision of a qualified person.<br>VLO 5 Install and troubleshoot static and rotating electrical machines and associated control systems under the supervision of a qualified person.<br>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.<br>VLO 7 Analyze, assemble and troubleshoot control systems under the supervision of a qualified person.<br>VLO 8 Use computer skills and tools to solve routine electrical related problems.<br>VLO 10 Prepare and maintain records and documentation systems.<br>VLO 12 Apply health and safety standards and best practices to workplaces. |

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2020-2021 academic year.



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|                                                                       | <p>VLO 13 Perform tasks in accordance with relevant legislation, policies, procedures, standards, regulations, and ethical principles.</p> <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <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>                                             | <p>Passing Grade: 50%, D</p> <p>A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Other Course Evaluation &amp; Assessment Requirements:</b>         | <p>Both the Theory Portion of the class and the Lab portion must be successfully passed in order to achieve a passing grade for the class.</p> <p>Grade<br/>Definition Grade Point Equivalent<br/>A+ 90 - 100% 4.00<br/>A 80 - 89%<br/>B 70 - 79% 3.00<br/>C 60 - 69% 2.00<br/>D 50 - 59% 1.00<br/>F (Fail) 49% and below 0.00</p> <p>CR (Credit) Credit for diploma requirements has been awarded.<br/>S Satisfactory achievement in field /clinical placement or non-graded subject area.<br/>U Unsatisfactory achievement in field/clinical placement or non-graded subject area.<br/>X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.<br/>NR Grade not reported to Registrar's office.<br/>W Student has withdrawn from the course without academic penalty.<br/>Cell Phones turned off and put away during tests<br/>Smart Watched turned off and removed during tests</p>                                                                                                                                    |

