SAINT LOUIS UNIVERSITY.

Program-Level Assessment: Annual Report

Program: Electrical Engineering	Department: School of Engineering
Degree or Certificate Level: UG	College/School: Parks College of Engineering, Aviation and Technology
Date (Month/Year): 9/2020	Primary Assessment Contact: Dr. Kyle Mitchell

In what year was the data upon which this report is based collected? AY 20

In what year was the program's assessment plan most recently reviewed/updated? Major AY18&19, Minor AY20

1. Student Learning Outcomes

Which of the program's student learning outcomes were assessed in this annual assessment cycle?

a - an ability to apply knowledge of mathematics, science, and engineering
b.1 - an ability to design and conduct experiments
b.2- an ability to analyze and interpret data
c - an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

2. Assessment Methods: Student Artifacts

Which student artifacts were used to determine if students achieved this outcome? Please identify the course(s) in which these artifacts were collected. Clarify if any such courses were offered a) online, b) at the Madrid campus, or c) at any other off-campus location.

ECE 3130, 4800 – Fall 2019 were in person Frost Campus classes
ECE 2013, 3090, 3132 3151 – Spring 2020 were scheduled as in person Frost Campus classes, All courses finished as online due to Covid 19

a - ECE 2103, ECE 3130, ECE 3151, ECE 4800 / 4810
b.1 - ECE 3090, ECE 3151, ECE 4800/ 4810
b.2 - ECE 3090, ECE 3151, ECE 4800/ 4810
c - ECE 3132, ECE 4800/ 4810

3. Assessment Methods: Evaluation Process

What process was used to evaluate the student artifacts, and by whom? Please identify the tools(s) (e.g., a rubric) used in the process and include them in/with this report.

Each of the artifacts were first assessed by the instructor of the course. They were then independently assessed by another member of the program. The recommendations from these two assessments were discussed by the full program faculty and program improvements developed.

For details on assessment material, rubrics and process see attached document starting on page 3.

4. Data/Results

What were the results of the assessment of the learning outcomes? Please be specific. Does achievement differ by teaching modality (e.g., online vs. face-to-face) or on-ground location (e.g., STL campus, Madrid campus, other off-campus site)?

There is no difference in teaching modality as the majority of these classes only have one section.

For data see results pages – Starting on Page 20.

5. Findings: Interpretations & Conclusions

What have you learned from these results? What does the data tell you?

For findings see results pages – Staring on Page 20.

6. Closing the Loop: Dissemination and Use of Current Assessment Findings

A. When and how did your program faculty share and discuss these results and findings from this cycle of assessment?

In a meeting on May 22, the results of the assessment activities were discussed. The recommendations were used to determine actions.

To see the determined actions please see attached – Starting on Page 20

B. How specifically have you decided to use findings to improve teaching and learning in your program? For example, perhaps you've initiated one or more of the following:

Changes to the Curriculum or Pedagogies	• Course content • Teaching techniques • Improvements in technology • Prerequisites	• Course sequence • New courses • Deletion of courses • Changes in frequency or scheduling of course offerings
Changes to the Assessment Plan	• Student learning outcomes • Student artifacts collected • Evaluation process	• Evaluation tools (e.g., rubrics) • Data collection methods • Frequency of data collection

Please describe the actions you are taking as a result of the findings.

To see the determined actions please see attached – Starting on Page 20

If no changes are being made, please explain why.

7. Closing the Loop: Review of Previous Assessment Findings and Changes

A. What is at least one change your program has implemented in recent years as a result of assessment data?

In May 2019 a change was suggested and subsequently made to have the students better obtain outcome I - a recognition of the need for, and an ability to engage in life-long learning

(i-19) The assignments in 3151 and 3090 will be modified to help lead the students to produce better evidence, while giving them less specific instruction each time they are asked to perform this activity.

B. How has this change/have these changes been assessed?

This outcome will not be re-assessed until May 2022.

C. What were the findings of the assessment?

We have only been doing data based curriculum changes for around 2 years.

D. How do you plan to (continue to) use this information moving forward?

As we continue to execute our assessment plan we will continue to use the prescribed assignment for outcome I to gather data on the students' ability to engage in lifelong learning. The hope is that in May 2022 we will see improvement and continue to deliver the course with the implemented change, otherwise we will look at the evidence and see if there evidence this has helped at all and suggest further changes in this and other courses.

IMPORTANT: Please submit any assessment tools and/or revised/updated assessment plans along with this report.

(a) an ability to apply knowledge of mathematics, science, and engineering

Student Outcome (a) assessment indicators and descriptions.

Indicator	Course	Assessment Description
1. Ability to mathematically describe a system using scientific principles.	ECE2103	Find the frequency response of an RLC circuit.
	ECE3130	Develop an energy band diagram of a semiconductor and calculate the carrier concentration.
	ECE3151	Develop a mapping function from an autocorrelation function estimate to echo gain.
	ECE4800/ECE4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.
2. Ability to develop and analyze mathematical models for a system.	ECE2103	Find the Thevenin Equivalent of a circuit.
	ECE3130	Develop a mathematical model for a semiconductor device such as a diode or transistor.
	ECE3151	Develop the impulse response for a filter that eliminates echo in an acoustic signal.
	ECE4800/ECE4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.
3. Ability to synthesize components/systems using mathematics and engineering knowledge	ECE2103	Design an RLC circuit with a desired frequency response.
	ECE3151	Develop a software module that eliminates an echo from an acoustic signal.
	ECE4800/ECE4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.

This outcome refers to an ability to use the techniques, methods, and concepts of mathematics, science and engineering in order to achieve a goal. By "use" we mean the practical knowledge and ability to carry out appropriate calculations, such as mathematical, or to make appropriate deductions using concepts from science and/or engineering. The "goal" can refer to the simple calculation of a system parameter, formulating a system in a mathematical representation suitable for determining system characteristics, or to synthesize a system for the purpose of design. The 3 indicators chosen for this outcome are focused on the nature of the goal, but in all cases require the application of practical knowledge and require the ability to carry out appropriate calculations or make appropriate deductions using science or engineering principles.

Indicator #1: This indicator refers to the ability to put a system into a mathematical form that illuminates its characteristics.

- ECE2103: The frequency response of an RLC circuit is a mathematical description that indicates whether the circuit is acting as a bandpass filter, a bandreject filter, or a high-Q filter.
  Students will demonstrate an ability to calculate the frequency response of an RLC circuit and classify the filter characteristics as evidenced by laboratory reports.
- ECE3130: *Students will demonstrate the ability to present the energy band diagram of a semiconductor and calculate the position of the Fermi Energy Level given the impurity concentration level as evidenced by the final exam*.
- ECE3151: *Students will demonstrate an ability to develop a matlab function that extracts parameters from the autocorrelation function of an acoustic signal and use those parameters to estimate echo gain as evidenced by laboratory project reports*.
- ECE4800/ECE4810: *Students will demonstrate an ability to use mathematics or science/engineering principles to characterize a system as evidenced in the project notebooks, technical reports, or technical presentations*.

Indicator #2: This indicator refers to the ability to create a system model, which is an alternative form of the system that acts, to some degree, like the original system.

