A. **Academic Division:** Business, Industry, and Technology  
B. **Discipline:** Industrial Technology - Industrial Maintenance  
C. **Course Number and Title:** EMMT2100 Advanced Fluid Power Systems  
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:** 2 hours  

F. **Prerequisites:** EMMT1050  

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

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

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

J. **Course Description:** Essentials of hydraulics includes: hydraulic power, basic circuits, symbols and principles of pressure and flow, electro-fluid power, hydraulic troubleshooting, piping and piping installation. The laboratory experience consists of hands-on experiments designed to reinforce concepts presented. Contains demonstrations, lab projects and simulations.  

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>
<td></td>
</tr>
<tr>
<td>Communication – Speech</td>
<td></td>
</tr>
<tr>
<td>Intercultural Knowledge and Competence</td>
<td></td>
</tr>
<tr>
<td>Critical Thinking</td>
<td></td>
</tr>
<tr>
<td>Information Literacy</td>
<td></td>
</tr>
<tr>
<td>Quantitative Literacy</td>
<td></td>
</tr>
</tbody>
</table>
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>
</tr>
</thead>
<tbody>
<tr>
<td>1. Differentiate between the functions of common manual and automatic hydraulic valves.</td>
<td>Quizzes, lab exercises and midterm during weeks 1-6.</td>
</tr>
<tr>
<td>2. Choose the correct hydraulic cylinder for a n application.</td>
<td>Quizzes, lab exercises and midterm during weeks 1-6.</td>
</tr>
<tr>
<td>3. Diagram a hydraulic system for specified machine operations.</td>
<td>Quizzes, lab exercises and final exam during weeks 8-14.</td>
</tr>
<tr>
<td>4. Construct various hydraulic circuits based on the student’s hydraulic designs.</td>
<td>Quizzes, lab exercises and final exam during weeks 8-14.</td>
</tr>
<tr>
<td>5. Analyze, troubleshoot and repair faults placed in operating hydraulic systems.</td>
<td>Quizzes, lab exercises and final exam during weeks 8-14.</td>
</tr>
<tr>
<td>6. Evaluate the condition of system components for maintenance, repair or replacement.</td>
<td>Quizzes, lab exercises and final exam during weeks 12-14.</td>
</tr>
<tr>
<td>7. Calculate the force, stroke and retract time, and speed of hydraulic cylinders operating under various conditions.</td>
<td>Quizzes, lab exercises and final exam during weeks 8-11.</td>
</tr>
</tbody>
</table>

