University of Central Florida

College of Engineering and Computer Science

Final Report - Task Force for Online Labs

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April 14, 2020

Background:

There is an urgent need to transition CECS labs to virtual/remote modality due to the ongoing COVID-19 crisis and subsequent Stay-At-Home order. The objective of this report is to summarize possible tools that can help CECS faculty to effectively perform labs while achieving student outcome (required by ABET and established by departments).

Methodology:

It is understandable that each lab is different and may need different tools to optimally deliver content and achieve student outcome. To develop broadest recommendations, we attempted to cast a broad net that captures most of the available methods. Faculty can, then, choose which tools would best fit their labs. Therefore, our methodology included:

A. Taskforce and CDL used Google search to find:

- Virtual labs developed by academia and commercial entities.
- Websites that contain demo videos of experiments relevant to engineering disciplines.
- Available literature on virtual labs used by higher education institutions.

CDL combined the above resources in a “Virtual Lab Resource” document.

B. The task force performed an initial review of the quality, suitability, and limitations of the above resources in relation to CECS lab courses. The final “Virtual Lab Resource” lists are provided in in Appendix A.

C. The Chair Developed a sample "Online Lab Delivery Plan" with feedback from the group. The CDL collaborating team reviewed the document and their input was included. The final "Online Lab Delivery Plan" is provided in Appendix B.

C. The group reached out to faculty (teaching for summer labs) and shared the above resources and sample Lab Delivery Plan. Each group member coordinated this step with his/he own department and asked his colleagues for input.

D. Faculty (teaching a summer lab) formulate and share their individual "Lab Delivery Plan" to provide input into practices that are most appropriate for their labs, in order to include those in the taskforce recommendations.

Results:

Virtual Experiments: The search resulted in 16 commercial, academic, and other public Websites for virtual/simulated demonstrations. Comments on each Website are in Appendix A, while general finding are provided here.

- The majority of websites had relatively simple demonstrations that are more appropriate for foundation and general education courses such as physics, chemistry, etc.
- Some commercial and university websites required a login, which made it difficult to evaluate. Only a few experiments from these websites appear to be directly useful for CECS Labs.
- The majority of the simulated demonstrations were 2-D and a decade or more old and were not compatible with modern browsers (e.g., Chrome and Edge).
- Therefore, it can be concluded that these simulations can be useful for certain classes, but utility is likely limited for the most part.

Video demonstrations: There were 6 Video demonstration Websites considered. Many of these videos tended to be more sophisticated than the above Virtual Experiments and can be helpful to, at least in some, CECS lab courses.

UCF faculty resources: Some UCF faculty have developed their own lab simulations using LabVIEW, Mathcad, ANSYS, LTspice, Multisim Live, etc. The majority of labs would likely benefit from more virtual labs developed by the instructor to target specific labs. For many courses, there were significantly more Youtube videos by UCF faculty describing their labs than self-developed virtual experiments. The availability of Zoom conferencing, and other simulation software (above) can play a key role in online lab delivery.

The Delivery plans submitted by faculty: The plans for most of the summer labs were compiled and included in Appendix C. These will be reviewed by CDL. The tools suggested in these plans are included in the recommendations below.

The most common theme in these plans include: Pre-recorded videos, conducting experiments during the scheduled lab time via Zoom, providing the acquired experimental data to the students for analysis, some computer simulations, Zoom office hours to answer student questions.

Recommendations to lab Instructors:

Based on the literature, CDL input and Faculty feedback; online lab delivery plans should consider implementing the following:

1. Step-by-step videos of actual experiments conducted at CECS labs.
2. Synchronously perform experiments during a Zoom meeting where the TA is running the experiment with students interactively. Record and post these sessions.
3. Actual acquired data that will be made available to the students to conduct their analysis.
4. Remote office hours for the TA and instructor.
5. Online public videos/virtual demos of relevant physical phenomena.
6. Phone apps.
7. Use of household (or easy to get) safe devices (e.g., rulers, stopwatch, measuring cups, hairdryer, bathroom scale, thermometer, etc).
8. Use of kits. Here, faculty should carefully investigate safety issues that may arise from use of kits at home. Kits should not be used if significant safety concerns exist. Kits with chemicals or biological agents, combustibles, high voltage, or sharp objects can raise safety concerns and, if so, should be avoided.
9. Online lab quizzes and exams.
10. Lab team reports, zoom team meetings.
11. Provide students with report samples, and rubric for each report.

Faculty are also encouraged to consider:

1. Develop creative economic solutions that contains the cost for students and university.
2. Use simulation tools specific to their fields.
3. Review the list of virtual experiments (in the resources document) to find simulations that are most relevant to their lab course.
4. Listing the resources students need to acquire (e.g., computer, Webcam, ruler, stop watch, …) on the syllabus.
5. Seek GTA and UTA input
6. Listing student outcomes in the delivery plan and corresponding lab activities.

7. May revise the student outcomes to reflect the course activities.
8. Suggest any needed upgrades to the video recording equipment.
9. Suggest any necessary software that will help faculty develop their own simulations.
10. Consider migrating to free open source resources. For example, may migrate to https://www.gnu.org/software/octave/ software GNU OCTAVE that runs Matlab scripts.
11. Include the Keep Learning site in the syllabus and/or Webcourses home page https://digitallearning.ucf.edu/newsroom/keeplearning/
12. Keep visiting the Keep Teaching site as there are so many great resources specific to UCF on this site: https://digitallearning.ucf.edu/newsroom/keepteaching/
13. Identify any software that students and instructor need but are only available on the university computers. Report the need to the college so that the college can consider providing remote access through UCFApps or some other means.
14. Utilize advanced Zoom features, and take a short training sessions https://cdl.ucf.edu/support/webcourses/zoom/
15. Visit CDL resources website for "**remote lab resources by college"** at: https://digitallearning.ucf.edu/ilab/remote-labs/

Recommendations to the College Leadership:

Any course redesign requires significant time commitment, focus and resolve. The following steps can be key to successful rapid development and implementation.