- ECE2103: *Students will demonstrate an ability to find the thevenin equivalent circuit as evidenced by laboratory reports. The Thevenin equivalent circuit is a simplified model that includes only one voltage source and one impedance/resistance. This circuit behaves the same as the one from which it is drawn*.
- ECE3130: *Students will demonstrate the ability to determine/develop the I-V Characteristics equation of semiconductor devices such as diodes and transistors as evidenced by the final exam*.
- ECE3151: *Students will demonstrate an ability to find and implement, via a matlab function, the impulse response of a system to remove an echo from an acoustic signal as evidenced by a Matlab computer program*.
- ECE4800/ECE4810: *Students will demonstrate an ability to use mathematics or science/engineering principles to create a system model as evidenced in the project notebooks, technical reports, or technical presentations*.

Indicator #3. This indicator refers to the ability to synthesize, i.e. create or specify or implement, components/subsystems using mathematics and engineering knowledge to create a larger whole.

- ECE2103: *Students will demonstrate an ability to design an RLC circuit in order to achieve a specific frequency response as evidenced by laboratory reports*.
- ECE3151: *Students will demonstrate an ability to develop a matlab function that eliminates an echo from an acoustic signal as evidenced by a Matlab computer program.* This requires that previous components be synthesized in order to create a complete working system in the form of a computer program.
- ECE4800/ECE4810: *Students will demonstrate an ability to synthesize, i.e. create or specify or implement, components/subsystems using mathematics or science/engineering principles to create a larger whole as evidenced in the project notebooks, technical reports, or technical presentations*.

The assessment rubrics are given in the following table

Assessment rubrics for Student Outcome (a).

	Rubric		
Ind	**1 = Does not meet Expectations**	**2 = Meets expectations**	**3 = Exceeds expectations**
ECE2103			
1	Either the frequency response function is not correct, or the filter type is stated incorrectly.	The frequency response function is correct and the filter type is stated correctly. The calculation is either missing or has insufficient details.	The frequency response function is correct, the calculation is shown in detail, and the filter type is stated correctly.
2	Either the thevenin model is incorrect or the model is correct but the component values are incorrect.	The thevenin model is correct and the component values are correct. The calculation details are either missing or are insufficient in details.	The thevenin model is correct, component values are correct, and calculation details are shown.
3	The RLC circuit values are incorrect for achieving a filter with the desired frequency response.	The RLC circuit values are correctly for achieving a filter with the desired frequency response. The calculations are either missing or insufficient.	The RLC circuit values are correct for achieving a filter with the desired frequency response. All calculations are present and correct.
ECE3130			
1	The energy band diagram is not correct or the labeling is insufficient.	The energy band diagram is correct and is properly labeled.	The energy band diagram is correct and is properly labeled. All calculations leading to the diagram are present and correct.
2	The I-V characteristic equations are incorrect.	The I-V characteristic equations are correctly stated. The calculations are not necessarily fully detailed.	The I-V characteristic equations are correctly stated and all calculations leading to the equations are present and sufficient detailed.

ECE3151			
1	Either the R[n]/R[0] measurement is incorrect, or the polynomial fit is either incorrect or seriously deficient in modeling the data.	The R[n]/R[0] measurement is correct, the plot of R[n]/R[0] versus alpha is correct, the number of plotted points may not be statistically relevant, and a reasonable polynomial has been fit to the data.	The R[n]/R[0] measurement is correct, the plot of R[n]/R[0] versus alpha is correct, the number of plotted points is statistically relevant, and a reasonable polynomial has been fit to the data.
2	Either the inverse filter form is incorrect or the echo gain and delay are not properly used.	The inverse filter form is correct and the echo gain and delay are used properly but the number of terms is between 2 and 3.	The inverse filter form is correct and the echo gain and delay are used properly and the number of terms is above 3 leading to an accurate system model.
3	The Matlab function does not properly combine the echo gain estimation from the autocorrelation function measures with the inverse filter function in order to remove the echo from an acoustic signal.	The Matlab function properly combines the echo gain estimation from the autocorrelation function measures with the inverse filter function in order to remove the echo from an acoustic signal. Either one or both the echo gain estimate and inverse filter are not well defined leading to a somewhat high mean square error between the echo-removed signal and the original acoustic signal.	The Matlab function properly combines the echo gain estimation from the autocorrelation function measures with the inverse filter function in order to remove the echo from an acoustic signal. Both the echo gain estimate and inverse filter are well defined leading to a low mean square error between the echo-removed signal and the original acoustic signal.
ECE4800/4810			
1	There is not sufficient evidence of any examples where mathematics and/or science/engineering principles have been applied to characterize a system.	There is evidence of one example where mathematics and/or science/engineering principles have been applied to characterize a system.	There is evidence of multiple examples where mathematics and/or science/engineering principles have been applied to characterize a system. If mathematics are used, then the system is expressed using appropriate equations along with appropriate values.
2	There is not sufficient evidence of any examples where a system has been modeled as it relates to an engineering design solution or implementation.	There is evidence of one example where a system has been modeled as it relates to an engineering design solution or implementation.	There is evidence of multiple examples where a system has been modeled as it relates to an engineering design solution or implementation.
3	There is not sufficient evidence of any examples where components and/or subsystems have been synthesized to create a larger whole.	There is evidence of one example where components and/or subsystems have been synthesized to create a larger whole.	There is evidence of multiple examples where components and/or subsystems have been synthesized to create a larger whole.

(b.1) an ability to design and conduct experiments

Student Outcome (b.1) assessment indicators and descriptions.

Indicator	Course	Assessment Description
1. Ability to develop a process, involving data collection and analysis, that leads to meaningful conclusions.	ECE3151	Develop a system to recognize the 5 vowel sounds across a group of students.
	ECE3090	Measure the internal resistance of a battery.
	ECE4800/ECE 4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.
2. Ability to set up an experiment using realistic and readily available components, tools, and test equipment.	ECE3151	Develop a system to recognize the 5 vowel sounds across a group of students.
	ECE3090	Measure the internal resistance of a battery.
	ECE4800/ECE 4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.
3. Ability to recognize the adequacy of collected data necessary to draw meaningful conclusions.	ECE3151	Develop a system to recognize the 5 vowel sounds across a group of students.
	ECE3090	Measure the internal resistance of a battery.
	ECE4800/ECE 4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.
4. Ability to find and correct errors in experiment setups and in experimental data.	ECE3151	Develop a system to recognize the 5 vowel sounds across a group of students.
	ECE3090	Measure the internal resistance of a battery.
	ECE4800/ECE 4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.

This outcome refers to an ability to design and conduct experiments with an appropriate goal. The word "ability" refers to, for example, identifying appropriate and readily available equipment, identifying appropriate range of component values, identifying a sequence of procedure steps to achieve a goal, identifying appropriate measurements, identifying appropriate data analysis calculations to achieve a meaningful goal, identifying sources of experimental error, etc.

In summary, it is all the characteristics of a laboratory experiment necessary to enable that experiment to be practically carried out in a suitable laboratory and to draw meaningful conclusions with confidence.

Indicator #1: This indicator refers to an ability to establish an experimental procedure, including identifying specific measurements to acquire, in order to draw meaningful conclusions.

- ECE3151: Student groups are required to acquire a set of training data of the long vowel sounds for each group member. That training data is to be analyzed in the frequency domain to identify unique spectral energy that allows each specific vowel sound to be uniquely identified among the 5 long vowel sounds and among the group members. The specific energy bands in the frequency domain represent the measurements to be acquired.

