A. Academic Division: Business, Industry, and Technology

B. Discipline: Electronic Engineering Technology

C. Course Number and Title: ELET2150 Motor Controls

D. Course Coordinator: Randy Storms
   Assistant Dean: Daniel Wagner

Instructor Information:
- Name: Click here to enter text.
- Office Location: Click here to enter text.
- Office Hours: Click here to enter text.
- Phone Number: Click here to enter text.
- E-Mail Address: Click here to enter text.

E. Credit Hours: 2
   Lecture: 1 hour
   Laboratory: 2 hours

F. Prerequisites: None
   Co-requisite(s): None

G. Syllabus Effective Date: Fall, 2017

H. Textbook(s) Title: None

I. Workbook(s) and/or Lab Manual: None

J. Course Description: A study of the methods and devices used to control and protect DC and AC motors on industrial machinery. The student will understand, develop, interpret, and troubleshoot ladder diagram circuits. The student will gain experience of DC Series, Shunt and Compound motors, single-phase motors, 3- motors, Stepper motors, Servos, and universal motors. The student will learn about OSHA safety regulations regarding Lockout/Tagout procedures and safe shut down procedures. The student will also wire control circuits that utilize soft-start techniques and dynamic braking techniques.

K. College-Wide Learning Outcomes

<table>
<thead>
<tr>
<th>College-Wide Learning Outcome</th>
<th>Assessments - - How it is met &amp; When it is met</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication – Written</td>
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<td>Communication – Speech</td>
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<td>Intercultural Knowledge and Competence</td>
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<td>Critical Thinking</td>
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<td>Information Literacy</td>
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<td>Quantitative Literacy</td>
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L. Course Outcomes and Assessment Methods:

Updated: 2/14/2017
Upon successful completion of this course, the student shall:

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Assessments – How it is met &amp; When it is met</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identify, read, design, build and troubleshoot various relay and motor control circuits utilizing the different control devices required for correct operation of the desired circuit.</td>
<td>Homework, quizzes, labs throughout the semester and the midterm and final exam</td>
</tr>
<tr>
<td>2. Identify, describe and troubleshoot various overload protect circuits used in motor control circuits.</td>
<td>Homework, quizzes, labs throughout the semester and the midterm and final exam</td>
</tr>
<tr>
<td>3. Identify the proper NEMA enclosure type of use for a given electrical application.</td>
<td>Homework, quiz and exams. (week 3, 7, and 15)</td>
</tr>
<tr>
<td>4. Identify and describe the differences between a three-phase Wye and a three-phase Delta motor.</td>
<td>Homework, quiz, labs and exams. (week 6, 7, and 8)</td>
</tr>
<tr>
<td>5. Identify, read, design, build and troubleshoot different types of DC and AC motor reversing circuits.</td>
<td>Homework, quizzes, labs throughout weeks 4-10 and the midterm and final exam</td>
</tr>
<tr>
<td>6. Identify, describe, built, test and troubleshoot various soft-start DC and AC motor control circuits</td>
<td>Homework, quizzes, labs throughout weeks 11 and 12 and the final exam</td>
</tr>
<tr>
<td>7. Identify, describe, built, test and troubleshoot various dynamic and passive braking systems used in DC and AC motor control circuits.</td>
<td>Homework, quizzes, labs throughout weeks 13 and 14 and the final exam.</td>
</tr>
<tr>
<td>8. Convert a motor control circuit to a PLC program.</td>
<td>Homework, a quiz, and a lab during weeks 14 &amp; 15 and the final exam</td>
</tr>
<tr>
<td>9. Use DVMs, clamp on ammeters, tachometers, Meggers and current transformers to troubleshoot motor control circuits</td>
<td>Throughout the semester in labs.</td>
</tr>
<tr>
<td>10. Use DVMs, clamp-on-ameters, tachometers, torquemeters, and wattmeters to determine power factor, starting/stopping torque, inrush current, and running current.</td>
<td>Throughout the semester in labs.</td>
</tr>
</tbody>
</table>

M. Topical Timeline (Subject to Change):

1. Squirrel cage motors
2. Single-phase windings, split-phase, and capacitor start motors.
3. 3 phase motors
4. AC reversing circuits
5. DC series, shunt, and compound motors.
6. DC reversing circuits
7. Braking torque
8. Braking methods
9. Plugging
10. Motor application categories
11. Speed control of a DC motor.
12. Speed control of an AC motor.
13. Accelerating and decelerating circuit logic
14. Good preventive maintenance programs
15. Using test instruments.
16. Motor failures
17. Remarking motor leads

N. Course Assignments:

Updated: 2/14/2017
Labs:

Given the motor control diagram the student will be able to:

1. Wire, test and troubleshoot a three-phase motor reversing full-voltage starter circuit, with jogging circuit.
2. Wire, test and troubleshoot a DC series motor full-voltage starter circuit.
3. Wire, test and troubleshoot a DC shunt motor full-voltage starter circuit.
4. Wire, test and troubleshoot a DC shunt motor full-voltage reversing circuit.
5. Wire, test and troubleshoot a DC compound motor full-voltage reversing circuit.
6. Wire, test and troubleshoot a three-phase, primary resistor, 2-step, reduced voltage starter.
7. Wire, test and troubleshoot a three-phase, primary resistor, 3-step, reduced voltage starter.
8. Wire, test and troubleshoot a three-phase, autotransformer, 2-step, reduced voltage starter.
10. Wire, test and troubleshoot a DC shunt motor reduced-voltage, 2-step starter circuit, using a CEMF accelerating relay.
11. Wire, test and troubleshoot a DC shunt motor reduced-voltage, 2-step starter circuit, using timed acceleration.
12. Wire, test and troubleshoot a DC shunt motor reduced-voltage, 3-step starter circuit, using series current relays.
13. Wire, test and troubleshoot a DC shunt motor reduced-voltage, 3-step starter circuit, using a CEMF accelerating relays.
15. Wire, test and troubleshoot a DC shunt motor full-voltage starter circuit with dynamic braking.
16. Wire, test and troubleshoot a three-phase motor full-voltage starter circuit with a field accelerating and decelerating relay.

Reading Assignments:

- Mechanical Improvements Chap 4, pg 73-75
- Need For Overload Protection Chap 4, pg. 83
- Proper Fusing Chap 4, pg. 87-88
- NEMA Selection Chap 4, pg. 89
- Types of Overload Protection Chap 6, pg. 129
- Overload Selection Chap 6, pg. 132
- Three-Phase Motors Chap 9, pg. 212
- Dual Voltage Motors Chap 9, pg. 214
- Wye And Delta Dual Voltage Motors Chap 9, pg. 214
- Reversing Three-Phase Wye And Delta Motors Chap 9, pg. 216
- Split-Phase Motors Chap 9, pg. 216
- Split-Phase Motors Chap 9, pg. 216
- Capacitor Motors Chap 9, pg. 218
- Capacitor Motors Chap 9, pg. 220
- Reversing DC Motors Chap 9, pg. 222
- Interlocking Methods Chap 9, pg. 224
- Reasons For Reduced Voltage Starting Chap 15, pg. 407
- Reduced Voltage Starting And The DC Motor Chap 15, pg. 407
- Reduced Voltage Starting Methods Chap 15, pg. 407
- Methods of Braking Chap 16, pg. 439
- Braking Torque Chap 16, pg. 441
- Braking Methods Advantages And Disadvantages Chap 16, pg. 437-448
- Plugging Chap 16, pg. 442
- Applications Chap 16, pg. 448
- Speed Control of DC Motors Chap 16, pg. 456
Recommended Grading Scale:

<table>
<thead>
<tr>
<th>NUMERIC</th>
<th>GRADE</th>
<th>POINTS</th>
<th>DEFINITION</th>
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<tbody>
<tr>
<td>93–100</td>
<td>A</td>
<td>4.00</td>
<td>Superior</td>
</tr>
<tr>
<td>90–92</td>
<td>A-</td>
<td>3.67</td>
<td>Superior</td>
</tr>
<tr>
<td>87–89</td>
<td>B+</td>
<td>3.33</td>
<td>Above Average</td>
</tr>
<tr>
<td>83–86</td>
<td>B</td>
<td>3.00</td>
<td>Above Average</td>
</tr>
<tr>
<td>80–82</td>
<td>B-</td>
<td>2.67</td>
<td>Above Average</td>
</tr>
<tr>
<td>77–79</td>
<td>C+</td>
<td>2.33</td>
<td>Average</td>
</tr>
<tr>
<td>73–76</td>
<td>C</td>
<td>2.00</td>
<td>Average</td>
</tr>
<tr>
<td>70–72</td>
<td>C-</td>
<td>1.67</td>
<td>Below Average</td>
</tr>
<tr>
<td>67–69</td>
<td>D+</td>
<td>1.33</td>
<td>Below Average</td>
</tr>
<tr>
<td>63–66</td>
<td>D</td>
<td>1.00</td>
<td>Below Average</td>
</tr>
<tr>
<td>60–62</td>
<td>D-</td>
<td>0.67</td>
<td>Poor</td>
</tr>
<tr>
<td>00-59</td>
<td>F</td>
<td>0.00</td>
<td>Failure</td>
</tr>
</tbody>
</table>

P. Grading and Testing Guidelines:

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Q. Examination Policy:

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R. Class Attendance and Homework Make-Up Policy:

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S. Classroom Expectations:

Click here to enter text.