1. Enhance the instructor resources to help them implement an optimal plan for online lab delivery. This can be in the form of providing needed software and hardware (to be identified by each instructor) and most importantly manpower in the form of TAs.
2. Provide incentives for faculty to invest their time to develop and implement redesign plans. This can be in the form of course release, travel funds, etc. Another form would be to commit for allowing instructors to teach the same course (that they are redesigning) for multiple future semesters.
3. Pair instructors with a CDL member to continuously help guide the redesign effort. Suggested meeting frequency is every one-two weeks (for 30 minutes).
4. Encourage instructors to take certain training such as Webcourses, Zoom, Honorlock (and other CDL-recommended training).
5. Require instructors to submit a short report (2 pages max) summarizing implementation progress and short-term plans. This is to be submitted every two weeks to the department chair and possibly the task force. When applicable, this

report should include: which experiment was redesigned, the tools used and lessons learned from the recently executed experiment(s).

6. Encourage instructors to share implementation success and challenges with the task force and other instructors (Monthly one-page report and/or 10-min PPT).
7. Encourage instructors to stay 1-2 experiments ahead of students.

Acknowledgements:

The authors would like to acknowledge the valuable input and review provided by the CDL taskforce, including:

- Dr. Wendy Howard (Chair)
- Dr. Baiyun Chen
- Joseph Lloyd
- Nicole Stahl
- Samantha Richardson
- Bren Bedford
- Katy Miller (Library Partner)

We would also thank the faculty teaching summer lab courses for their timely submission of their lab delivery plans contained in Appendix C.

Appendix A:

Possible Online Resources for CECS Labs

Virtual/Interactive Labs

1. WOLFRAM Demonstrations Project: https://demonstrations.wolfram.com/topics.php
[Comment: Has engineering & technology labs, Simple graphics but it works]

- School Applied Sciences
- Chemical Engineering
- Civil Engineering
- Control Theory
- Electrical Engineering (Circuit Design, Signal Processing)
- Fluid Mechanics
- Image Processing
- Machines
- Mechanical Engineering
- Nanotechnology
- Robotics
- Signal Processing (Audio, Wavelets)

2. PhET Interactive Simulations: https://phet.colorado.edu/en/simulations/category/new
[Comment: Many experiment. Simple topics and graphics, but it works]

3. Labster: https://www.labster.com/simulations/ [Comment: limited to a few civil engineering simulations. Involve a cost for use. Need to contact a representative to get pricing details.]

4. Praxilabs: https://praxilabs.com/en/ [Comment: Very limited number of experiments, 3D simulations]

- Heat and Thermodynamics: https://praxilabs.com/en/virtual-labs.aspx?ID=18&UL=18&TAB=1#LOL
- Properties of matter: https://praxilabs.com/en/virtual-labs.aspx?ID=25&UL=25&TAB=1#LOL
- Mechanics: https://praxilabs.com/en/virtual-labs.aspx?ID=33&UL=33&TAB=1#LOL
- Waves: https://praxilabs.com/en/virtual-labs.aspx?TAB=1#LOL
- Electricity: https://praxilabs.com/en/virtual-labs.aspx?TAB=1#LOL

5. VIRTLABS Virtual Laboratories and Technical Simulators: [Comment: limited utility, English and Russian support]

- General: https://virtlabs.tech/ Choose areas under from "Products" menu.
- Thermodynamics: https://virtlabs.tech/physics-thermodynamics/
- Mechanics: https://virtlabs.tech/physics-mechanics/

6. Merlot labs: https://virtuallabs.merlot.org/engineering/index.html [Comments: A lot of apps are very old and may not run. Has serious compatibility issues].

- Aerospace and Aeronautical Engineering
- Agricultural and Biological Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Electrical Engineering
- Engineering Science
- Environmental Engineering
- General
- Industrial and Systems
- Manufacturing Engineering
- Materials Science and Engineering
- Mechanical Engineering
- Nuclear Engineering
- Ocean Engineering

7. Virtual Amrita Laboratories Universalizing Education: http://vlab.amrita.edu/index.php [Comment: Appears to suffer from broken links or incompatibility issues.]

- Biotechnology and Biomedical Engineering
- Computer Science
- Mechanical Engineering

8. Energy3D: http://energy.concord.org/energy3d/ [Comment: Only focused on a limited field]

- Interactive simulation for designing green buildings and power stations

9. BeyondLabz: [Comment: Useful for basic physics labs. Have preset labs with worksheets, can customize own lab activities. Will carry a cost.]

- BeyondLabz website
- List of Preset Activities with Worksheets

10. Chemcollective: http://chemcollective.org/vlabs [Comment: Useful for chemistry]

Video Demos

1. Linkedin Learning: https://www.linkedin.com/learning

- Computer Science: https://www.linkedin.com/learning/search?keywords=computer%20science&u=57691257
- Engineering: https://www.linkedin.com/learning/search?keywords=Engineering&u=57691257

2. PBS (engineering search results): https://www.pbs.org/search/?q=engineering

- Crash Course Engineering: https://www.pbs.org/show/crash-course-engineering/
- The Secret Life of Scientists & Engineers: https://www.pbs.org/show/secret-life-of-scientists/
- 1,090 Video Results

3. PBS (computer science search results): https://www.pbs.org/search/?q=computer+science

- Crash Course Computer Science: https://www.pbs.org/show/crash-course-computer-science/
- 63 Video Results

4. Alexander Street – 60 Minutes (354 video results for engineering):
https://video.alexanderstreet.com/channel/60-minutes-1997-2014?q=Engineering

Alexander Street – 60 Minutes (444 video results for computer science):
https://video.alexanderstreet.com/channel/60-minutes-1997-2014?q=computer%20science

5. JoVE Education Videos (free access through June 15, 2020): https://www.jove.com/science-education/eng

- Bioengineering
- Electrical Engineering
- Mechanical Engineering
- Chemical Engineering
- Structural Engineering
- Biomedical Engineering
- Materials Engineering
- Aeronautical Engineering

6. LabXchange: https://www.labxchange.org/library

- Does not specifically target Engineering areas but physics is the closest relevant area. https://www.labxchange.org/library?t=SubjectArea%3APhysics&page=1&size=15

7. Khan Academy:
https://www.youtube.com/results?search_query=khan+academy+engineering

Lab Kits and Remote labs

1. eScience Labs – 2nd Edition General Physics Version 1:
https://esciencelabs.com/productdisplay/2nd-edition-general-physics-version-1 [Comment: Involve a cost)

2. Remote Laboratory: https://remotelaboratory.com/remote-laboratories/what-are-remote-laboratories/

3. Labs Land: https://labsland.com/en [Comment: Remote laboratory access marketplace.]

University, Agency, or Organization Resources

1. Ministry of Human Resource Development, India - Virtual Labs: http://www.vlab.co.in/ [Comment: Various virtual labs. Simple graphics. Compatibility issues. May only run in internet explorer.)