  Students will demonstrate an ability to develop a procedure for analyzing the 5 long vowel sounds across the group members in order to establish energy bands that are useful for discriminating the 5 vowel sounds as evidenced by a technical report.
- ECE3090: The battery experiment was first introduced into this course in Spring 2017. Therefore, the assessment is drawn from various project reports prior to Spring 2017 and is drawn specifically from the battery experiment on and after Spring 2017.

  Prior to S17: *Students will demonstrate an ability to establish an experimental procedure, including identifying specific measurements to acquire, in order to draw meaningful conclusions as evidenced by the laboratory reports, presentations, or project notebooks*.

S17 and after: Each student group is to establish a process by which the internal resistance of a battery is measured. This process includes establishing an appropriate circuit with appropriate measurements and analysis that leads to a meaningful estimate of the internal battery resistance. This process must include a recognition and specification of the battery test conditions such as battery charge (rechargeable batteries are used), the battery temperature, battery age, etc., that would affect the true value of the internal resistance.

Students will demonstrate an ability to establish an experimental procedure, including identifying specific measurements to acquire, in order to estimate the internal resistance of a battery as evidenced by the battery technical report or the experiment report.

- ECE4800/ECE4810: *Students will demonstrate an ability to establish an experimental procedure, including identifying specific measurements to acquire, in order to draw meaningful conclusions as evidenced in the project notebooks, technical reports, or technical presentations*.

Indicator #2: This indicator refers to an ability to recognize readily available equipment and components, in the ECE facilities, that would allow an experiment to be practically carried out. This indicator also refers to an ability to use that equipment and components to set up an experiment.

- ECE3151: For the long vowel sound experiment, students are provided a set of software functions, provided by the instructor, that are useful for analyzing the long vowel sound data. They also have available a series of software tools in matlab that can be used. *Students will demonstrate an ability to use matlab software functions in order to analyze the vowel sound data as evidenced by a technical report*.
- ECE3090:

  Prior to S17: *Students will demonstrate an ability to recognize readily available equipment and components, in college laboratories, that would allow an experiment to be practically carried out as evidenced by the laboratory reports, presentations, or project notebooks*.

  S17 and after: For the internal battery resistance measurement, students need to identify and be able to use standard laboratory equipment and components that are available in our department. *Students will demonstrate an ability to establish an experimental procedure that uses readily available equipment and components in college laboratories as evidenced by the battery technical report or the experiment report*.
- ECE4800/ECE4810: *Students will demonstrate an ability to recognize and use readily available equipment and components, in college laboratories, that are used to set up and carry out an experiment as evidenced in the project notebooks, technical reports, or technical presentations*.

Indicator #3: This indicator refers to an ability to recognize whether the set of acquired measurements are adequate for drawing meaningful conclusions. By "adequate" we mean that the type and quantity of collected data is sufficient for drawing meaningful conclusions with confidence.

- ECE3151: For the long vowel sound experiment, each student group needs to determine whether the vowel sounds recorded are sufficient for developing a useful decision tree. *Students will demonstrate an ability to recognize whether the set of vowel sounds acquired is sufficient for developing a useful decision tree as evidenced by a technical report*.
- ECE3090:

  Prior to S17: *Students will demonstrate an ability to recognize whether the set of acquired measurements are adequate for drawing meaningful conclusions as evidenced by the laboratory reports, presentations, or project notebooks*.

  S17 and after: For the internal battery resistance measurement, students need to determine whether the collected data is sufficient for providing reasonable statistical bounds on the true internal battery resistance. This requires some assessment of how much data to collect. *Students will demonstrate an ability to determine the adequacy of the battery resistance measurements for the purpose of drawing meaningful conclusions with confidence as evidenced by the battery technical report or the experiment report*.
- ECE4800/ECE4810: *Students will demonstrate an ability to recognize whether a set of acquired measurements are adequate for drawing meaningful conclusions with confidence as evidenced in the project notebooks, technical reports, or technical presentations*.

Indicator #4: This indicator refers to an ability to find errors in experimental setups and experimental data. Errors in experimental setups can include things such as improper use of a voltmeter, incorrect setting in a DMM, and improper grounding when an oscilloscope and power supply are used in the same circuit. Errors in data can include things such as corruption, undesirable artifacts, distortion, or simply mis-recorded measurements.

- ECE3151: For the long vowel sound experiment, each student group needs to determine which vowel sounds in the training data are free from undesirable artifacts such as early/late sound truncation, signal saturation, significant signal attenuation into the noise floor, or significant background sounds occurring during vowel sound recording as evidenced by a technical report.

  Students will demonstrate an ability to recognize the adequacy of recorded vowel sounds as evidenced by a technical report.
- ECE3090:

  Prior to S17: *Students will demonstrate an ability to find errors in experimental setups and experimental data as evidenced by reports, presentations, or project notebooks*.

  S17 and after: For the internal battery resistance measurement, students need to determine whether the collected data is sufficient for providing reasonable statistical bounds on the true internal battery resistance. This requires assess how much data needs to be collected. *Students will demonstrate an ability to determine the adequacy of battery resistance measurements for the purpose of drawing meaningful conclusions as evidenced by the battery technical report or the experiment write-up*.
- ECE4800/ECE4810: *Students will demonstrate an ability to find errors in experimental setups and experimental data as evidenced in the project notebooks, technical reports, or technical presentations*.

The assessment rubrics are given in the following table

Assessment rubrics for Student Outcome (b.1).

	Rubric		
Ind	**1 = Does not meet Expectations**	**2 = Meets expectations**	**3 = Exceeds expectations**
ECE3151			
1	There is little evidence that unique energy bands are defined resulting from an experimental procedure or that the procedure that was followed did not result in a effective decision tree to classify the 5 long vowel sounds with a degree of reasonable accuracy.	There is evidence that unique energy bands are defined resulting from an experimental procedure that lead to a decision tree for classifying the 5 long vowel sounds across a group of students. The experimental procedure is not well defined or well articulated to the point where another group could follow the same procedure.	There is evidence that unique energy bands are defined resulting from an experimental procedure that lead to a decision tree for classifying the 5 long vowel sounds across a group of students. The experimental procedure is well defined and well articulated to the point where another group could follow the same procedure.
2	There is no evidence that instructor-provided software tools were used for analyzing the long vowel sound acoustic signals.	There is evidence that instructor-provided software tools were used for analyzing the long vowel sound acoustic signals. That evidence mainly involves general statements of usage without clearly articulating how they were used or not illustrating data generated from those tools.	There is evidence that instructor-provided software tools were used for analyzing the long vowel sounds acoustic signals. Furthermore, usage of those functions is clearly articulated with appropriate data illustrating how they were used.
3	There is no meaningful evidence that the collective set of long vowel sounds (25 sounds/long vowel/student) has been assessed to determine whether it is sufficient for developing a reliable classifier tree.	There is evidence that the collective set of long vowel sounds (25 sounds/long vowel/student) has been assessed to determine whether it is sufficient for developing a reliable classifier tree. This assessment is a general statement without references to specific data illustrations.	There is evidence that the collective set of long vowel sounds (25 sounds/long vowel/student) has been assessed to determine whether it is sufficient for developing a reliable classifier tree. This assessment is specific to each vowel sound and is articulated with appropriate data illustrations.