T. College Procedures/Policies:

Attendance Requirements: All students are required to attend all scheduled classes and examinations. Each faculty member has the right to establish regulations regarding attendance that he/she considers necessary for successful study.

Students who do not attend classes may be administratively withdrawn from those classes. However, failure to attend classes does not constitute withdrawal, and students are expected to process a formal withdrawal through the Student Records Office in Kee Hall.

Student engagement requirements:
Student engagement is based on the “active pursuit” of learning which can be measured by class attendance, class participation (in class or online), taking required quizzes/examinations, and submission of work assignments or papers. Student engagement consists of a student attending at least 60% of the class sessions (there should be attendance throughout the term) and/or completing 75% of the assignments listed on the syllabus at the midpoint in the term. Exceptions can be made when there is on-going communication between the student and faculty member. The communication must be documented and the faculty member and student must be in agreement regarding the exception. Students not meeting the expectation will be administratively withdrawn from class. If a student believes he/she was administratively withdrawn in error, he/she may file an appeal. Being administratively withdrawn may have program and financial aid implications.

Academic Misconduct is any activity that tends to compromise the academic integrity of the college, or subvert the educational process. Examples of academic misconduct include, but are not limited to:

Violation of course or program rules as contained in the course syllabus or other information provided to the student; violation of program requirements as established by departments and made available to students.

1. Plagiarism including, but not limited to, submitting, without appropriate acknowledgment, any written, visual or oral material that has been copied in whole or in part from the work of others (whether such source is published or not) even if the material is completely paraphrased in one’s own words. This includes another individual’s academic composition, compilation, or other product, or a commercially prepared paper. Plagiarism also includes submitting work in which portions were substantially produced by someone acting as a tutor or editor.

Such practices constitute plagiarism regardless of motive. Those who deny deceitful intent, claim not to have known that the act constituted plagiarism, or maintain that what they did was inadvertent are nevertheless subject to penalties when plagiarism has been confirmed.

2. Cheating and dishonest practices in connection with examinations, papers and projects, including but not limited to using unauthorized notes, study aids or information on an examination; obtaining help from another student during an examination; taking an exam or doing work for another student; providing one’s own work for another student to copy and submit as his/her own; or allowing another student to do one’s work and then submitting the work as one’s own. Also included would be altering a graded work after it has been returned, then submitting the work for re-grading; or submitting identical or similar papers for credit in more than one course without prior permission from the course instructors.

3. Fabrication including but not limited to falsifying or inventing any information, data or citation; presenting data that were not gathered in accordance with defined appropriate guidelines, and failing to include an accurate account of the method by which data were collected.

4. Obtaining an Unfair Advantage including, but not limited to stealing, reproducing, circulating, or otherwise gaining access to examination materials prior to the time authorized by the instructor; unauthorized collaborating on an academic assignment; taking, hiding or altering resource material; or undertaking any activity with the purpose of creating or obtaining an unfair advantage over another student’s academic work.

5. Aiding and Abetting Academic Dishonesty including, but not limited to providing material, information or other assistance to another person with the knowledge that such aid could be used in any of the violations stated above, or providing false information in connection with any inquiry regarding academic integrity.

6. Alteration of Grades or Marks including but not limited to, action by the student in an effort to change the earned credit or grade.
In addition, cases of academic dishonesty may involve photocopied materials. Materials used may fall under the Copyright Act. Violations of said Act may subject the user and/or the College to sanctions.

**Statement on Disabilities:** Any student who requires reasonable accommodations related to a disability should inform the course instructor and the Coordinator of Specialized Services (Room 138 in Kee Hall; phone 419-755-4727).

Students who encounter difficulty in any of their courses are encouraged to visit the Tutoring Resource Center (Room 119 in Fallerius Technical Education Center) for tutoring assistance, and the Student Success Center (Room 136 in Kee Hall) for academic assistance, advising services, referrals for personal counseling and Learning Disability (LD) Testing.

**Statement on Withdrawals:** As a student, you are expected to attend class. If you are unable or choose not to attend class, or if for whatever reason you are unable to keep up with the requirements of a course, you need to officially drop the class at the Student Records Office. Refund dates and withdrawal dates will vary slightly from term to term. Contact the Student Records Office for applicable dates. Additionally these dates are posted on the academic calendar available on the college’s website, [www.ncstatecollege.edu](http://www.ncstatecollege.edu), under the Academics heading on the home page and are available at the Student Records Office in Kee Hall. Students should go to the Student Records Office (Room 142 in Kee Hall) to process their withdrawal from any class.

If you choose to walk away from your class without officially withdrawing from it, the faculty member teaching the class must grade your classroom performance on the material available to him or her. This normally results in an "F" grade. An "F" grade can lower your grade point average considerably depending on the total credits accumulated.