- Electronics & Communications
- Computer Science & Engineering
- Electrical Engineering
- Mechanical Engineering
- Chemical Engineering
- Biotechnology and Biomedical Engineering
- Civil Engineering
- Physical Sciences
- Chemical Sciences
- Soil Mechanics
- Environmental Engineering

2. John Hopkins University – Virtual Laboratory: https://pages.jh.edu/~virtlab/virtlab.html [Comment: Links to html labs for engineering/science experiments; last updated in 2000. Simple graphics. Has compatibility issues. May only run in internet explorer.)

- Logic circuits
- Diffusion processes
- Drilling for oil
- Robotic arm control

- Heat transfer in a duct
- Bridge designer
- How many trees?
- Sound propagation
- Heat conduction
- Probability distributions

3. National Center for Science and Engineering Statistics: https://www.nsf.gov/statistics/

Gendered Innovations – Case Studies on engineering:
https://genderedinnovations.stanford.edu/fix-the-knowledge.html

- Exploring Markets for Assistive Technologies for the Elderly
- HIV Microbicides
- Human Thorax Model
- Information for Air Travelers
- Machine Translation
- Making Machines Talk
- Pregnant Crash Test Dummies
- Video Games

4. Auburn University – Virtual Lab: http://www.eng.auburn.edu/admin/ens/helpdesk/off-campus/vdi.html [Comment: Access is possible fro only their faculty and students]

5. University of Liverpool – Virtual Engineering Centre:
https://www.liverpool.ac.uk/engineering/research/vec/

6. Loyola Marymount University – Virtual Engineering Science Learning Lab:
http://seaugust.lmu.build/VESLL/index.htm

7. RAGE Project: http://rageproject.eu/ [Comment: No clear Virtual labs available]

8. University of North Dakota – Electrical Engineering (B.S.E.E.):
https://und.edu/programs/electrical-engineering-bsee/index.html [Comment: No clear Virtual labs available]

9. SAGE Research Methods: https://guides.ucf.edu/database/SageResearch

10. SAGE Research Methods Videos: https://guides.ucf.edu/database/SRMVideo

11. UCF Academic Resources during COVID-19 Situation: https://guides.ucf.edu/covid
[Comment: UCF Library resources]

- Civil, Environmental and Construction Engineering https://guides.ucf.edu/cece
- Electrical Engineering and Computer Science https://guides.ucf.edu/ece
- Industrial Engineering and Management Systems https://guides.ucf.edu/ie

- Materials Science and Engineering https://guides.ucf.edu/mse
- Mechanical and Aerospace Engineering https://guides.ucf.edu/mae
- **Engineering Subject Librarian – Ven Basco:** https://library.ucf.edu/staff/basco-ven/

12. UCF Engineering & Computer Science Library Resources:
https://guides.ucf.edu/textbooks/engineering

16. **UCF Synthesis Digital Library (Morgan & Claypool)**:
https://guides.ucf.edu/database/Synthesis

Research Articles

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Tips for Recording Your Labs

Follow these tips from CDL for recording and uploading your own labs onto a video platform. https://cdl.ucf.edu/teach/resources/diy-video/

Appendix B:

Sample - Online Lab Delivery Plan (Reviewed by CDL and shared with faculty teaching summer labs)

Mechanical and Aerospace Engineering Measurements (EML 3303C & EAS 3800C)

Online Lab Delivery Plan,

Instructor: Hansen A Mansy

Course description: Theory, calibration and use of mechanical and aerospace engineering measurement instruments. Measurement techniques, data analysis, report writing, and team work.

The lab topics: Statistical analysis of experimental data, basic electronic instruments, digital data acquisition, spectral analysis of dynamic signals, measurement techniques for displacement, fluid flow, forces, pressure, vibration, and strain.

Target student outcome (ABET)

- Outcome 6: Develop and conduct experimentation, analyze data …(Lab videos and Zoom)
- Outcome 5: Function in teams …(team reports and Zoom meetings)
- Outcome 3: Communicate effectively …(lab reports)
- Outcome 2: Apply engineering design to produce solutions …(build computer models)

General approach for online delivery of labs: All labs are to be modified for online delivery. Great care will be exercised to still satisfy the learning objectives. Lab handouts will be modified and new videos that demonstrate the modified experiments will be created. In re-deigning lab delivery, the following mechanisms will be utilized:

1. Step-by-step videos of actual experiments in our UCF physical lab
2. Use of household (or easy to get) devices (e.g., rulers, stopwatch, measuring cups, hairdryer, bathroom scale, thermometer, etc)
3. Virtual instruments developed at UCF using LabVIEW software.
4. Remote interactive experiments during a Zoom meeting where the TA is running the experiment with students.
5. Phone apps
6. Actual acquired data that will be made available to the students (for analysis)
7. Online public virtual demos of relevant physical phenomena.
8. Virtual experiments (a few) developed at UCF for this lab.

