Teaching an Electrical Circuits Course Online

Carlotta A. Berry, Ph.D.

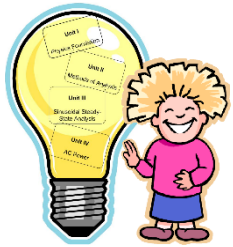
Rose-Hulman Institute of Technology

berry123@rose-hulman.edu

ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Motivation

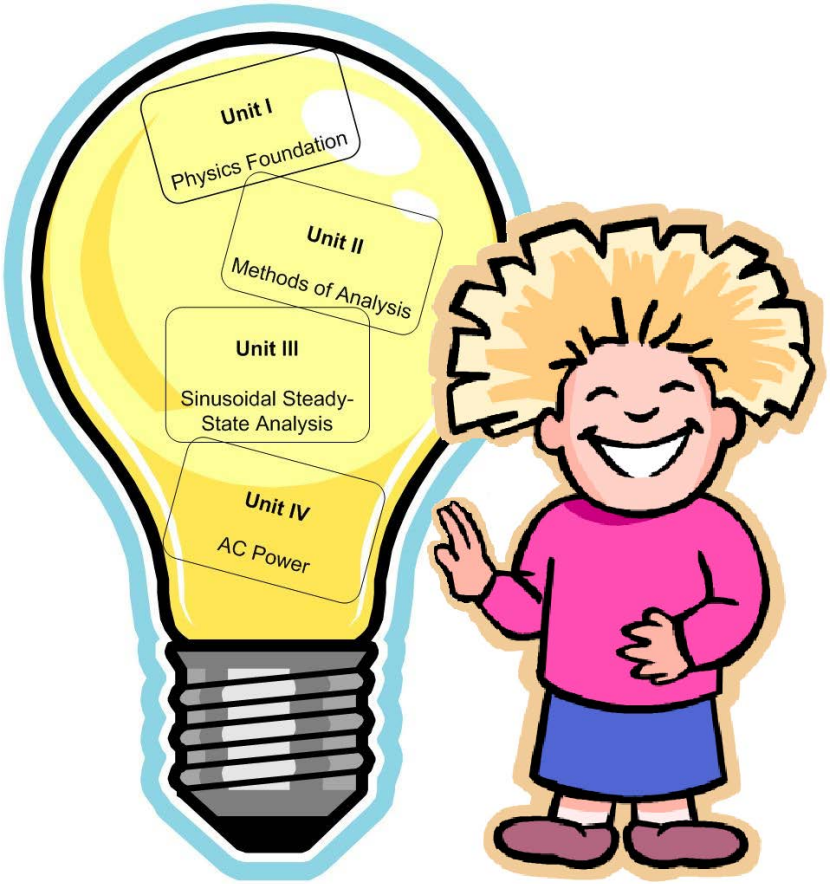
- Allow students to get ahead or stay on schedule in the curriculum
- Allow students to take class while on internships, co-ops, REUs
- Provide same quality of instruction as the on-campus course



ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Course Overview

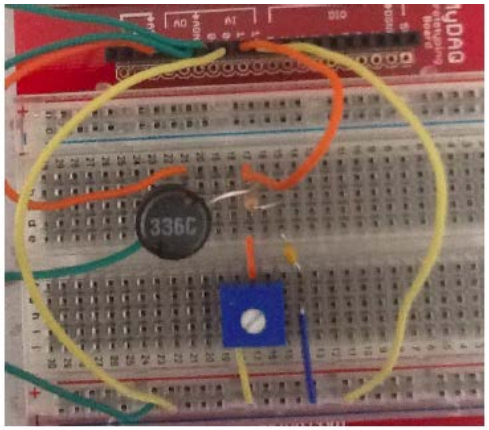
- Electrical systems course for non-majors
- Sophomore-level course
- Semi-synchronous
- DC and AC circuits
- KCL, KVL, Thevenin/Norton
- Operational Amplifiers
- Phasor Analysis
- AC Power
- Integral lab component
- Summer 2013/14