M. **Topical Timeline (Subject to Change):**

1. Hydraulics applications.
2. The functions of five basic components of a hydraulic system.
3. Define hydraulic pressure and its units of measurement.
4. The operation of a hydraulic power unit.
5. The function of a hydraulic schematic.
6. The function of a hydraulic quick disconnect fitting and its schematic symbol.
7. The function of a tee and its schematic symbol.
8. The operation of a pressure gage and its schematic symbol.
10. The function of a hydraulic cylinder and an application.
11. The operation of a double-acting hydraulic cylinder and its schematic symbol.
12. The function of a 3-position, 4-way DCV and its application.
13. Define flow rate and explain how it can be measured.
14. The operation of two types of flow meters and their schematic symbol.
15. The operation of a fixed-displacement pump and its schematic symbol.
16. The operation of three types of fixed displacement pumps and an application of each.
17. The main function of a needle valve.
18. The function of a hydraulic motor and an application.
19. List three types of hydraulic motors and an application of each
20. The eight basic rules for drawing hydraulic schematics.
21. How to calculate the force output of an extending cylinder.
22. How to calculate the force output of a hydraulic cylinder in retraction.
23. State Pascal’s Law and explain its significance in hydraulics.
24. Explain how force is multiplied using Pascal’s Law.
25. The two types of resistance in a hydraulic system.
26. How pressure is distributed in a hydraulic system.
27. The two methods of representing hydraulic pressure.
28. How oil flows on the suction side of the pump.
29. The function of a relief valve and an application.
30. The operation of a direct-acting relief valve and its schematic symbol
31. How a relief valve is used for system protection.
32. How a relief valve is used for speed control.
33. The function of a check valve and an application.
34. The operation of three types of check valves and their schematic symbol.
35. The function of the flow control valve and an application.
36. The operation of a flow control valve and its schematic symbol.
37. The effect of actuator load changes on flow control valve operation.
38. The operation of a meter-in and meter-out flow control circuit and give an application.
39. Independent speed control and an application.
40. How speed control valves can be used to provide multiple speeds.
41. How to calculate the extend speed of a hydraulic cylinder.
42. How to calculate the retract speed of a cylinder.
43. How to calculate the stroke of time of a cylinder.
44. The function of a pressure sequence valve and an application.
45. The operation of a direct-acting sequence valve and its schematic symbol.
46. The function of a bypass check valve in a sequence valve circuit.
47. The operation of an integral check valve and its schematic symbol.
48. The function of a two-sequence valve control circuit.
49. Why a sequence valve is externally drained.
50. The function of a pressure reducing valve and an application.
51. The operation of a direct-acting PRV and its schematic symbol.
52. The function of a PRV’s bypass check valve.
53. Why a PRV is externally drained.
54. The terms used to specify DCVs.
55. The function of a hydraulic 4/2 DCV and application.
56. The function of a hydraulic 3/2 DCV application.
57. The function of a hydraulic pilot-operated DCV application.
58. The function of a hydraulic cam-operated valve and name an application.
59. Two types of hydraulic cam-operated valves and their application.
60. The operation of four types of cylinders and an application of each.
61. The construction of two types of cylinders and an application of each.
62. The three common cylinder mounting styles and an application of each.
63. The three common cylinder feature options.
64. The principle of cylinder regeneration and name an application.
65. The operation of a basic regeneration circuit.
66. How to calculate the extend speed of a cylinder in regenerations.
67. How to calculate the extend force of a cylinder in regeneration.
68. The function of a pressure-compensated flow control valve application.
69. The function of a double-rod cylinder application.
70. Cylinder synchronization and name three applications.
71. Explain why cylinders do not operate in synchronization.
72. List five methods used in synchronize cylinders.
73. The advantage of a pilot-operated relief valve.
74. The operation of a pilot-operated relief valve and its complete schematic.
75. The function of the vent port of a pilot-operated relief valve.
76. The two methods of pump unloading and an application of each.
77. The operation of a remote-controlled relief valve circuit.
78. The multiple pressure relief valve operation and one application.
80. The operation of a P-port check valve circuit.
81. The construction of an integral P-port check valve.
82. The function of a pilot-operated check valve and an application.
83. The operation of a load-lock circuits using one POC valve.
84. The operation of a double-POC check valve.
85. The function of a prefill valve and an application.
86. POC valve pilot ration and explain its importance.
87. How to calculate the pressure required to open a POC valve.
88. Pressure intensification and its importance.
89. The function and operation of a POC valve with decompression poppet.
90. List five application guidelines for POC valves.
91. The function of a manual control system and an application.
92. The function of a sequence of operation.
93. The basic control process and explain how it is used.
94. Two types of automatic control systems and an application.
95. The function of the major components of an automatically-controlled non-servo machine.
96. The operation of a non-servo type automatic control system and an application.
97. Four types of non-servo type control systems and an application of each.
98. The function of electro-hydraulic solenoids and explain the application
99. The operation of a solenoid-operated hydraulic DCV manual override