9. Use of kits.
10. Online lab quizzes
11. Lab team reports, zoom team meetings
12. Report samples, and rubric for each report

Proposed experiments (Current experiments, modified for online/remote modality):

Experiment	Mechanisms used (From the list above)
1.Statistical description of experimental data	1, 2, 6, 10,11,12
2.Digital data acquisition	1, 3, 4, 5, 6, 10,11,12
3.Spectral analysis of dynamic quantities	1, 3, 4, 5, 6,10,11,12
4.Lab Midterm	3, 6, 10,11,12
5.Methods of force and strain measurements	1, 2, 4, 6, 7,10,11,12
6.Pressure and flow velocity measurements	1, 2, 3, 4, 6, 7,10,11,12
7.Dynamic characteristics of first and second order systems	1, 2, 4, 6, 8,10,11,12
8.Forces and flow visualization for wings and moving objects	1, 2, 4, 6, 7, 8, 9,10,11,12

Details of implementing these mechanisms in each experiment will be in the revised experiment handout.

Appendix C:

Online Lab Delivery Plans for most CECS summer lab courses (To be reviewed by CDL)

Computer Organization (CDA 3103)
Online Delivery Plan

Course description: This course is designed to provide a fundamental of the organization and design of computers from both the *computer programmer's* perspective and *computer architect's* perspective.

The lab topics: Boolean logic design, instruction set architecture (MIPS and SPIM simulator), computer arithmetic, performance and power metrics, datapath design and control logic design, memory hierarchy and caches, I/O interface, system software interfaces.

Target student outcome:

- Outcome 1: A passing student shall be familiar with various representations in logic design, including Boolean algebra, truth table, logic gates, and Karnaugh maps; shall be able to design simple combinational circuits and sequential circuits.
- Outcome 2: A passing student shall be familiar with various data representations in computing systems, including binary, hexadecimal, signed/unsigned integers, and floating point numbers.
- Outcome 3: A passing student shall understand and be able to perform arithmetic operations as implemented in computer systems for both integer and floating-point numbers, and the Booth's algorithm.
- Outcome 4: A passing student shall be able to understand, write, and debug simple MIPS assembly programs.
- Outcome 5: A passing student shall be familiar with basic concepts of memory hierarchy and shall be able to design or analyze simple cache systems including direct map, and n-way associative.

General approach for online delivery of Recitations: All recitations are to be modified for online delivery. Great care will be exercised to still satisfy the learning objectives. Recitations using PowerPoint presentations will be delivered via Zoom and posted on web courses. In re-deigning recitations delivery, the following mechanisms will be utilized:

1. Remote interactive discussions during a Zoom meeting where the TA is presenting the topic and exercises to students. Demos will be given.
2. Recitations will be recorded.

<u>Proposed Recitations</u>:

Experiment	Mechanisms used (From the list above)
1.Combinational circuits	1 and 2
2.Sequential circuits	1 and 2
3.Data representation (binary, hexadecimal, octal)	1 and 2
4.Arithmetic operations (including floating point)	1 and 2
5.Assembly Language (ISA)	1 and 2
6.ALU and control unit	1 and 2
7.Memory hierarchy	1 and 2
8.Input/output system	1 and 2
9.Pipelining	1 and 2

Systems Software (COP3402)
Online Delivery Plan

Course description: This course is designed to provide a fundamental understanding of real and virtual machines as language processor and the implementation of compilers. We will study processors as instruction interpreters. Compilers, assemblers, linkers and loaders, and virtual machines will be presented as systems software for program development. Run time environments and an introduction to Operating system will be given.

The lab topics: Computer Organization, virtual machines implementation, compilation process, regular expressions, symbol tables, parsing, code generation, and Makefile.

Target student outcome:

- Outcome 1: A passing student shall be able to understand a computer and virtual machines as instruction interpreter, and to have an in depth understanding of the run-time environment (Code segment, data segment, stack, and heap).
- Outcome 2: A passing student shall have an understanding of how to implement all the stages of a compiler (scanner, parser, symbol table, intermediate code, and code generation).
- Outcome 3: A passing student shall have tan understanding of how assemblers, linkers and loaders work.
- Outcome 4: A passing student shall be able to understand the fundamentals concepts on interrupt handling and process management in an OS.

General approach for online delivery of Recitations: All recitations are to be modified for online delivery. Great care will be exercised to still satisfy the learning objectives. Recitations using PowerPoint presentations will be delivered via Zoom and posted on web courses. In re-deigning recitations delivery, the following mechanisms will be utilized:

1. Remote interactive discussions during a Zoom meeting where the TA is presenting the topic and exercises to students. Demos will be given.
2. Recitations will be recorded.

Proposed Recitations:

Experiment	Mechanisms used (From the list above)
1.Computer Organization	1 and 2
2.Virtual Machines and stack mechanism for subroutine control	1 and 2
3.Compilation process	1 and 2
4.Regular expressions	1 and 2
5.Symbol table	1 and 2
6.Top down parsing of context free languages	1 and 2
7.Code generation	1 and 2
8.Makefile	1 and 2

Computer Science 2 (COP3503C)
Online Delivery Plan

Course description: Algorithm design and analysis for tree, list, set, and graph data models; algorithmic strategies and applications, and algorithmic complexity analysis; sorting and searching; practical applications.

The lab topics: Introduction to the relevant programming environment; review of basic programming concepts in Java; additional exposition of algorithms and data structures; and additional exposition of advanced programming techniques.

Target student outcomes (ABET)

- Students will be evaluated on their ability to use current techniques, skills and tools necessary for the computing practices based on programming assignments and exam questions on the following topics: (1) implementation of standard algorithms utilizing the greedy, divide and conquer, and dynamic programming paradigms and (2) using mathematical analysis to calculate the time and memory usage of various algorithms and operations on various data structures.
- Students will be evaluated on their ability to apply design and development principles in the construction of software systems of varying complexity by their performance on a variety of programming assignments pertaining to: (1) implementation details of various advanced data structures, (2) implementation details of several algorithms, and (3) designing portions of code that fit into a greater existing framework based on design specifications.
- Students will be evaluated on their knowledge of, and ability to apply, programming fundamentals in at least three programming languages through their performance on homework assignments which will require them to construct programs to implement (1) multiple advanced data structures and (2) several algorithms utilizing the greedy, divide and conquer, and dynamic programming paradigms.