4	There is no evidence that each vowel sound has been assessed to determine if it contains experimental errors such as early/late sound truncation, etc.	There is evidence that each vowel sound has been assessed to determine if it contains experimental errors such as early/late sound truncation, etc. This assessment is a general statement without reference to specific data illustrations or without reference appropriate quantitative measurements.	There is evidence that each vowel sound has been assessed to determine if it contains experimental errors such as early/late sound truncation, etc. This assessment is specific to each vowel sound and examples are articulated with appropriate data illustrations or with appropriate quantitative measurements.
ECE3090			
1	The experimental procedure is not sufficiently defined to be repeatable by several people working independently.	The experimental procedure is sufficiently detailed with step-by-step instructions and with appropriate setup illustrations so as to be unambiguous and repeatable. Measurements to be taken may not be fully defined by a blank data table.	The experimental procedure is sufficiently detailed with step-by-step instructions, with appropriate setup illustrations, and with detailed blank data tables so as to be unambiguous and repeatable.
2	The experimental procedure requires the use of components and equipment that are not readily available in college laboratories or the components/equipment usage does not satisfy safety requirements. This might include, for example, requiring that the power rating of a resistor be exceeded.	The experimental procedure requires the use of components and equipment that are readily available in college laboratories with the possible exception of a few special-purpose resistors. The required usage of the components and equipment satisfies all safety requirements but without reasonable operational margins.	The experimental procedure requires the use of components and equipment that are readily available in college laboratories with the possible exception of a few special-purpose resistors. The required usage of the components and equipment satisfies all safety requirements and with reasonable operational margins.
3	There is no evidence that the data collected has been assessed to determine whether it is sufficient for estimating the internal resistance of a battery.	There is evidence that the data collected has been assessed to determine whether it is sufficient for estimating the internal resistance of a battery. This assessment is a simple statement and is not supported with appropriate data illustrations nor numeric measures.	There is evidence that the data collected has been assessed to determine whether it is sufficient for estimating the internal resistance of a battery. This assessment is supported with appropriate data illustrations or numeric measures.
4	There is no evidence that errors in experimental setups or experimental data, if they occur, have been identified. If the experimental data does not contain errors, there is not statement to that effect.	There is evidence that errors in experimental setups or experimental data, if they occur, have been identified. If the experimental data does not contain errors, then a statement to that effect is present. The determination as to whether errors occur or not is simply stated and not supported by appropriate illustrations or numeric measures.	There is evidence that errors in experimental setups or experimental data, if they occur, have been identified. If the experimental data does not contain errors, then a statement to that effect is present. The determination as to whether errors occur or not is supported by appropriate illustrations or numeric measures.
ECE4800/4810			
1	There is insufficient evidence where an experimental procedure has been established for the	There is evidence where an experimental procedure has been established for the purpose of	There is evidence where an experimental procedure has been established for the purpose of

	purpose of drawing meaningful conclusions as part of carrying out an engineering design.	drawing meaningful conclusions as part of carrying out an engineering design. This procedure is not fully defined.	drawing meaningful conclusions as part of carrying out an engineering design. This procedure is completely defined, unambiguous, and repeatable.
2	There is no evidence of components and equipment being identified for use in carrying out an experimental procedure.	There is evidence where readily available components and equipment have been identified for use in carrying out an experimental procedure. Usage of these components/equipment is not very specific nor detailed.	There is evidence where readily available components and equipment have been identified for use in carrying out an experimental procedure. Usage of these components/equipment is specific and detailed.
3	There is no evidence where measured data has been assessed to determine if it is suitable for drawing meaningful conclusions.	There is evidence where a set of measured data has been assessed to determine if it is suitable for drawing meaningful conclusions related to an engineering design. This assessment is a simple statement and is not supported with appropriate data illustrations or numeric measures.	There is evidence where a set of measured data has been assessed to determine if it is suitable for drawing meaningful conclusions related to an engineering design. This assessment is supported with appropriate data illustrations or numeric measures.
4	There is insufficient evidence where errors in experimental setups or measured data have been considered and addressed.	There is evidence where errors in experimental setups have been identified or where errors in measured data have been identified if they occur. If they do not occur, there is a statement stating this and illustrations or numeric measures given to support this conclusion.	There is evidence where errors in experimental setups have been identified or where errors in measured data have been identified if they occur. If they do not occur, there is a statement stating this and illustrations or numeric measures given to support this conclusion.

(b.2) an ability to analyze and interpret data

Student Outcome (b.2) assessment indicators and descriptions.

Indicator	Course	Assessment Description
1. Ability to recognize the precision of measured data.	ECE3151	Assess the precision of vowel sound metrics for the purpose of developing a vowel sound decision tree.
	ECE3090	Assess the precision of measured data for estimating the internal resistance of a battery.
	ECE4800/ECE4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.
2. Ability to recognize the relevancy of measured data.	ECE3151	Assess the relevancy of vowel sound metrics for the purpose of developing a vowel sound decision tree.
	ECE3090	Assess the relevancy of measured data for estimating the internal resistance of a battery.
	ECE4800/ECE4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.
3. Ability to observe data trends or data features for the purpose of modeling, prediction, or drawing conclusions.	ECE3151	Observe data features of vowel sound metrics for the purpose of developing a vowel sound decision tree.
	ECE3090	Measure the internal resistance of a battery laboratory report.
	ECE4800/ECE4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.

This outcome refers to an ability to analyze and interpret data where the data is either provided or comes from an experiment involving data collection. The word "ability" refers to, for example, plotting data and observing trends or analyzing the plot to measure system parameters such as line slope, maximum value, zero-crossings, etc. It can also mean determining statistical measures associated with collected data to assess measurement precision and/or to determine the relevancy of collected data for drawing meaningful conclusions. The word "relevant" refers to whether the type of data collected is suitable for drawing the intended conclusions.

In summary, it is all the necessary analysis and interpretation of data necessary to draw meaningful conclusions.

Indicator #1: This indicator refers to the ability to recognize the precision of the measured data.

- ECE3151: Each student group is required to convert each vowel sound track into a metric vector. As part of the development of the classification decision tree, the metrics are plotted which provides a setting to qualitatively assess the precision of each vowel sound metric for the purpose of creating a reliable classifier. *Students will demonstrate an ability to assess the precision of the various metrics in order to determine which are most suitable for developing a reliable classifier tree as evidenced by a technical report*.
- ECE3090:

  Prior to S17: *Students will demonstrate an ability to recognize the precision of measured data as evidenced by the laboratory reports, presentations, or project notebooks*.

  S17 and after: *For the internal battery resistance measurement project, students will demonstrate an ability to determine the precision of measured data in order to determine whether meaningful conclusions can be drawn as evidenced by the battery technical report or the experiment report*.
- ECE4800/ECE4810: *Students will demonstrate an ability to recognize the precision of the measured data as evidenced in the project notebooks, technical reports, or technical presentations*.

Indicator #2: This indicator refers to the ability to recognize which measurements do not relate to the intended solution or measurement of interest and should be discarded.