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|                                                 | If your Phone or Watch ring during a test, your test will be immediately collected and a score of 0 will be issued.<br>Students texting or playing on their phones during class will be asked to leave the room and go elsewhere to play. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Books and Required Resources:</b>            | Electrical Machines, Drives, And Power Systems by Wildi<br>Publisher: Pearson Prentice Hall Edition: 6th<br>ISBN: 0-13-177691-6                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Outcomes and Learning Objectives:</b> | <b>Course Outcome 1</b>                                                                                                                                                                                                                   | <b>Learning Objectives for Course Outcome 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                 | 1. Analyze the operation of various types of diode and rectifier circuits                                                                                                                                                                 | 1.1 Describe energy transfer between inductors and capacitors in diode /RLC circuits<br>1.2 State the various types of diode rectifier circuits and draw the associated circuit diagrams<br>1.3 Choose the correct type and rating of rectifier diode for a given application<br>1.4 Draw associated voltage and current waveforms for single phase, three phase and six phase diode rectifiers<br>1.5 Identify safety issues of non-isolated oscilloscopes if used to test power circuits<br>1.6 Set-up and use isolated oscilloscopes and oscilloscope isolators in the lab environment<br>1.7 Connect, test and troubleshoot diode rectifier circuits |
|                                                 | <b>Course Outcome 2</b>                                                                                                                                                                                                                   | <b>Learning Objectives for Course Outcome 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                 | 2. Understand the operation characteristics of Thyristors and Power Transistors                                                                                                                                                           | 2.1 State the five major categories of power electronic switching devices<br>2.2 Describe the operating characteristics of power SCRs, BJTs, MOSFETs and IGBTs<br>2.3 Connect and test simple power electronic switching circuits in the lab environment                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                                 | <b>Course Outcome 3</b>                                                                                                                                                                                                                   | <b>Learning Objectives for Course Outcome 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                 | 3. Analyze various types of SCR commutation circuits                                                                                                                                                                                      | 3.1 Define natural and forced commutation<br>3.2 Draw and describe the operation of various forced commutation circuits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                 | <b>Course Outcome 4</b>                                                                                                                                                                                                                   | <b>Learning Objectives for Course Outcome 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                 | 4. Analyze the operation of various types of single and polyphase controlled rectifiers.                                                                                                                                                  | 4.1 Describe the principal of phase controlled converter operation<br>4.2 Draw circuit diagrams for, and describe the operation of, single and three-phase semi-converters, full converters and dual converters<br>4.3 Describe the effects of an inductive load on various controlled rectifiers<br>4.4 Describe the effects of controlled rectifiers on system power factor and harmonic content<br>4.5 Draw voltage and current waveforms associated with the various converter circuits<br>4.6 Build and test a three phase controlled rectifier                                                                                                     |
|                                                 | <b>Course Outcome 5</b>                                                                                                                                                                                                                   | <b>Learning Objectives for Course Outcome 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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| 5. Analyze the operation of various types of static switches        | 5.1 Draw circuit diagrams for, and describe the operation of various AC and DC static switches<br>5.2 Describe common applications of static switches                                                                                                                                                                                                                                                                     |
| <b>Course Outcome 6</b>                                             | <b>Learning Objectives for Course Outcome 6</b>                                                                                                                                                                                                                                                                                                                                                                           |
| 6. Analyze the operation of various types of AC voltage controllers | 6.1 Draw circuit diagrams for, and describe the operation of, various AC voltage controllers<br>6.2 Draw voltage waveforms associated with various AC voltage controllers<br>6.3 Describe common applications of AC voltage controllers                                                                                                                                                                                   |
| <b>Course Outcome 7</b>                                             | <b>Learning Objectives for Course Outcome 7</b>                                                                                                                                                                                                                                                                                                                                                                           |
| 7. Analyze the operation of various types of DC chopper circuits    | 7.1 Describe the principle of operation of a step down (buck) chopper<br>7.2 Describe the operation of a step up (boost) chopper<br>7.3 Describe the operation of specific buck, boost and buck/boost chopper circuits                                                                                                                                                                                                    |
| <b>Course Outcome 8</b>                                             | <b>Learning Objectives for Course Outcome 8</b>                                                                                                                                                                                                                                                                                                                                                                           |
| 8. Analyze the operation of various types of inverter circuits      | 8.1 Draw circuit diagrams for, and describe the operation of, common single and three phase inverters<br>8.2 Draw voltage waveforms associated with common inverters<br>8.3 Describe how pulse width modulation is used for wave shaping<br>8.4 Draw circuit diagrams for, and describe the operation of, various resonant pulse inverters<br>8.5 Draw voltage waveforms associated with various resonant pulse inverters |
| <b>Course Outcome 9</b>                                             | <b>Learning Objectives for Course Outcome 9</b>                                                                                                                                                                                                                                                                                                                                                                           |
| 9. Analyze the operation of various types of DC motor drives.       | 9.1 Describe the basic electrical and mechanical characteristics of DC motors<br>9.2 Describe how DC drives are used to control the operation of DC motors<br>9.3 Identify power and control sections of DC drive circuitry and produce simplified block diagrams of specific DC motor drives in the lab<br>9.4 Connect and test DC drives in the lab                                                                     |
| <b>Course Outcome 10</b>                                            | <b>Learning Objectives for Course Outcome 10</b>                                                                                                                                                                                                                                                                                                                                                                          |
| 10. Analyze the operation of various types of AC motor drives.      | 10.1 Describe the basic electrical and mechanical characteristics of AC motors<br>10.2 Describe how AC drives are used to control the operation of AC motors<br>10.3 Identify power and control sections of AC drive circuitry and produce simplified block diagrams of specific AC motor drives in the lab<br>10.4 Connect and test AC drives in the lab                                                                 |
| <b>Course Outcome 11</b>                                            | <b>Learning Objectives for Course Outcome 11</b>                                                                                                                                                                                                                                                                                                                                                                          |
| 11. Analyze the operation of various types of industrial            | 11.1 State the general requirements for industrial power supplies                                                                                                                                                                                                                                                                                                                                                         |

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|                                               | power supplies                                                                                                                                                                | 11.2 Describe the operation of switched-mode, resonant and bi-directional DC power supplies<br>11.3 Describe the components of a basic UPS system<br>11.4 State the purpose of multistage AC power supplies<br>11.5 Describe the operation of various multistage AC power supplies |                 |                   |                        |     |                   |     |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|------------------------|-----|-------------------|-----|
| <b>Evaluation Process and Grading System:</b> | <table><tr><th>Evaluation Type</th><th>Evaluation Weight</th></tr><tr><td>Laboratory Assignments</td><td>30%</td></tr><tr><td>Tests and Quizzes</td><td>70%</td></tr></table> |                                                                                                                                                                                                                                                                                    | Evaluation Type | Evaluation Weight | Laboratory Assignments | 30% | Tests and Quizzes | 70% |
| Evaluation Type                               | Evaluation Weight                                                                                                                                                             |                                                                                                                                                                                                                                                                                    |                 |                   |                        |     |                   |     |
| Laboratory Assignments                        | 30%                                                                                                                                                                           |                                                                                                                                                                                                                                                                                    |                 |                   |                        |     |                   |     |
| Tests and Quizzes                             | 70%                                                                                                                                                                           |                                                                                                                                                                                                                                                                                    |                 |                   |                        |     |                   |     |
| <b>Date:</b>                                  | September 2, 2020                                                                                                                                                             |                                                                                                                                                                                                                                                                                    |                 |                   |                        |     |                   |     |
| <b>Addendum:</b>                              | Please refer to the course outline addendum on the Learning Management System for further information.                                                                        |                                                                                                                                                                                                                                                                                    |                 |                   |                        |     |                   |     |

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