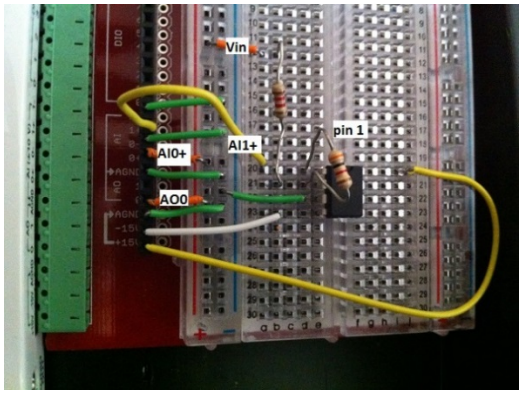


ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Lab Assignments

- Prelab - Analytical and Simulation using MultiSim
- Ni myDAQ – power supply, multimeter, function generator, oscilloscope
- Breadboard, resistors, capacitors, inductors, op amps, voltage regulator





ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Comparison to On-campus Course

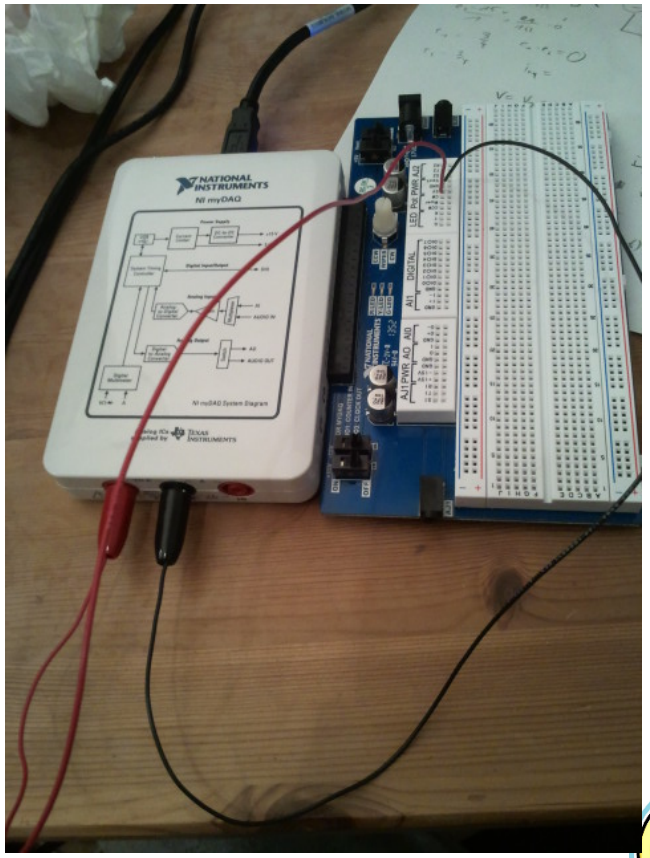
- Same Syllabus
- Same Calendar
- Same Lab Manual
- 3 - 50 minute lectures
- 1 - 150 minute lab
- partial lecture notes
- 3 midterms
- 2 lab practicals
- 10 quizzes
- 10 homework assignments (MasteringEngineering)

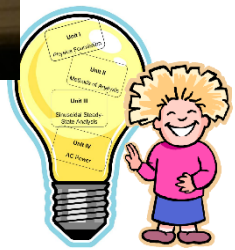
Midterms	36%
Final Exam	26%
Homework	10%
Labs and Memos	15%
Lab Practical Test	5%
Quizzes	5%

ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Course Expectation Meeting

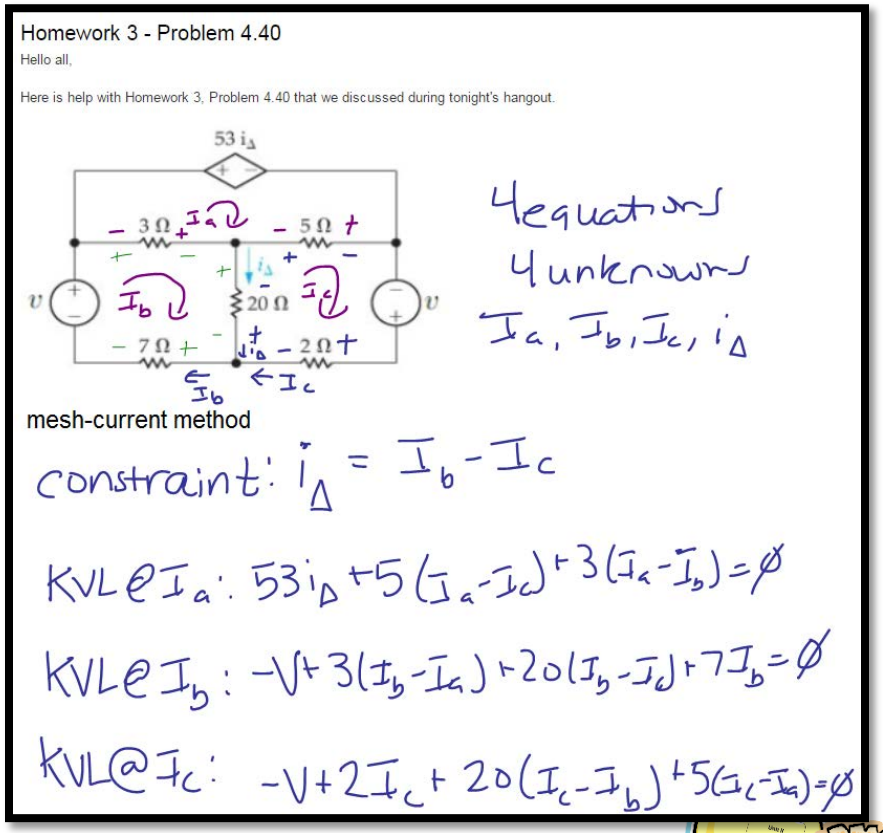
- Be more focused, disciplined, and independent
- Level of difficulty
- Scale on-campus course by 1.5
- Test of Online Learning Success (ToOLS) self-assessment
- Textbook
- Study Guide
- Lab Manual
- Lab Kit
- NI myDAQ

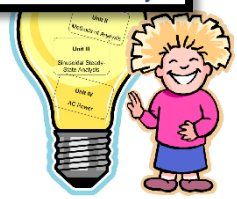




Instructor Interaction

- Piazza message board for anonymous posts
- Weekly Google Hangouts to review quizzes, exams, homework
- Moodle learning management system for quizzes, exams, discussion board

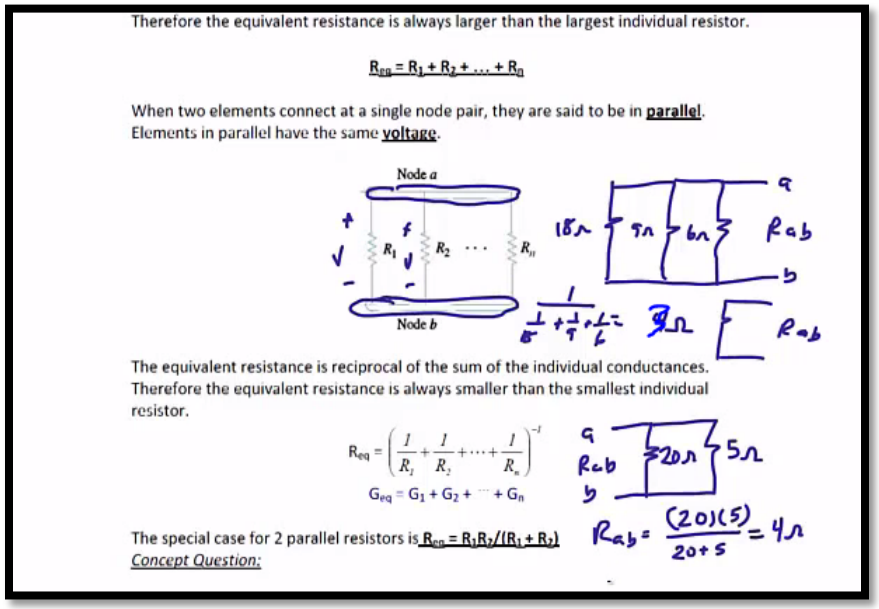




ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Online Lecture Videos on YouTube

