

## University of Pittsburgh Course Syllabus: Engineering of the Renaissance

**Semester and Year:** Summer 2015

**Course Number and Title:** Pitt in Florence: Engineering of the Renaissance

**Faculty Names:** Giovanni P. Galdi and Anne M. Robertson

### **Qualifications of the Instructors:**

**Dr. Giovanni P. Galdi** is Leighton E. and Mary N. Orr Professor of Engineering as well as Professor of Mathematics at the University of Pittsburgh. Prior to joining the University of Pittsburgh, he was professor at the University of Naples, Italy (1980-1985) and the University of Ferrara, Italy (1985-1998). In 1989 he founded the School of Engineering of the University of Ferrara where he taught a similar course. Incidentally, Nicolaus Copernicus, one of the most prominent scientists of the Renaissance, earned his degree at the University of Ferrara in 1503. Dr. Galdi is a world' renowned expert for his work on aspects of the mechanics of fluids and solid. He has authored or coauthored over 100 original research papers and five books, and edited or coedited 13 books dedicated to mathematical fluid mechanics. In 2003 he was awarded the Mercator Professorship by the Deutsche Forschungsgemeinschaft (German Research Foundation). He is cofounder with J.G. Heywood and R. Rannacher of Journal of Mathematical Fluid Mechanics.

**Dr. Anne M. Robertson** is William Kepler Whiteford Professor of Engineering as well as Professor of Mechanical Engineering and Materials Science and Professor of Bioengineering, all at the University of Pittsburgh. Her research team carries out theoretical, computational and experimental research on cerebral vascular disease and constitutive modeling of soft biological tissues. She has held visiting research professorships at universities including the Politecnico di Milano (Italy), the University of Pisa (Italy) and RWTH University of Aachen (Germany). She has co-authored over 75 publications including journal papers, book chapters, and conference proceedings. In 2007, she was awarded the Beitle-Veltri Memorial Outstanding Teaching Award for the Swanson School of Engineering as well as the Robert O. Agbede Faculty Award for Diversity. She earned her Bachelor of Science from Cornell University and Master's and Doctoral degrees from the University of California at Berkeley. She was a President's Postdoctoral Fellow in Chemical Engineering, also at the University of California at Berkeley.

**Prerequisite:** This course is open to any students with a basic knowledge of algebra, geometry, trigonometry, introductory physics, and calculus.

### **Required Texts:**

- Brunelleschi's Dome, How a Renaissance Genius Reinvented Architecture, Ross King
- Leonardo DaVinci, Carlo Pedretti, ISBN-10: 1844060365, 2005

### **Methods of Evaluation:**

Team based projects and presentations, homework, class participation.

- Homework: 15%
- Class Participation: 20%
- Midterm Project: 25%
- Final Project: 40%

## **Course Description**

The objective of this course is to introduce the students to engineering and technological achievements of the Renaissance period and place these achievements within the sociological and artistic context of that period. We will focus on revolutionary advances in understanding of physics and engineering during the Renaissance, with particular emphasis on architecture, mechanical inventions and biomedical engineering.

## **Curriculum**

The components of *Pitt in Florence: Engineering of the Renaissance* will include classroom lectures as well as related museum/excursion based learning.

## **Course Syllabus**

1. Introduction to the Renaissance
  - Florence at the time of the Renaissance
  - The Medici Family
2. Overview of Leonardo's Life and his Influence on the Renaissance
  - Leonardo's beginnings and early life in Florence
  - Leonardo in Milan
  - Leonardo's later life- the migratory period
3. Pre-Renaissance Science: Aristotle and his Long-standing Influence
  - The Dawn of Western Science (Babylonians, Egyptians)
  - Ancient Greece Scientists- Aristotle and his influence on Modern Ages
  - Advent of a New Breeze- Nicolaus Copernicus and Tycho Brahe
  - The Giants- Galileo Galilei and Isaac Newton
  - Final Dismissal of Aristotle's Theories- Albert Einstein
4. From the Fall of the Roman Empire, through the "Dark Ages" to the Birth of the Renaissance
  - The Middle Age
  - The Black Death
  - The Birth of the Renaissance
5. Filippo Brunelleschi's Cupola - above the church of Santa Maria del Fiore
  - Historical Overview
  - The Central Engineering Challenges
  - Hoisting machines- from here to there
  - Efficient worksite organization- Brunelleschi the Industrial Engineer?
  - Brunelleschi's legacy in Florence
6. Engineering at the Time of the Renaissance: Predecessors and Contemporaries of Leonardo da Vinci
  - Predecessors (Konrad Kyeser, Mariano di Jacopo (Taccola), Roberto Valturio)
  - Contemporaries (Francesco di Giorgio Martini)
7. *Leonardo Da Vinci's* Contribution to Engineering

- Hydraulics
- Mechanics
- Design and Construction
- The Deflection of Beams and Columns

#### 8. *Leonardo Da Vinci's Contributions to Science*

- The Laws of Friction
- The "Theory" of Flight
- The "Helicopter" and the Principle of Action and Reaction
- Fluid Dynamics
- Turbulence

#### 9. Brief History of Western Medicine prior to the Renaissance

- Hippocrates- Father of Medicine
- Herophilus
- Galen of Pergamon

#### 9. *Leonardo Da Vinci's Contributions to Biomedical Engineering*

- Form and mechanical function in the human body
- Leonardo's genius in connections- analogies between flow in the human body and in nature
- Da Vinci's investigations of the heart

#### 10. *The Transformative Power of the Renaissance on Biomedical Knowledge- A case study on the Circle of Willis*

- Scientific Context- What we know now
- Historical Background-Misconceptions and Illusions
- Triumph of the Renaissance- from first public disagreement to true scientific discovery.

#### **Proposed Field Components of the Course (tentative) include**

- Overview Tour of Florence
- Tour up into the Duomo - Cathedral of Santa Maria del Fiore
- Visit to the Duomo Museum (Museo dell'Opera del Duomo)
- Visit to the Museo Galileo- Institute Museum of the History of Science
- Visit to the Uffizi Gallery
- Visit to Palazzo Vecchio
- Attendance of an Opera at St. Mark's Anglican Church (evening)