- ECE3151: Each student group will need to sift through the vowel metric vectors in order to recognize which metrics are relevant for creating a reliable classifier tree. Some metric vector components do not provide adequate discrimination of vowels and therefore are not relevant to creating a reliable classifier tree while, generally speaking, others will be relevant. *Students will demonstrate an ability to recognize which metric components are relevant for creating a reliable classifier tree as evidenced by a technical report*.
- ECE3090:

  Prior to S17: *Students will demonstrate an ability to recognize which measurements do not relate to the intended solution or measurement of interest and should be discarded as evidenced by the laboratory reports, presentations, or project notebooks*.

  S17 and after: *For the internal battery resistance measurement project, students will demonstrate an ability to determine the relevancy of the collected data in order to determine which measurements can lead to meaningful conclusions as evidenced by the battery technical report or the experiment report*.
- ECE4800/ECE4810: *Students will demonstrate an ability to recognize the relevancy of measured data as evidenced in the project notebooks, technical reports, or technical presentations*.

Indicator #3: This indicator refers to the ability to observe data trends or data features for the purpose of modeling, prediction, or drawing conclusions.

- ECE3151: Each student group will need to sift through the vowel acoustic spectral data in order to observe trends that lead to determining which metric components are worth considering for developing the classifier tree. *Students will demonstrate an ability to observe trends in either the spectral energy of their vowel sounds or the metric vectors for the purpose of developing a reliable classifier tree as evidenced by a technical report*.
- ECE3090:

  Prior to S17: *Students will demonstrate an ability to observe data trends or data features for the purpose of modeling, prediction, or drawing conclusions as evidenced by the laboratory reports, presentations, or project notebooks*.

  S17 and after: For the internal battery resistance measurement experiment, each student group needs to look at their measurement data to observe trends such as a change in resistance as the battery gets hot (changes temperature) or perhaps to observe the change in resistance over time for the same test. *Students will demonstrate an ability to observe trends or data features in their internal battery resistance measurement experiment as evidenced by the battery technical report or the experiment report*.
- ECE4800/ECE4810: *Students will demonstrate an ability to observe data trends as evidenced in the project notebooks, technical reports, or technical presentations*.

The assessment rubrics are given in the following table

Assessment rubrics for Student Outcome (b.2).

	Rubric		
Ind	**1 = Does not meet Expectations**	**2 = Meets expectations**	**3 = Exceeds expectations**
ECE3151			
1	There is little or no evidence that metric pairs have been inspected and the precision of the various vowel sounds have been recognized and considered for the purpose of creating a good decision tree.	There is evidence that one or two metric pairs have been inspected and the precision of the various vowel sounds in the metric space have been recognized and considered as part of the metric selection process for the purpose of creating a reliable decision tree.	There is evidence that many metric pairs have been inspected and the precision of the various vowel sounds in the metric space have been recognized and considered as part of the metric selection process for the purpose of creating a reliable decision tree.
2	There is little or no evidence that any of the metric pairs have been assessed and discarded as unsuitable for creating a reliable decision tree are discarded.	There is evidence that some of the metric pairs have been assessed and those deemed unsuitable for creating a reliable decision tree are discarded.	There is evidence that most or all of the metric pairs have been assessed and those deemed unsuitable for creating a reliable decision tree are discarded.

3	There is no evidence that any data trends have been observed in either the spectral energy distributions or the metric vectors for the purpose of simplifying the process of creating a reliable decision tree.	There is evidence that one data trend has been observed in either the spectral energy distributions or the metric vectors for the purpose of simplifying the process of creating a reliable decision tree.	There is evidence that several data trends have been observed in either the spectral energy distributions or the metric vectors for the purpose of simplifying the process of creating a reliable decision tree.
ECE3090			
1	There is no evidence that the experiment results have been numerically nor qualitatively assessed to determine the precision of resistance measurements for the purpose of drawing meaningful conclusions.	There is evidence that the experiment results have been qualitatively assessed to determine the precision of resistance measurements for the purpose of drawing meaningful conclusions.	There is evidence that the experiment results have been numerically assessed to determine the precision of resistance measurements for the purpose of drawing meaningful conclusions.
2	There is no evidence that experiment results have been assessed to determine which, if any, of the measurements should be discarded.	There is evidence that experiment results have been qualitatively assessed to determine which, if any, of the measurements should be discarded.	There is evidence that experiment results have been numerically assessed to determine which, if any, of the measurements should be discarded. If there are none to discard, this is stated and justified using appropriate illustrations or numeric results.
3	There is no evidence that data trends have been observed.	There is evidence that data trends have been observed by qualitative statements.	There is evidence that data trends have been observed and clearly described using illustrations or numerical measures.
ECE4800/4810			
1	There is no evidence that the precision of experimental data has been recognized and assessed for the purpose of drawing meaningful conclusions.	There is evidence that the precision of experimental data has been recognized and assessed for the purpose of drawing meaningful conclusions. The assessment is described by a simple statement with little or no justification evident.	There is evidence that the precision of experimental data has been recognized and assessed for the purpose of drawing meaningful conclusions. The assessment is clearly described using illustrations or numeric measures.
2	There is no evidence that experiment results have been assessed to determine which, if any, of the measurements should be discarded.	There is evidence that experiment results have been qualitatively assessed to determine which, if any, of the measurements should be discarded.	There is evidence that experiment results have been numerically assessed to determine which, if any, of the measurements should be discarded. If there are none to discard, this is stated and justified using appropriate illustrations or numeric results.
3	There is no evidence that data trends have been observed.	There is evidence that data trends have been observed by qualitative statements.	There is evidence that data trends have been observed and clearly described using illustrations or numerical measures.

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, etc.

Student Outcome (c) assessment indicators and descriptions.

Indicator	Course	Assessment Description
1. Awareness of and an ability to discern the importance of realistic constraints for a particular design or design component.	ECE3132	The practical limitations, such as gain and bandwidth, of semiconductor devices.
	ECE4800/ECE4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.
2. Ability to translate practical quantitative constraints to appropriate design constraints.	ECE3132	Develop design constraints consistent with the physical limitations of semiconductors for an amplifier design.
	ECE4800/ECE4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.
3. Ability to implement a design and verify that it meets the constraints.	ECE3132	Implement the design of an amplifier and demonstrate that it meets the constraints.
	ECE4800/ECE4810	Exhibit through technical details found in the Project Notebook, technical reports, or technical presentations.

This outcome refers to an ability to consider practical and realistic constraints for the purpose of engineering design. The word "realistic" refers to practical constraints that either lead to a realizable solution or lead to long-term market viability of the resulting design product such as cost, health and safety, sustainability, etc. These constraints might lie outside the typical performance constraints established by a client and may need to be established by the design team internally.

Indicator #1: This indicator refers to an awareness of practical and realistic constraints and an ability to discern which are applicable for a particular design.

- ECE3132: *Students will demonstrate an awareness of and ability to discern the practical limitations, such as gain and bandwidth, of semiconductor devices as evidenced in an experiment report*.
- ECE4800/ECE4810: *Students will demonstrate an awareness of practical and realistic constraints and an ability to discern which are applicable for a particular design as evidenced in the project notebooks, the PDR/CDR/FDR technical reports, or technical presentations*.

Indicator #2: This indicator refers to an ability to assess practical constraints and put them in a quantitative form that directly relates to the technical aspects of the design solution. For example, the constraint that the design must be "safe" would need to be converted into quantitative technical aspects of the design solution which might include constraints such as maximum battery voltage, maximum robot speed, etc. All design constraints ultimately need to be put into a technical/quantitative form so that engineering design decisions can be made.