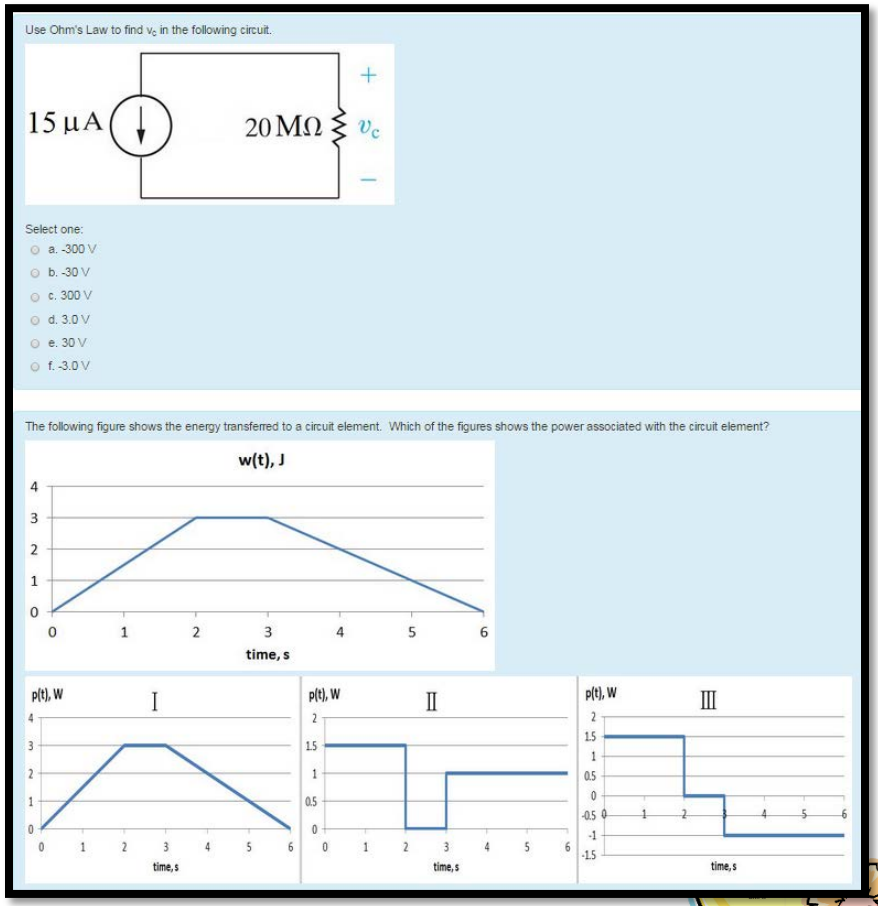
- Same lecture and notes used in the face to face class but there was no opportunity to stop and ask questions
- Benefit of rewinding and watching multiple times
- Still include partial lecture notes

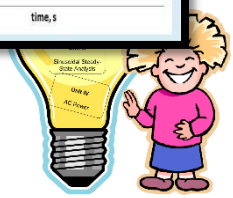


ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Concept Quizzes

- Weekly on Moodle
- Typically 10 questions
- Multiple Choice
- Random Questions
- Timed
- Assessed students mastery of prior week's concepts

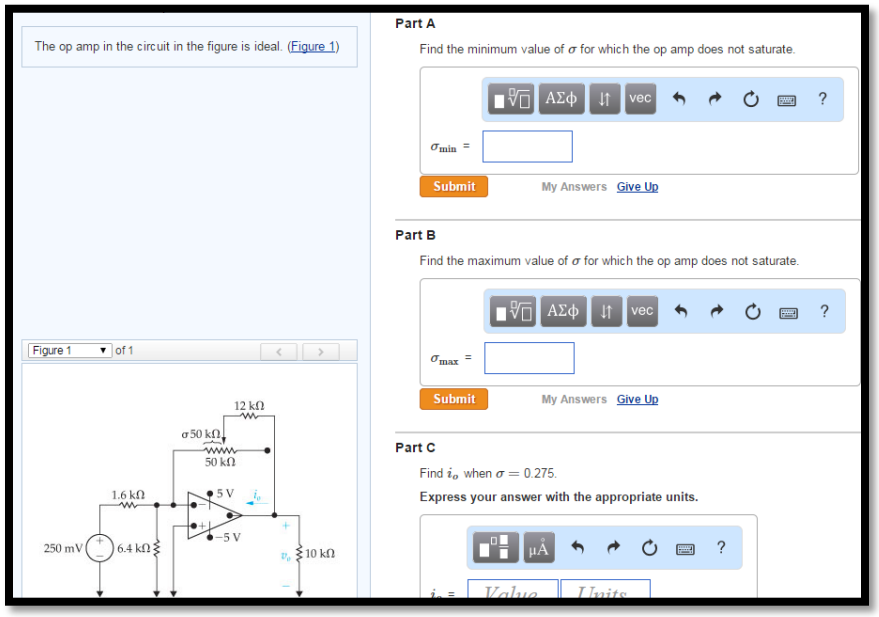


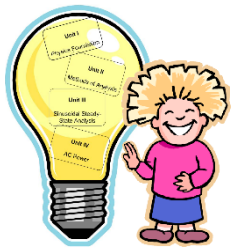


ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Online Homework

- MasteringEngineering
- No time limit
- Fill in the blank but many opportunities to get hints and help
- 3 to 6 tries to arrive at the correct answer
- Students could work through out the week