General approach for online delivery of labs: All labs will be delivered online. In this course we have the advantage that the lab topics are fundamentally supplementary to the lectures, directly related to the programming projects in the course proper, and computer-based rather than physical in any case.

We will still take all due care to satisfy both the course learning objectives and the above learning outcomes.

Mechanism: Teaching assistants will use online delivery by Zoom, synchronous to the scheduled lab time, both to exposit content directly and to show examples of relevant techniques. Skilled use of Zoom will still permit students to ask questions of, and interact with, the teaching assistants. These sessions will be recorded.

Proposed topics (tentative, same as current topics)

We expect some of these topics to require more than one lab session. There will be an initial plan, but the schedule will be intentionally designed to be flexible.

Explanation of programming environment, review of Java basics
Review of Java data structures
Practical exploration of tree structures and techniques
Practical exploration of graph structures and techniques
Practical exploration of newly taught algorithmic techniques
Review of divide-and-conquer techniques learned previously
Practical exploration of dynamic programming

Introduction to Discrete Structures (COT 3100C)
Online Delivery Plan

Course description: Introduction to Discrete Structures: PR: MAC 2311C with a grade of "C" (2.0) or better. Logic, sets, functions, relations, combinatorics, graphics, Boolean algebras, finite-state machines, Turing machines, unsolvability, computational complexity.

The lab topics: Propositional Logic, Predicates and Quantifiers, Proof Methods, Sets and Set Operations, Functions, Equivalence Classes, Modular arithmetic, Division Algorithm, Fundamental Principle of Counting, Permutations and Combinations.

Target student outcome (ABET)

Outcome 1/a: Apply knowledge of computing and mathematics… (Lab Handouts, Virtual Office Hours)
Outcome 10/j: Apply mathematical foundations and computer science theory…(Lab Handouts, Virtual Office Hours)

General approach for online delivery of labs: There will be no need for any physical tool, software or experiments to conduct any of the labs for COT 3100C. The labs will be delivered in the form of handouts posted on a weekly basis on Webcourses. Typically, a lab will contain a set of mathematics problems on the topics listed above. Students will be encouraged to work on the labs in groups, and there will be virtual office hours throughout the week for the students to contact the instructor and/or the TAs for any questions or concerns about their labs.

<u>Modeling Methods in Mechanical and Aerospace Engineering EML 3034C 3(3,1)</u>
<u>Online Delivery Plan</u>

<u>Course description:</u> Computer aided modeling of mechanical and aerospace systems. Solution methods. Curve fitting. Optimization. Case studies with applications to MAE design.

<u>The lab topics:</u> Truncation and round off, root finding, solving linear systems by direct and iterative methods, solving non-linear systems of equations, least-squares, numerical solution of a first order ODE, numerical solution of second order ODE. Application of the labs are taken from statics, dynamics, heat transfer, vibrations and aerodynamics problems encountered in the mechanical and aerospace engineering curriculum.

<u>Target student outcome (ABET)</u>

- Outcome 1: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- Outcome 8: An ability to use the technique, skills, and modern engineering tools necessary for engineering

<u>General approach for online delivery of computer labs and assessment:</u> All labs have been modified in Spring 2020 for online delivery of content and assessment. The lab instructions and delivery have been coordinated with the course TAs and UTAs.

1. We have migrate to free open source https://www.gnu.org/software/octave/ software GNU OCTAVE that runs Matlab scripts and migrated the labs to that software.

2. GTAs hold labs sessions using zoom and hold zoom office hours to aid the students with the programming questions.

3. Assessment is online and multipart:

    a. Students complete a webcourses answer quiz (no time limit) on specific questions for the given project [40%].
    b. Students complete a timed (15 minute) webcourses based quiz requiring use of their code (this replaced the in-class iclicker quizzes) [50%].
    c. Students upload their code on webcourses for TA verification and to earn full credit earned in parts a. and b. [10%]

<u>Proposed lab projects</u> (Currently modified for Spring 2020 online/remote modality):

Computer Projects
1. Introductory project: truncation and round-off error in finite difference
2. Numerical solution of a scalar non-linear equation – fluid mechanics problem
3. Numerical solution of a linear systems of equations by direct methods – truss problem
4. Numerical solution of a linear systems of equations by iterative methods – heat transfer fin problem
5. Numerical solution of a systems of coupled non-linear equations – non-linear heat conduction problem
6. Applying least-squares to simulated data – curve fitting accelerometer data
7. Numerical solution of a first order ODE – capacitor discharging to ground across a resistance.
8. Numerical solution of a second order ODE – non-linear response of pendulum

Civil Engineering Measurements (CGN 3700C)
Online Delivery Plan

Course description: This course covers civil engineering measurements, data analysis, hardware of experiments, system components, and calibration, with specific applications in civil engineering and land surveying.

The lab topics: Statistical analysis of experimental data, leveling, horizontal distance, traverse, GNSS, GIS

Target student outcome (ABET)

- Outcome 6: Develop and conduct experimentation, analyze data …(Lab videos and Zoom)
- Outcome 3: Communicate effectively …(lab reports)

General approach for online delivery of labs: Lab handouts will be modified and new videos that demonstrate the modified experiments will be created. The instructor and TA will create videos of the laboratory procedures and share data with the students for them to do analyses and prepare laboratory reports. The following are brief descriptions of the laboratory experiments. The exact changes that will occur for each experiment has yet to be determined.

