College of Engineering

Department of Civil Engineering

CE 324 Hydraulics

Credit and Contact hours	2/ 2 (Lectures), 1 (Tutorials), 0 (Laboratory)
Required, or Elective	Required for a BSCE degree
Course Description	Energy equation, friction losses, minor losses, types of pipe flow & Reynolds number, series piping, parallel piping, pump power, unsteady pipe flow (water hammer), classification of free-surface flows, Froude number, uniform flow, critical flow, basics of channel design, specific energy, non-uniform rapidly varied flow (hydraulic jump), introduction to non-uniform gradually varied flow.
Prerequisites or Co-requisites	Fluid Mechanics (CE 320)
Course Learning Outcomes	Students completing this course successfully will be able to

Course Learning Outcomes	***Related Student Outcomes (SO)***
CLO1. Calculate friction losses and minor losses in closed conduits	**SO1**
CLO2. Determine the pump power in closed conduits.	**SO1**
CLO3. Analysis of flow in a single pipe and in pipes connected in series and in parallel.	**SO1**
CLO4. Analysis and computation of transient flow in pipes (Water Hammer)	**SO1**
CLO5. Determine the elements that define an open channel section and classify flow in the channel.	**SO1**
CLO6. Analysis of critical and uniform flows in open channels and introduction to non-uniform flows.	**SO6**

Student Outcomes related to this Course	**SO 1.** an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. [ABET 1], and using modern engineering tools. **SO 6.** an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. [ABET 6]

<table>
<tr><td>Topics Covered</td><td>
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<tr><th>List of Topics</th><th>Related CLOs</th></tr>
<tr><td>1. Introduction to friction losses in pipes and Reynolds number, Darcy-Weisbach Equation and Moody Diagram.</td><td>CLO1</td></tr>
<tr><td>2. Introduction to minor losses and their calculations, and Darcy-Weisbach Equation Applications (three applications).</td><td>CLO1</td></tr>
<tr><td>3. Examples on friction and minor losses in single pipeline & pump power calculation example.</td><td>CLO1and CLO2</td></tr>
<tr><td>4. Introduction to Hazen-Williams Equation and its nomogram with example; Pipes in series and parallel introduction and examples.</td><td>CLO3</td></tr>
<tr><td>5. Unsteady pipe flow introduction; this includes differential continuity and momentum equations, mechanism of water hammer and energy cycles, speed of pressure wave and time of closure. Examples on rapid, very slow and slow closure of</td><td>CLO4</td></tr>
<tr><td>6. Introduction to open channel cross-section geometric and hydraulic elements, Froude number and types of open channel flows and Specific Energy and its diagram.</td><td>CLO5</td></tr>
<tr><td>7. Critical depth derivation and how to calculate it (direct calculation for rectangular section and indirectly using section factor for critical flow); Uniform flow and introduction to Manning Equation and its applications with examples.</td><td>CLO6</td></tr>
<tr><td>8. Rigid boundary channel design (best hydarulic section concept, non-silting non-scouring velocity and freeboard); Introduction to rapidly varied and gradually varied flows (analysis and example of hydraulic jump in rectangular channels).</td><td>CLO6</td></tr>
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<tr><td>Textbook(s) and Other Required Material</td><td>Hydrology & Hydraulic Systems by Ram S. Gupta, Published by Prentice-Hall, New Jersy, U.S.A., 1989. A newer edition of 2013 has been ordered through Book Purchase Center.</td></tr>
<tr><td>Grading System</td><td>Two Mid-term exams 40 %
Quizzes, Assignments 20%
Final Exam: 40%</td></tr>
<tr><td>Instructors</td><td>Dr. Osama S. Algahtani (2A61), email; oalgahtani@ksu.edu.sa
Dr. Faisal M. Alfaisal (2A93), email: falfaisal@ksu.edu.sa</td></tr>
<tr><td>Date of Review</td><td>October, 2020</td></tr>
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