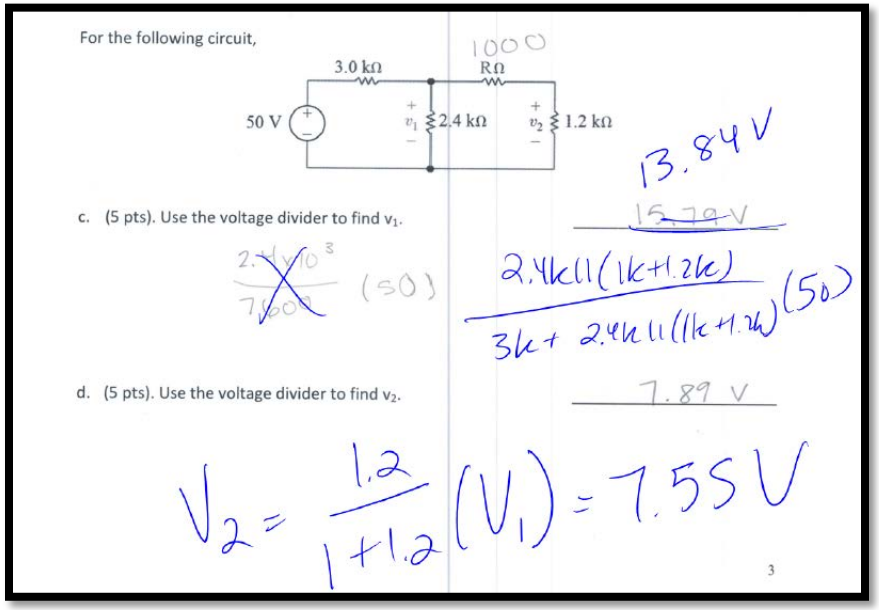




ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Exams

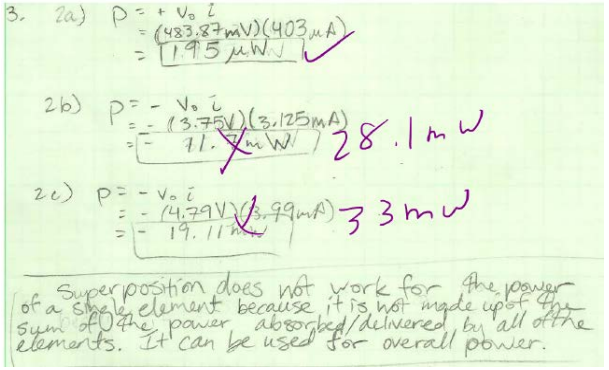
- Exams were handwritten and scanned and uploaded to Moodle
- Typically 4 to 5 open ended questions that involved hand calculations