Experiment	Mechanisms used (From the list above)
1. Lab Orientation and Replicates	Students will be introduced to how the labs will proceed for the semester and learn how to use their field books to take proper notes. Students will use household materials (forks, knives, pens, etc.) to make measurements and do statistical analyses. Before the experiment starts, the TA will go through report writing and field book writing conventions, report and field book samples, and briefly explain the labs that will be engaged.
2. Leveling	The purpose of this lab is to introduce students to field procedure used for finding the elevation(s) (height above a datum) of specific point(s) in the field using an automatic level and a level rod. In brief terms, the procedure goes as follows: a level person sets up an automatic level between two points; a rod person stands over the turning point that falls back of the automatic level holding a level rod and the level person takes a measurement the elevation (backsight to the turning point); the rod person walks over the turning point that falls ahead of the automatic level and stands over the point

	holding the level rod; and the level person takes a measurement of the elevation (foresight to turning point 2). The procedure follows for as many sides as the predetermined polygon has. The students also measure the horizontal distance between each point using a measuring wheel.
3. Horizontal Distance	The purpose of this lab is to introduce students to field techniques used for horizontal distance measurement in surveying and construction. In brief terms, the students measure the horizontal distances between each point of a predetermined polygon using three different techniques backward and forward; and they analyze the data collected.
4. Traverse	The purpose of this lab is to introduce students to field procedure used for measuring horizontal angles and distances in a loop traverse using an electronic theodolite. Students also compute Latitudes (Northing) and Departures (Easting) for the closed traverse legs. In brief terms, the procedure goes as follows: an electronic theodolite is set up on each point of a predetermined polygon and, after leveling the device, students measure the horizontal angle of each point twice – from left to right and from right to left. Students also measure the horizontal distances between each point using the techniques shown in the previous lab to compute additional parameters.
5. Static GNSS	The purpose of this lab is to introduce students to the procedure for establishing survey control using Rapid Static GPS. The students will also experience the process of submitting data files to NGS OPUS for positioning. In brief terms, the procedure goes as follows: a GPS device is set up over a point to conduct a static observation for a given time, which was 18 minutes for the purposes of this lab; after this duration, the device is taken over to a next point, set up again, and the point is "occupied" for the same duration. The procedures are to be followed for at least 3 points. The data collected during this lab would be uploaded by students to the OPUS

	for data processing and solutions would be acquired by e-mail.
6. Kinematic GNSS	The purpose of this lab is to introduce students to the procedure for using established survey control for Real Time Kinematic topographic surveying. The procedure goes as follows: a GPS device is set up over a benchmark point and used as the base station; a GPS rover is set up and configured to be connected to the base station; students walk over a given area applying the stop-n-go technique to collect data. The procedure goes on until each group collects at least 100-120 data points. The data collected will be used in the next and last lab.
7. GIS	The purpose of this lab is to introduce students to the ESRI ArcMap software. Students will add their kinematic GNSS points to a map and add an aerial image basemap. Students will then generate and symbolize digital elevation model (DEM) of the southwest lawn at memory mall and produce point statistics. The students will use the Virtual Desktop Environment to run ArcMap 10.7.1 software and process data and complete the lab.

Hydraulics Lab-CWR 4202C

(3.0 credit hour course-lab required)

Online Delivery Plan

Course description: In this course students will practice the application of basic principles of fluids at rest and in motion to analyze and design of hydraulic systems. The laboratory portion of the course will implement an active learning environment to assess students' understanding while covering experiments of pipe and open channel flow. Practical engineering problems and design applications will be emphasized.

Topics Discussed in this Lab: The different velocity distributions and how to recognize/measure them , energy losses in hydraulic jumps, how water flows over different hydraulic structures, different head losses in pipe flow and how to measure them, how pipes in series and parallel change pipe distribution analysis

Target student outcome (ABET)

- Outcome 6: Develop and conduct experimentation, analyze data …(pre-recorded videos posted online)
- Outcome 5: Function in teams …(Group lab reports and Zoom meetings)
- Outcome 3: Communicate effectively …(lab reports/technical memos)
- Outcome 2: Apply engineering design to produce solutions …(use to computer models to fit data and identify sources of error)

General approach for online delivery of labs: All labs are to be modified for online delivery. Great care will be exercised to still satisfy the learning objectives. Lab handouts will be modified with supplementary videos posted online to Webcourses. The assigned GTA, with assistance from the instructor, will record and post new videos that demonstrate the modified experiment. Students will watch the online videos then will analyze data generated by the GTA and/or data compiled from previous semesters. In re-deigning lab delivery, the following mechanisms will be utilized:

12. Step-by-step videos of actual experiments recorded using camera and mic by the GTA in our UCF physical lab
13. Pictures and short clips showing laboratory devices and explaining how to use apparatuses.
14. Use of household (or easy to get) devices (e.g. stopwatches, rulers, measuring cups, empty household containers)
15. Actual acquired data that will be made available to the students (for analysis)
16. Online public virtual demos of relevant physical phenomena.
17. Online lab quizzes
18. Lab team reports, zoom team meetings
19. Report Format (with rubric) posted to Webcourses

Proposed experiments (Current experiments, modified for online/remote modality):

Experiment	Mechanisms used (From the list above)
1. Velocity Distributions and Measurement	1, 3, 4, 6, 7, 8
2. Energy Equation-Critical Depths	1, 2, 4, 5, 6, 7, 8
3. Hydraulic Jumps	1, 2, 3, 4, 5, 6, 7, 8
4. Flow over Hydraulic Structures	1, 4, 5, 6, 7, 8

5. Head Losses in Pipe Flow	1, 2, 3, 4, 6, 7, 8
6. Water Hammer Effects in a Pipe System	1, 2, 3, 4, 6, 7, 8
7. Pipes in Series and Parallel	1, 2, 3, 4, 6, 7, 8
8. Pipe Network Design and Analysis	1, 2, 3, 4, 6, 7, 8

An Updated-Laboratory Manual with details of implementing each experiment utilizing these mechanisms will be revised and posted online for access.

Structural Analysis Class and Lab (CES4100C)

Online Delivery Plan

Course description: To introduce the fundamental principles of structural analysis of determined and undetermined structures and their applications to problems of engineering.