100. The function of electro-pneumatic controls and an application
101. The operation of a pneumatic DCV
102. The function of a control transformer
103. The operation of a fuse and its schematic symbol
104. The operation of a circuit breaker
105. The function of a control relay and an application
106. The operation of an electromechanical relay and its ladder diagram symbol
107. The construction of a general purpose relay and an application
108. How relay contacts are specified
109. The construction of a machine control relay
110. The operation of a relay used to energize a fluid power valve solenoid
111. The function of a seal-in circuit
112. The operation of a single-cycle cylinder reciprocation circuit
113. The operation of a continuous-cycle cylinder reciprocation circuit
114. The function of multiple cylinders in a machine
115. How multiple cylinders are controlled with multiple limit switches and an application
116. The function of a time-delay relay and an application
117. List two types of time delay relays and an application of each
118. The operation of an unloaded motor start circuit
119. The operation of a cylinder dwell circuit
120. The function of a solenoid operated relief valve and an application
121. The function of a pump unloading circuit that uses a solenoid relief valve
122. The operation of a Hi-Lo circuit that uses a solenoid relief valve
123. The operation of a multiple-pressure control circuit that uses a solenoid relief valve
124. The function of a hydraulic pressure switch and three applications
125. The operation of pressure controlled sequencing
126. The operation of an accumulator pump unloading circuit
127. The function of a safety interlock and an application
128. The operation of a safety interlock circuit
129. The five basic guidelines to follow when working with manual control circuits
130. The function of a rapid traverse-slow feed circuit and an application
131. Hydraulic troubleshooting and explain its importance
132. The two levels of hydraulic troubleshooting and an application of each
133. The two methods of testing a hydraulic component and an application of each
134. The six hydraulic safe dress rules
135. The eight hydraulic troubleshooting safety rules
136. The function of a pressure-compensated pump and an application
137. The procedure to shut down a hydraulic system
138. The function of automatic and manual modes and an application of each
139. The function of a maximum volume stop cavitation and explain its effect
140. Pseudo-cavitation and explain its effect
141. The flow vs. pressure characteristics of a pressure-compensated pump
142. How volumetric pump efficiency affects flow rate
143. The function of a case drain on a pressure-compensated pump
144. The input power characteristics of a pressure-compensated pump
145. The function of the horsepower limiting option
146. The four types of in-circuit component tests and an application of each
147. The construction of 3 types of pressure test points and an application of each
148. Name the two typical locations of pressure test points
149. The three ways to use a flow meter to troubleshoot a hydraulic system
150. The two methods of measuring flow
151. The eleven symptoms of pressure-compensated pump failure
152. How to interpret a troubleshooting chart
153. How to inspect and troubleshoot a pressure-compensated pump
154. The function of a cylinder cushion and an application
155. How to adjust a cylinder cushion
156. The function of a cylinder rod boot and an application
157. How to install a cylinder rod boot
158. The causes of five symptoms of hydraulic cylinder failure
159. How to inspect and troubleshoot a hydraulic cylinder
160. The five symptoms of motor failure and their causes
161. How to inspect and troubleshoot a hydraulic motor
162. The five symptoms of direct-operated DCV failure and their causes
163. The function of a sandwich valve and an application
164. The operation of a sandwich valve
165. The function of a cross cushion relief sandwich valve
166. The function of a pilot-operated DCV
167. The function of internal and external pilots
168. The six symptoms of pilot-operated DCV failure and their causes
169. The seven symptoms of non-compensated flow control valve failure and their causes
170. How to inspect and troubleshoot a non-compensated flow control valve
171. The function of a dial-type pressure-compensated flow control valve and an application
172. How to inspect and troubleshoot a check valve
173. The construction and operation of a subplate-mounted relief valve
174. The construction and operation of a pilot-operated pressure-reducing valve
175. The function of an “R” series pressure control valve
176. The four configurations of an “R” series pressure control valve
177. The function of an unloader valve and an application
178. The operation of a hi-lo circuit that uses an unloader valve
179. Identify the schematic symbol for an unloader valve
180. The function of a counterbalance valve and an application
181. The operation of an internally and externally-piloted counterbalance valve
182. The three categories of hydraulic system faults and an example of each
183. The function of a troubleshooting flowchart
184. How to use PLC I/O indicators to troubleshoot a hydraulic system process
185. How to troubleshoot zero system pressure
186. How to troubleshoot high and low system pressure
187. How to troubleshoot vibration in a hydraulic system
188. How to troubleshoot actuators
189. How to troubleshoot incorrect acceleration and deceleration

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>
</tr>
</thead>
<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:**

Click here to enter text.

Q. **Examination Policy:**

Click here to enter text.

R. **Class Attendance and Homework Make-Up Policy:**

Click here to enter text.

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:

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.

Updated: 2/14/2017
**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, 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.