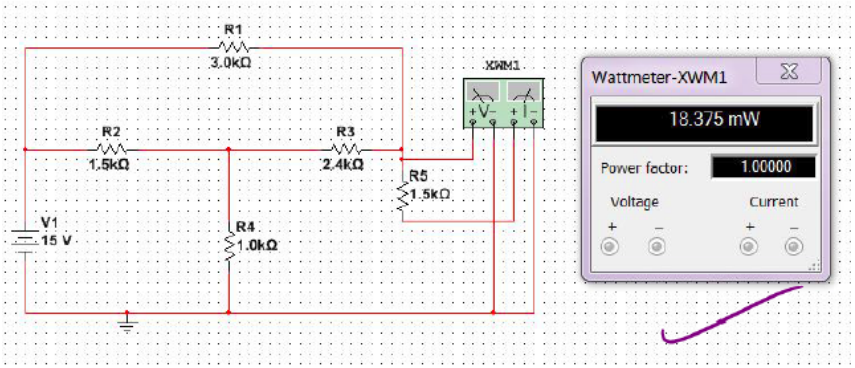


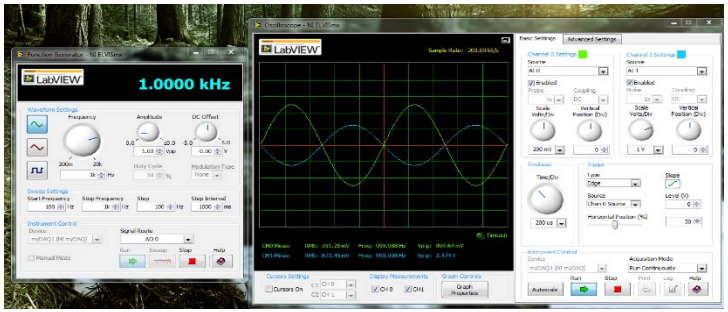
ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Pre-labs & Labs

- Lab manual with images of circuits
- Supplemental lab videos on NI website on Multisim and using myDAQ
- Supplemental videos on using a breadboard, building circuits, and using lab equipment



