A. **Academic Division:** Business, Industry, and Technology

B. **Discipline:** Industrial Technology - Industrial Maintenance

C. **Course Number and Title:** EMMT2400 - Control Processes

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:** 3  
   Lecture: 2 hours  
   Laboratory: 3 hours

F. **Prerequisites:** EMMT2250 and EMMT2300 (both may be concurrent)

G. **Syllabus Effective Date:** Fall 2017

H. **Textbook(s) Title:** None

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

J. **Course Description:** This course studies the control devices, sensors, transducers, instrumentation and control loop strategies and structures that control applications such as, boilers, chillers, rotating machinery, cooling towers, HVAC, heat exchangers, batch reactors and distillation processes used in industry by chemical plants, oil refineries, steel mills, water treatment plants, drink producers, and waste treatment plants.

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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Updated: 2/14/2017
L. **Course Outcomes and Assessment Methods:**

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>
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</thead>
<tbody>
<tr>
<td>1. Identify the primary sensors and transducers and describe their functions for measuring flow, temperature, pressure, and level.</td>
<td>Quizzes, lab exercises throughout weeks 1-4, midterm and final exam.</td>
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<td>2. Identify the primary control valve actuators, the purpose of positioners and discuss the application of each of them.</td>
<td>Quizzes, lab exercises throughout week 5, midterm and final exam.</td>
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<tr>
<td>3. Explain the use of alternative final control devices and the advantages or disadvantages of each of them.</td>
<td>Quizzes, lab exercises during week 5, midterm and final exam.</td>
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<tr>
<td>4. Illustrate the principles of operation, terminology, safety considerations and applications for common analytical instruments used in industry.</td>
<td>Quizzes, lab exercises during week 6, midterm and final exam.</td>
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<tr>
<td>5. Employ the principles of operation and applications for on-stream analytical instruments used in industry including sampling systems and sampling techniques.</td>
<td>Quizzes, lab exercises during week 7, midterm and final exam.</td>
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<td>6. Discuss the types of electronic instrument communication signals (4-20 mA, 10-50 mA, 1-5 V, etc.) and their methods of transmission.</td>
<td>Quizzes, lab exercises during week 9, and the final exam.</td>
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<tr>
<td>7. Setup and test the final control elements in process control loops.</td>
<td>Quizzes, lab exercises throughout weeks 9-14, and the final exam.</td>
</tr>
<tr>
<td>8. Install, test and operate electronic automatic process controller hardware.</td>
<td>Quizzes, lab exercises throughout weeks 9-14, and the final exam.</td>
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M. **Topical Timeline (Subject to Change):**

1. **PRIMARY LEVEL SENSORS AND TRANSDUCERS**
   a. What are the primary sensors and transducers for level measurement (sight glasses, float systems, displacers, head pressure, differential pressure, dip pipes, elevation and suppression, capacitance, thermal, resistance, sonic, solid level measurement and nuclear devices).
   b. How to select appropriate level sensors for specific applications.

2. **PRIMARY PRESSURE SENSORS AND TRANSDUCERS**
   a. The primary sensors and transducers for pressure measurement (manometers, barometers, bourdon tubes, spiral elements, helix elements, stiff diaphragms, bellows, potentiometers, differential transformers, strain gauges (bonded and unbonded), silicon diaphragm, inductive, capacitance, vibrating diaphragm and piezoelectric).
   b. How to select appropriate pressure sensors for specific applications.

3. **PRIMARY TEMPERATURE SENSORS AND TRANSDUCERS**
   a. How various types of sensors measure temperature and the application of each (expansion thermometers, mercury in glass thermometers, vapor pressure thermometers, resistance thermometers, RTDs, thermistors, self-heating resistance sensors, thermocouples, reference junctions [above ambient and below ambient], thermopiles, bi-metallic elements, thermostats, extension wire and temperature ranges for different sensors).
   b. How to select appropriate temperature sensors for specific applications.

4. **CONTROL VALVE ACTUATORS AND POSITIONERS**
   a. The different types of control valve actuators, the purpose of positioners and the application of each (spring and diaphragm, piston, rolling diaphragm, double acting, air to open, air to close, positioner characterization, electro-mechanical actuators, electro-hydraulic actuators and electric...
actuators). The use of alternative final control devices and the advantages or disadvantages of each (positive displacement pumps, variable speed pumps).

5. ANALYTICAL INSTRUMENTATION
a. The principles of operation, terminology, safety considerations and applications for common analytical instruments used in industry (chromatography, pH, conductivity, ultraviolet, infrared, oxygen, dissolved oxygen, turbidity, ambient air analysis, etc.)

6. CONTROL VALVES AND FINAL CONTROL DEVICES
a. The final control elements in a process control loop, the interrelations of control valve components and the proper operation of each. Various types of control valve bodies (globe, gate, diaphragm, butterfly, ball) and the preferred application for each.
b. Valve trim and the selection for specific processes (CV, linear, equal percentage, parabolic, quick-opening, characterization guiding, balancing forces and sealing); bonnets and stem packing (bonnet connections, steam bonnets, stem seals, packing, stuffing box design, follower, packing materials).

7. ELECTRONIC CONTROLLERS, OPERATION
a. Electronic automatic process controller hardware, control modes, input/output relationships, and calibration techniques. The modes of control, the action of each mode at the input-output level (manual, on-off, proportional action, integral action, derivative action).

8. PROCESS INSTRUMENTATION DIAGRAMS AND SYMBOLS
a. How to recognize and interpret the symbols and standard practices used in the preparation of process and instrument flow diagrams. For example: functional identification, loop identification, identification letters, letter combinations, function blocks, function designations, instrument line symbols, general instrument or function symbols, control valve body and actuator symbols, primary element symbols and complex combinations.

9. PROCESS ANALYZERS
a. The principles of operation and applications for on-stream analytical instruments used in industry including sampling systems and sampling techniques.
b. The analytical terminology, safety, types of analysis (on-stream gas and liquid chromatography, mass spectrometers, pH, conductivity, refractometers, oxygen, dissolved oxygen, turbidity and ambient air analysis). Be familiar with process and on-stream analyzer sample systems (valves, sample conditioning, multi-stream systems, safety considerations and applications).

10. TUNING MULTIVARIABLE LOOPS
a. The tuning concepts and procedures for tuning multivariable loops including cascade, ratio, feedforward and deadtime control.

11. SMART TRANSMITTERS
a. "Smart Transmitters" (capabilities, use, configuration, rangeability, span, installation, input signals, output signals, hand-held calibrators, diagnostics, off-line calibration, on-line calibration and maintenance).

12. ADAPTIVE TUNING
a. Nonlinear processes and be familiar with how adaptive tuning capabilities can improve control of these processes.

13. SINGLE-LOOP/STAND-ALONE DIGITAL CONTROLLERS
a. Be familiar with single-loop, stand-alone digital controllers (application, function, capabilities, configuration, function blocks, networking, input signals, output signals, self-diagnostics).

14. SELF-TUNING CONTROLLERS
a. Understand the function and advantages of self-tuning controllers. Be familiar with the configuration procedures and steps required to apply a typical self-tuning controller to a specific process construction and application.

N. Course Assignments:

1. Homework: Selected problems and questions from weekly reading assignments must be completed.
2. Labs: Various self-paced and computer monitored labs administered in the IST lab.
3. Quizzes: Quizzes will be administered online via LMS.
4. Midterm: The midterm exam will be administered during week 8.
5. Final: There will be a comprehensive final at the end of the semester.
O. **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>
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</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:**

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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:

1. **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.

2. **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.

3. **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.

4. **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.

5. **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.

6. **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.

7. **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.