Course learning outcomes

1. Develop an understanding and knowledge of different structural systems (e.g., beams, frames, trusses) and their general behavior. Perform force analysis of determinate and indeterminate structures to obtain reactions and internal member forces (e.g., shear, moment) 2. Qualitatively and quantitatively, determine structural deformations such as deflections and rotations. 3. Use of structural analysis software; analysis and interpretation of data resulting from the software. 4. Laboratory structural testing of members and assemblies; analysis and interpretation of data resulting from the tests; design physical structure projects. 5. Technical writing of laboratory reports; presentation of projects 6. Build a technical foundation for design courses and more advanced analysis courses

The lab topics: Structural analysis software, laboratory structural analysis testing of members and assemblies, anlysis and interpretation of data and results, model building, technical writing of laboratory reports, presentation of topics

Target student outcome (ABET)

- Outcome1: (1.2, 1.5)An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- Outcome 3: (3.1, 3.2) An ability to communicate effectively with a range of audiences-lab reports
- Outcome 6: (6.1, 6.2)An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

General approach for online delivery of labs: All labs are to be modified for online delivery. Great care will be exercised to still satisfy the learning objectives. Lab handouts will be modified and new videos that demonstrate the modified experiments will be created. In re-deigning lab delivery, the following mechanisms will be utilized:

20. Step-by-step videos of actual experiments in our UCF Structures lab
21. Actual acquired data that will be made available to the students (for analysis)
22. Individual/Group Projects
23. Use of household (or easy to get) devices (e.g., rulers, stopwatch, measuring cups, hairdryer, bathroom scale, thermometer, etc)
24. Use of Visual analysis and SAP 200 Software for Virtual Simulations
25. Remote interactive demonstrations during a Zoom meeting where the Professor is interacting.
26. Online lab quizzes
27. Lab team reports, zoom team meetings
28. Report samples, and rubric for each report

Proposed experiments (Current experiments, modified for online/remote modality):

Experiment #1 – Structural Analysis Software and Beams	1,2,3,5,6,7,8,9
Experiment #2 – Structural Analysis Software and Frames	1,2,3,5,6,7,8,9
Experiment #3 – Deflections in Cantilever Beams	1,2,3,5,6,7,8,9
Experiment #4 – Plastic Bending of a Simply-Supported Beam	1,2,3,5,6,7,8,9
Experiment #5 – Influence Lines for Statically Determinate Truss	1,2,3,5,6,7,8,9
Experiment #6 – Deflection of Statically Determinate Truss	1,2,3,5,6,7,8,9
Experiment #7 – Statically Determinate Frame Analysis	1,2,3,5,6,7,8,9
Experiment #8 – Statically Indeterminate Frame Analysis	1,2,3,5,6,7,8,9
Project #1 – Construction of a Balsa Wood Bridge	1,3,4,5,6,7,8,9
Project #2 – Structural Analysis of a Frame	1,3,4,5,6,7,8,9

Details of implementing these mechanisms in each experiment will be in the revised Laboratory Manual.

Course Number and Title: EEL 3123C Linear Circuits II

Lab Topics: DC measurements in resistive circuits, transient analysis of 1st and 2nd order circuits, sinusoidal steady-state analysis and frequency response analysis.

Delivery Plan:

1. Hand analysis can be performed remotely and submitted online.
2. Computer simulations can be performed remotely using software such as LTspice or Multisim Live.
3. Record videos that show the step-by-step process of all experiments in the lab manual. Online demos or videos in the public domain can be used as supplementary material.
4. Supply of real experimental data to students for analysis and interpretation.
5. Lab reports and/or online lab quizzes.
6. Live assessments of students' understanding of the experiments on Zoom through Q&A and/or discussions.

Course Number and Title: EEE 3307C Electronics I

Lab Topics: diode circuits, BJT biasing and small-signal analysis, frequency response and amplifier design.

Delivery Plan:

1. Hand analysis can be performed remotely and submitted online.
2. Computer simulations can be performed remotely using software such as LTspice or Multisim Live.
3. Record videos that show the step-by-step process of all experiments in the lab manual.
4. Supply of real experimental data to students for analysis and interpretation.
5. Lab reports.

Course Number and Title: EEE 4309C Electronics II

Lab Topics: op-amp applications, voltage regulators, precision diode circuits, active filters, comparators and waveform generators.

Delivery Plan:

1. Hand analysis can be performed remotely and submitted online.
2. Computer simulations can be performed remotely using software such as LTspice or Multisim Live.
3. Record videos that show the step-by-step process of all experiments in the lab manual.
4. Supply of real experimental data to students for analysis and interpretation.
5. Lab reports.

Course Number and Title: EEL 3552C Signal Analysis & Analog Communications

Lab Topics: spectrum analysis, periodic signal spectra, filters and modulation.

Delivery Plan:

1. Hand analysis can be performed remotely and submitted online.
2. Computer simulations can be performed remotely using Matlab.
3. Record videos that show the step-by-step process of all experiments in the lab manual.
4. Supply of real experimental data to students for analysis and interpretation.
5. Lab reports.

Course Number and Title: EEE 3342C Digital Systems

Lab Topics: design of digital circuits such as logic gates, binary adder, multiplexers, demultiplexers, RAM, flip-flops and sequential circuits.

Delivery Plan:

1. The students will download and install the free Vivado Design Suite on their computers. This software enables specifying digital circuits via 1) schematic capture and 2) Verilog language. The software also facilitates testing of the design by generating waveforms that represent the inputs and outputs of a circuit.
2. Lab reports.

Course Number and Title: EEL 3801C Computer Organization

Lab Topics: MIPS assembly language programming.

Delivery Plan:

1. All lab assignment is software based. Codes can be written, debugged and tested using a robust free educational simulator.
2. Project programming, project quiz and project report.

Course Number and Title: EEL 4742C Embedded Systems

Lab Topics: programming the microcontroller and its peripherals (e.g. timer, ADC, communication) and programming external devices (e.g. sensors, pixel display).

Delivery Plan:

1. The plan is for the students to have the boards at home.
2. The basic board Texas Instruments MSP430FR6989 LaunchPad costs $20 and is used for Labs 1-8.
3. The sensor board Texas Instruments Educational BoosterPack Mark II costs $30 and is used for Labs 9-11.
4. The students submit a lab report for each lab.

<u>Course Number and Title:</u> 3331C Mechanics of Materials

We Concur with the general guidance and plan to.

1. Record the lab ahead of time to be sure camera captures everything properly,
2. Then host live Zoom sessions during lab hours to watch the lab video and explain / answer questions,
3. provide experimental data (preferably different for each lab section) for use in completing the lab reports.
4. The GTA will develop the lab syllabus / procedures and will refine the plan when they are on-board."