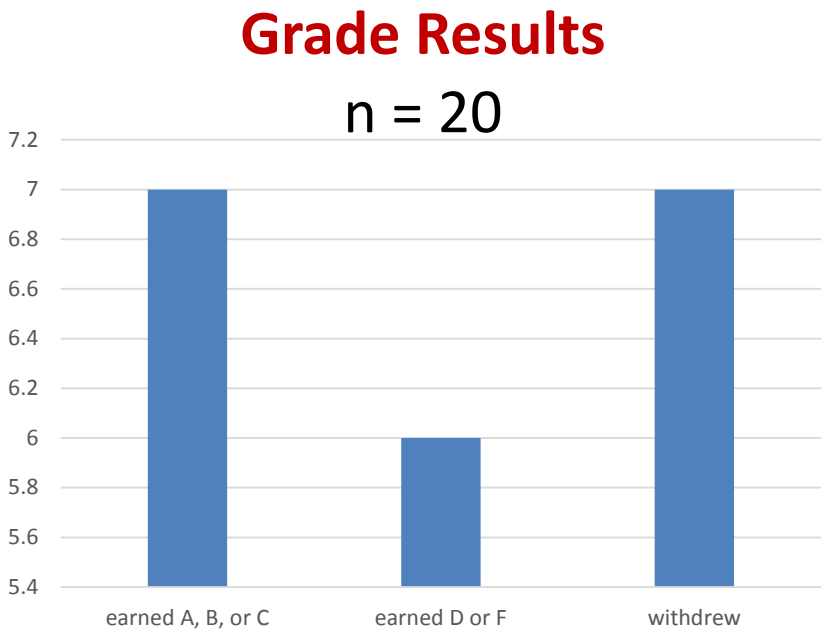




ROSE-HULMAN INSTITUTE OF TECHNOLOGY

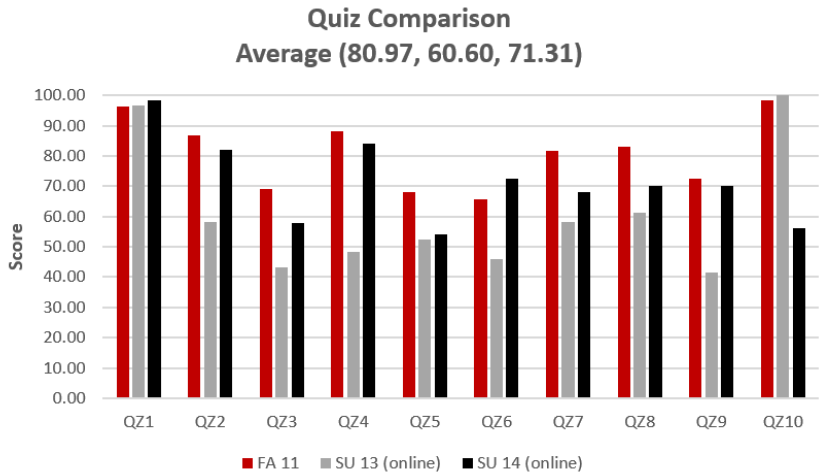
Results

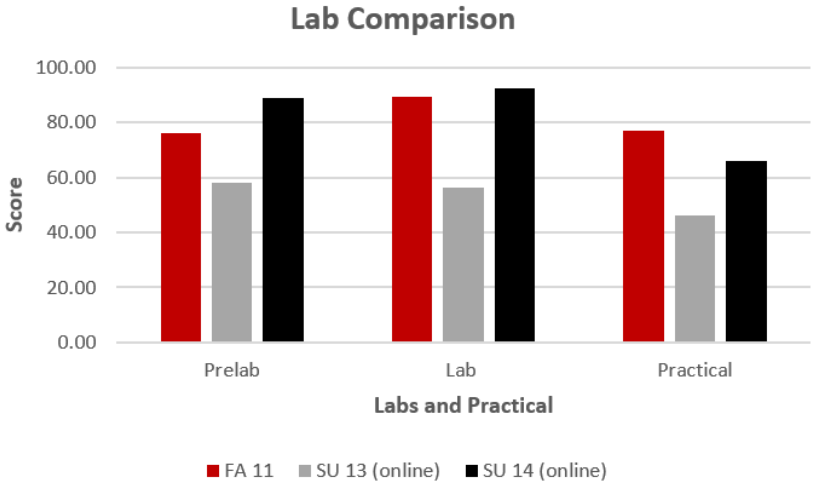
- 28% of students rated the course a 9 or higher with respect to difficulty
- 71% of the students thought the labs were the most difficult part of the online course

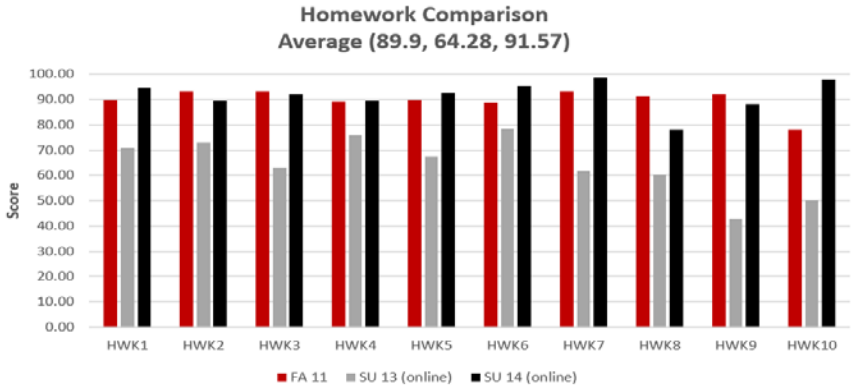


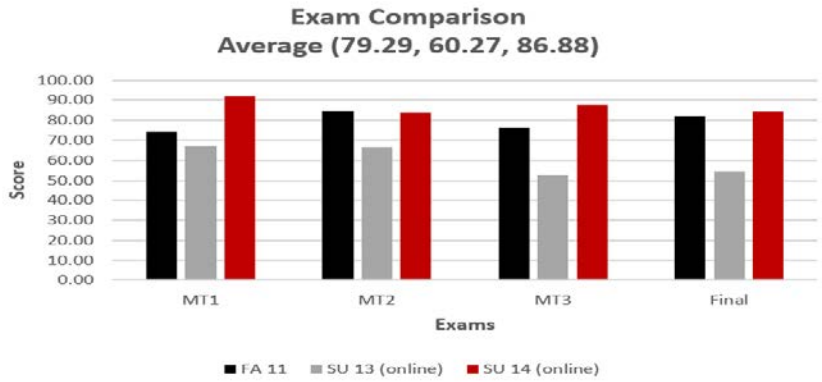
ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Comparison to Face to Face Classroom









ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Qualitative Results

- Debugging and building circuits own their own was the biggest challenge
- No real time help was challenging
- Hard to communicate circuit problems electronically
- One student felt that there was actually more interpersonal interaction with the professor
- Timed quizzes were too difficult for new material
- Engagement increased by 50%

ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Conclusions and Recommendations

- Similar level of engagement but sometimes more for online course
- Respond to all questions in all formats within 24 hours
- Use screen sharing software for questions and problem solving
- Piazza encouraged students to engage with each other
- Randomize component values and questions on quizzes, practicals and exams
- More lab review at expectation meeting
- Make attendance mandatory at virtual office hours

ROSE-HULMAN INSTITUTE OF TECHNOLOGY

More information

- Carlotta A Berry
  - berry123@rose-hulman.edu
- Course Study Guide
  - http://www.rose-hulman.edu/~berry123/Courses/ES203.html
- Video Lectures
  - goo.gl/KXKx2M

ROSE-HULMAN INSTITUTE OF TECHNOLOGY