- ECE3132: *Students will demonstrate an ability to consider the practical limitations of semiconductor devices in order to develop a realizable design solution as evidenced in an experiment report*.
- ECE4800/ECE4810: *Students will demonstrate an ability to assess practical constraints and put them in a quantitative form that directly relates to the technical aspects of the design solution as evidenced in the project notebooks, the PDR/CDR/FDR technical reports, or technical presentations*.

Indicator #3: This indicator refers to an ability to develop and carry out testing procedures in order to verify that the design meets the required constraints. These testing procedures require, to some degree of formality, the development of an experiment that is carried out in order to draw an appropriate conclusion about constraint performance.

- ECE3132: *Students will demonstrate an ability to design an amplifier with given constraints and then carry out an experiment to test whether the amplifier constraints are met as evidenced by an experiment report*.

- ECE4800/ECE4810: *Students will demonstrate an ability to develop and carry out testing procedures in order to verify that the design meets the required constraints as evidenced in the project notebooks, the PDR/CDR/FDR technical reports, or technical presentations*.

The assessment rubrics are given in the following table

Assessment rubrics for Student Outcome (c).

	Rubric		
Ind	**1 = Does not meet Expectations**	**2 = Meets expectations**	**3 = Exceeds expectations**
ECE3132			
1	There is no evidence that any practical and realistic limitations of a semiconductor device have discerned to be applicable to the design of a semiconductor device.	There is evidence that one practical and realistic limitation of a semiconductor device has been discerned to be applicable to the design of a semiconductor device.	There is evidence that multiple practical and realistic limitations of a semiconductor device have discerned to be applicable to the design of a semiconductor device.
2	There is no evidence that any practical and realistic limitations of a semiconductor device have been quantified for the purpose of carrying out the design of a semiconductor device.	There is evidence that one practical and realistic limitation of a semiconductor device has been quantified for the purpose of carrying out the design of a semiconductor device.	There is evidence that multiple practical and realistic limitations of a semiconductor device have been quantified for the purpose of carrying out the design of a semiconductor device.
3	There is no evidence that any practical and realistic limitations of a semiconductor device have been applied to the design of a semiconductor device.	There is evidence that one practical and realistic limitation of a semiconductor device has been applied to the design of a semiconductor device.	There is evidence that multiple practical and realistic limitations of a semiconductor device have been applied to the design of a semiconductor device.
ECE4800/4810			
1	There is no evidence that any practical and realistic constraints have been identified as being applicable to a particular design component.	There is evidence that one practical and realistic constraint has been identified as being applicable to a particular design component.	There is evidence that multiple practical and realistic constraints have been identified as being applicable to a particular design component.
2	There is no evidence that any practical and realistic constraints have been quantified as they relate to a particular design component.	There is evidence that one practical and realistic constraint has been quantified as they relate to a particular design component.	There is evidence that multiple practical and realistic constraints have been quantified as they relate to a particular design component.
3	There is no evidence that any practical and realistic constraints have been applied to the solution of a particular design component.	There is evidence that one practical and realistic constraint has been applied to the solution of a particular design component.	There is evidence that multiple practical and realistic constraints have been applied to the solution of a particular design component.

(d) an ability to function on multidisciplinary teams

Student Outcome (d) assessment indicators and descriptions.

Indicator	Course	Assessment Description
1. Ability to perform individual tasks in a timely manner with respect to the team-developed timelines.	ECE3090	Exhibit through details found in the Project Notebook.
	ECE4800/ECE4810	Exhibit through details found in the Project Notebook.
2. Ability to share and fully articulate important and interrelated information with other team members to further a design solution.	ECE3090	Exhibit through details found in the Project Notebook.
	ECE4800/ECE4810	Exhibit through details found in the Project Notebook.
3. Ability to effectively participate in team meetings.	ECE3090	Exhibit through details found in the Project Notebook.
	ECE4800/ECE4810	Exhibit through details found in the Project Notebook.
4. Ability to document work in a timely manner and in sufficient detail to speed development.	ECE3090	Exhibit through details found in the Project Notebook.
	ECE4800/ECE4810	Exhibit through details found in the Project Notebook.

This outcome refers to an ability for a student to be an effective team member. The word "effective" refers to an ability to carry out independent work in a timely manner, to coordinate with other team members in team meetings and otherwise as needed, to properly document work such as computer code, and by maintaining a legally defensible project notebook, etc.

Both ECE3090 Junior Design and ECE4810 Senior Design II require that students maintain a legally defensible project notebook. The notebook is to contain notes related to individual design work and also contain properly documented team meetings.

Indicator #1: This refers to an ability to carry out tasks independently and in a timely manner. This should be evident in the project notebook by the relationship between action items identified at each team meeting and the documented work between team meetings.

- ECE3090 & ECE4800/4810: *Students will demonstrate an ability to carry out tasks independently and in a timely manner as evidenced in the project notebooks*.

Indicator #2: This refers to an ability to share appropriate and interrelated information between team members in order to further the overall team design. This should be evident in the project notebook through documented team meetings and perhaps through documented work between team meetings.

- ECE3090 & ECE4800/4810: *Students will demonstrate an ability to share appropriate and interrelated information between team members in order to further the overall team design as evidenced in the project notebooks*.

Indicator #3: This refers to an ability to properly articulate in a team meeting work accomplished since the last meeting, an ability to engage in a team conversation about the design leading to design decisions, and an ability to articulate action items to be performed by the next meeting. Articulation of work accomplished as well as action items should be as specific as possible and quantitative as appropriate. For example, to write that "I'm working on motors" is not an appropriate action item because it is not a quantitative statement that describes, for example, the required electrical characteristics of the motors.

- ECE3090 & ECE4800/4810: *Students will demonstrate an ability to properly articulate in a team meeting work accomplished since the last meeting, an ability to engage in a team conversation about the design leading to design decisions, and an ability to articulate action items to be performed by the next meeting as evidenced in the project notebooks*.

Indicator #4: This refers to the ability to document work as it is being performed and to demonstrate that the documented work is useful for speeding development. This should be evident in the project notebook with numbered pages, initialed and dated pages, and by evidence that the notebook is being filled out sequentially over time.

- ECE3090 & ECE4800/4810: *Students will demonstrate an ability to document work as it is being performed and to demonstrate that the documented work is useful for speeding development as evidenced in the project notebooks*.

The assessment rubrics are given in the following table

Assessment rubrics for Student Outcome (d).