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Feedback on CECS Labs Task Force Delivery Plans

Overall, we were very impressed with the Delivery Plans that were shared with us, and the Center for Distributed Learning (CDL) is prepared to assist faculty members with implementing these plans. In particular, the Instructional Design and Webcourses@UCF Support teams are on standby as you prepare for summer courses. Also, please remember that the written report produced by the task force included a list of resources. That list continues to get updated on the iLab site at: https://digitallearning.ucf.edu/ilab/college-of-engineering-and-computer-science-remote-lab-resources/

Below is our feedback on each delivery plan. Please contact iLab@ucf.edu to request an appointment to discuss this feedback in more detail if needed.

CDA3103

- Student outcomes are clear and well-written.
- Interaction via Zoom fits the purpose of the course
- The numbering system of the general approach for online delivery should start from 1
- No assessment strategy has been identified. How will students be graded on those outcomes? Quiz, lab reports, graded Zoom discussion, etc?
- Please consider enrolling in Teaching with Lecture Capture – Zoom Edition (TLC-z) or Zoom Essentials if you haven't already

CES4100C

- Tips from CDL for recording and uploading your own labs onto a video platform: https://cdl.ucf.edu/teach/resources/diy-video/
- Rubrics can speed up grading of lab reports in Webcourses. Learn more at https://community.canvaslms.com/docs/DOC-26472-how-do-i-add-a-rubric-to-an-assignment
- Consider using the Groups feature in Webcourses to provide student teams with workspaces the instructor has access to. Learn more at https://community.canvaslms.com/docs/DOC-10717-67952724469

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- Consider using Breakout rooms during the live Zoom sessions. Learn more at: https://support.zoom.us/hc/en-us/articles/206476093-Getting-Started-with-Breakout-Rooms
- Please consider enrolling in Teaching with Lecture Capture – Zoom Edition (TLC-z) or Zoom Essentials if you haven't already

CGN3700C

- Outcome 6: separate this outcome into two or three outcomes. "Analyze data" might be done via ArcMap 10.7.0 (the virtual desktop environment)?
- The "Mechanisms used" column can be broken into two: description and mechanism. Not all mechanisms were identified here.
- For the GIS lab, I believe access to the ArcMap 10.7.1 software has already been implemented through UCFApps. Please let iLab know if you do need assistance with this.
- Tips from CDL for recording and uploading your own labs onto a video platform: https://cdl.ucf.edu/teach/resources/diy-video/
- Please consider enrolling in Teaching with Lecture Capture – Zoom Edition (TLC-z) or Zoom Essentials if you haven't already

COP3402

- Student outcomes are clear and well-written.
- Interaction via Zoom fits the purpose of the course
- No assessment strategy has been identified. How will students be graded on those outcomes? Quiz, lab reports, graded Zoom discussion, etc?
- Please consider enrolling in Teaching with Lecture Capture – Zoom Edition (TLC-z) or Zoom Essentials if you haven't already

COP3503C

- Student outcomes are clear and well-written.
- Interaction via Zoom fits the purpose of the course
- No assessment strategy has been identified. How will students be graded on those outcomes? Quiz, lab reports, graded Zoom discussion, etc?
- Please consider enrolling in Teaching with Lecture Capture – Zoom Edition (TLC-z) or Zoom Essentials if you haven't already

COT3100

- It is assumed that the virtual office hours will be delivered via Zoom
- If necessary, the instructor can also use Zoom to record short sessions to clarify common errors

- Consider using the Groups feature in Webcourses to provide student teams with workspaces the instructor has access to as they work on the labs in groups. Learn more at https://community.canvaslms.com/docs/DOC-10717-67952724469
- Consider using Breakout rooms during the live Zoom sessions. Learn more at: https://support.zoom.us/hc/en-us/articles/206476093-Getting-Started-with-Breakout-Rooms
- Please consider enrolling in Teaching with Lecture Capture – Zoom Edition (TLC-z) or Zoom Essentials if you haven't already

CWR4202C

- What will students use for analyzing data? Do students have access to the software at home or via the virtual desktop environment?
- Tips from CDL for recording and uploading your own labs onto a video platform: https://cdl.ucf.edu/teach/resources/diy-video/
- If you need assistance locating "online public virtual demos of relevant physical phenomena," your subject librarian may be able to help.
- Rubrics can speed up grading of lab reports in Webcourses. Learn more at https://community.canvaslms.com/docs/DOC-26472-how-do-i-add-a-rubric-to-an-assignment
- Consider using the Groups feature in Webcourses to provide student teams with workspaces the instructor has access to. Learn more at https://community.canvaslms.com/docs/DOC-10717-67952724469
- Consider using Breakout rooms during the live Zoom sessions. Learn more at: https://support.zoom.us/hc/en-us/articles/206476093-Getting-Started-with-Breakout-Rooms
- Please consider enrolling in Teaching with Lecture Capture – Zoom Edition (TLC-z) or Zoom Essentials if you haven't already

EML3034C

- According to the Assessment section, 50% of the course grade depends on a 15-minute webcourses quiz. It does not sound right. The instructor might need to revisit this assessment strategy.
- Please consider enrolling in Teaching with Lecture Capture – Zoom Edition (TLC-z) or Zoom Essentials if you haven't already

ECE Plans

- These were all very short, so not as much detail to react to from an instructional design perspective.

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- Rubrics can speed up grading of lab reports in Webcourses. Learn more at https://community.canvaslms.com/docs/DOC-26472-how-do-i-add-a-rubric-to-an-assignment
- Tips from CDL for recording and uploading your own labs onto a video platform: https://cdl.ucf.edu/teach/resources/diy-video/
- If you think students may struggle with access to software that they normally would not have purchased for your course, please report this up through your chair to Manoj Chopra to see if UCFApps may be a viable solution.
- For those that mentioned Zoom, please consider enrolling in Teaching with Lecture Capture – Zoom Edition (TLC-z) or Zoom Essentials if you haven't already