	Rubric		
Ind	**1 = Does not meet Expectations**	**2 = Meets expectations**	**3 = Exceeds expectations**
ECE3090 & ECE4800/4810			
1	There is evidence that none or few identified or general tasks have been carried out in a timely manner, typically within one or two weeks of being identified.	There is evidence that some identified or general tasks have been carried out in a timely manner, typically within one or two weeks of being identified.	There is evidence that most identified or general tasks have been carried out in a timely manner, typically within one or two weeks of being identified.
2	There is little or no evidence that interrelated information is shared with other team members.	There is evidence that some interrelated information is qualitatively shared with appropriate team members, but not necessarily in a timely manner.	There is evidence that most interrelated information is quantitatively shared with appropriate team members and in a timely manner.
3	There is little or no evidence that action item progress has been reported in team meetings nor that action items, to be performed by the next meeting, have been established.	There is evidence that, for a few meetings, action item progress has been qualitatively reported in team meetings in a timely manner and that qualitative action items, to be performed by the next meeting, are established.	There is evidence that, for most meetings, action item progress has been quantitatively reported in team meetings in a timely manner and that quantitative action items, to be performed by the next meeting, are established.
4	There is little or no evidence that, between most meetings, work has been documented.	There is evidence that, between a few meetings, work has been appropriately and qualitatively documented in a legally defensible notebook.	There is evidence that, between most meetings, work has been appropriately and quantitatively documented in a legally defensible notebook.

Assessment for Student Outcome (a).

	Assessments		
Ind	**Value**	**Observation**	**Recommendations**
ECE 2103			
1	2, 1, 3	1. The frequency response values are accurate, but the equations are not documented completely. 2. There are errors in the equations and the frequency response values. --- The frequency response function is correct, the calculation is shown in detail, and the filter type is stated correctly.	1, 2. Students will be asked to redo few reports at the beginning of the semester to realize the importance of accurate and complete documentations. Necessary modifications for the Indicator#1: 1. "Classify the filter characteristics" needs to be eliminated. 2. The rubric table 4.2 needs to be modified.Stating of the filter type needs to be eliminated. --- None
2	3, 2, 2	2. Only the Rthequation was included, the equations for Eth and IN are missing. The values are accurate. --- The thevenin model is correct and the component values are correct. The calculation details are either missing or are insufficient in details.	--- None
3	3, 3, 3	1. The accurate equations are provided, the numerical calculations are not provided. The design is accurate. --- The RLC circuit values are correct for achieving a filter with the desired frequency response.	Only two students emailed their graded reports. Due to social distancing, it was not possible to collect the students' portfolios at the end of the semester. --- Include multisim simulation along with simulation obtained from the actual experiment in the lab report guidance. Also guidance for students to include detail derivations of various formulas used
ECE 3130			
1		Not Evaluated Due To Covid	
2		Not Evaluated Due To Covid	
3	Not Used		
ECE 3151			
1	3, 2, 1	grp1: There are a sufficient number of points used grp2: The number of data points appears marginal although the mapping looks fine grp3: The number of data points used is seriously deficient, although the mapping is not too bad. --- Two out of three groups were on track but not 3rd group They seem to have sufficient data points.	The grading program thresholds should be adjusted so that small deviations in the curve of best fit affects the grading result. --- Students need to know apriori what and how data points affect the ratio. Suggest altering prelab info.

2	3, 2, 3	In 2 cases, the alpha and tau parameters were estimated correctly and properly used in the inverse filter. In one case, the tau parameter was incorrectly calculated. ---------- All groups do not have clear understanding of correlation between tau and the echo cancellation quality. All three groups have widely differing data points/graphs.	For the one group that used an incorrect tau value, the grading program did not provide sufficient motivation for them to check their work. This needs to be adjusted. ---------- Need more info to students to overcome lack of understanding
3	3, 3, 3	In all 3 cases the inverse filter was taken out to a sufficient number of terms and the convolution operation was properly used to eliminate the acoustic echo. ---------- Two groups seem to have right number of operations	None ---------- None. Adjust inconsistency of report writing
ECE 4800 / 4810			
1	1, 1, 1	In general, most of the mathematical derivations and simulations are carried. You may find most experimental work and results are presented in FDR appendix. ---------- Models and reasons are sufficiently used on analyzing and modelling the system	Close consideration may be needed for the next year's design. Need access to logbooks and As a feedback, modify FDR (in consultation with Dr. Bledsoe) Table of content to include More of mathematical and scientific work. ---------- None
2	1, 3, 2	FDR is used. More detail may be found in logbooks. Most results are presented in FDR appendix. ---------- Ability to develop and analyze mathematical models for a system. All three projects did not have suitable or insufficient Need for mathematical modeling	Need access to logbooks for more evidence of Workcarried out. ---------- Suggest choose projects fit the criteria. I did not see much of this skill in the reports to evaluate.
3	1, 2, 2	FDR and logbooks should be used. Only FDR was used to assess this outcome. Typically, detailed work may be found in FDR appendix. ---------- Sufficient skills in synthetical analysis were used	This assessment cycle did not have access to Logbooks, hence may not be an accurate reflection Of work performed. ---------- None

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Improvements for Student Outcome (a).

Improvement
From 2103 Refactor the indicators to remove the filter type requirement
From 2103 Work on developing a program wide lab report format
From 2103 Have students rework reports until they have met a certain format minimum
From 3151 Rework the assignment to reflect this is an introduction to statistical data fitting.

From 4800 Discuss what belongs in an FDR, should these contain mathematical derivations and model development
From 4800 Should the FDR discuss how components were designed, how these were integrated and how the whole product came together

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Assessment for Student Outcome (b.1).

	Assessments		
Ind	**Value**	**Observation**	**Recommendations**
ECE 3151			
1	2, 2, 2	Each group provided some sort of description of the experimental procedure they followed but it was not clear enough to be carried out by the reader.	The language in the requirements could be made more specific to articulate the procedure including how the specific frequency bands were chosen.
2	2, 3, 2	All groups put in either plots generated from instructor- provided software or specified what functions were used. This was clearly articulated in the requirements.	None
3	3, 3, 3	All groups performed an assessment, showed results in the form of confusion matrices, and explained why certain vowels did not classify well.	None
4	NA	None of the groups went back and reassessed their collected data once they had completed their classifier assessment with the confusion matrix.	This needs to be addressed. The requirements don't explicitly require that time-domain data be post-analyzed to see why a particular vowel didn't classify correctly, but this would seem to be natural. It is recommended that this be a specific requirement of the report.
ECE 3090			
1	2, 1, 3	assessed the experiment procedures	I recommend that the procedure written by one group is conducted by a different group. All of these should be done on the same day and at the same time. This amounts to peer-group assessment.
2	1, 3, 2	assessed the experiment procedure. For group 2 also used experiment report	See Above
3	1, 3, 2	assessed the experiment report	None
4	1, 3, 3	assessed the experiment report	None
ECE 4800 / 4810			
1	3, 3, 3	Relevant data may be found in FDR Appendix as part of results. No access to logbooks to observe more details presented.	No further action is required. Logbook may have been an additional Evidence to use for this indicator
2	1, 3, 3	Relevant data may be found in FDR Appendix as part of results. No access to logbooks to observe more details presented.	May require more detail presented on Technical reports and logbooks. No access to Logbook that may have been an additional resource to use for this indicator

3	1, 3, 3	Relevant data may be found in FDR Appendix as part of results. No access to logbooks to observe more details presented.	Place more emphasis on data collection And recording to draw meaningful conclusion Logbook may have been an additional Evidence to use for this indicator
4	1, 2, 2	Used FDR for finding evidence for this outcome. Logbooks would have presented more evidence to assess students' abilities.	More emphasis on data collection and Iterative process to correct experimental setups To minimize errors in data. Logbooks may have been a better Evidence to use for this indicator.

Improvements for Student Outcome (b.1).

Improvement
From 3151 Have the report requirement specify where certain ABET material is to be placed.
From 3151 Only give the students 2 frequency bands, then have the report contain a section discussing how the frequency bands were chosen
From 3151 Have the report contain a section that discusses how the students did post analysis. The students should critique their results, study what can be improved, improve this and critique again, specifically around which vowels did not classify correctly.
From 3090 Have one group run the experiment as designed by a second group
From 3090 Shorten Junior design to only have one experiment, but have this iterated until all aspects are complete and understood.
From 3090 Have one group assess the work of another group
From 4800 Again discuss what belongs in the FDR, we would like to assess B.1 in the FDR, make sure the format allows this.
From 4800 Emphasis that design is a series of small experiments. These experiments should be documented separately. Some of these should collect data that informs the redesign of the experiment in an iterative process.

Assessment for Student Outcome (b.2).

	Assessments		
Ind	**Value**	**Observation**	**Recommendations**
ECE 3151			
1	2, 3, 1	The data plots illustrate that the groups understood, for the most part, how to assess precision, or tight clustering.	I don't think this particular indicator is appropriate for this laboratory exercise. I think it should be removed from this assessment outcome.
2	2, 3, 1	The plots illustrate that the groups understood, for the most part, how to assess the relevancy of the data for separating out specific vowels or vowel groups. One group had a very inefficient solution.	I recommend that groups are required to find an efficient solution and justify how they know it is efficient. One group clearly did not have a useful plan for developing their classifier.
3	2, 3, 1	The data plots and the comparison solution results demonstrate that the groups were able to observe data trends to create a reliable decision tree. One group did not analyze their data well.	It is hard to distinguish these three indicators for this outcome. I feel these should be combined and generalized to one indicator. I also think I should require the student groups to answer questions that directly relate to these outcomes
ECE 3090			

1	2, 3, 3	None	None
2	1, 3, 3	None	I recommend that the report require each group to comment on their assessment as to whether data points should be discarded and explain why.
3	1, 3, 3	None	None
ECE 4800 / 4810			
1	2, 2, 2	Students have considered experimental results accuracy. Results are presented in FDR appendix.	Need to clarify the indicator's language to make more sense to all readers.
2	1, 2, 2	Refer to FDR appendix for results and discussion. Posters may also present some assessment data	In weekly lectures and during one on one Meetings, may want to place more emphasis on data trend Observation and discuss the accuracy And relevancy of collected data
3	2, 3, 3	Used FDR conclusion and appendix results and discussions. Groups have done a better job for this part of the outcome.	In weekly lectures and during one on one Meetings Discuss measured data and trends to assist With presenting a more meaningful Conclusion.

Improvements for Student Outcome (b.2).

Improvement
From 3151 Think about how the assignment can be modified to have the students use the tools provided to analyze the similarness of the recorded vowel sounds
From 3151 This could be motivated by the students that have to rerecord their vowel sounds
From 3151 Modify the assignment to have the students evaluate if their classifier is efficient. Have them justify this evaluation
From 3151 Have the students identify where they have addressed outcomes.
From 3090 Modify the experiment to have the students assess if they have recorded bad data, discuss how they arrived at this assessment and discuss what should be done about it.
From 4800 The students need to do a better job documenting the individual experiments they perform.
From 4800 The students should be asked to identify where they are performing these activities and helped in this regard at the PDR
From 4800 The students need to be instructed that the appendix should contain this type of information.
From 4800 We need to talk about what belongs in an FDR, should it be more like a thesis/research paper?

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Assessment for Student Outcome (c).

	Assessments		
Ind	**Value**	**Observation**	**Recommendations**
ECE 3132			
1	2, 3, 3	1. The gain, input and output resistance values are not clearly stated.2.The gain, input and output resistance values are stated in the equations.3. The gain, input and output resistance values are stated in the equations.	The indicators 1 and 2are not clear. The rubrics for indicators 1 and 2 are not clear. 1. The gain, input and output resistance values should be stated before providing the equations and calculations.

			2. The gain, input and output resistance values should be stated before providing the equations and calculations. 3. The gain, input and output resistance values should be stated before providing the equations and calculations.
2	3, 3, 2	3. An inaccurate equation was used.	None
3	3, 3, 3	None	None
ECE 4800 / 4810			
1	3, 3, 3	There is evidence that multiple practical and realistic constraints have been identified as being applicable to a design component. Teams regular meeting with mentor/advisor has been helpful in identifying realistic and attainable constraints.	Due to early dismissal of classes due to virus We do not have access to logbooks. No further action is recommended for this Assessment cycle.
2	3, 3, 3	In general all three groups have been able to successfully complete their design to meet design constraints	Future assessment cycle special attention needs to be paid on the practical and realistic design constraints.
3	2, 3, 3	FDR report, conclusion and process. All three groups have implemented a design which show attempt to meets the design constraints and deliverables.	No further specific actions are recommended for this Assessment cycle.

Improvements for Student Outcome (c).

Improvement
From ECE3132 Refactor the Assessment Descriptions, Indicators and Rubrics
From ECE3132 Make sure to emphasize things like Thevenin resistance as parameters that are not specifically stated but requires students to take stated characteristics and produce

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Assessment for Student Outcome (d).

	Assessments		
Ind	**Value**	**Observation**	**Recommendations**
ECE 3090			
1	1, 3, 1	For the most part, this outcome has not been satisfied. 2 out of 3 notebooks do not contain meaningful documented work between meetings, therefore there is no real way to assess "timeliness" --------- No tasks assignments or timeline presented Even the groups that have this information have a very haphazard documentation style There is evidence of tasks assignments and accomplishment results, but they do not seem to follow each other	I think it would help if notebooks were evaluated regularly to give students feedback about what is missing and to impress upon them the need to document. This can be done with an upload of notebook pages each week. --------- We should have the students assess each others meeting minutes under a set of expectations as a learning exercise
2	1, 3, 1	For the most part, this outcome has not been satisfied. 2 out of 3 notebooks do not have	see recommendation from above. ---------

		sufficient information in them to determine whether information has been "shared". --------- Little evidence of information sharing sharing meeting There are some findings reported, but they do not seem to be tied to assigned tasks	See Above and Below
3	1, 3, 1	All notebooks have some evidence that progress has been made toward action items, but only with a brief sentence of what was accomplished in a team meeting, with little or no supporting documentation between meetings about those claims. --------- There are statements of accomplishments, but not very many details There is reports of accomplishments, but not much detail other than completion	see recommendation from above. --------- I would recommend reducing this to possibly 2 indicators. One that deals with Setting tasks / Goals, reporting on tasks / goals with detail And a second Indicator that deals with the students doing meaningful work between meetings
4	1, 3, 1	Most notebooks do not contain documented work between meetings. This makes it hard to evaluate other indicators from above. --------- here is evidence of independent work, but not much to tie this to assigned tasks or time lines While certain details exist in meeting minutes, there is no documented work	see recommendation from above. --------- See Above
ECE 4800 / 4810			
1	1, 1, 1	There seems to be issues with websites. Do not have access to logbook. --------- Group 1 does not have meeting minutes, they only have group working sessions. Group2	I will double check the websites. Need to emphasis to students The importance and need for proper record keeping. --------- The "meeting" minutes from this webpage are minutes from formal meetings, there are a diary of the team working as a group. We need to instill in students that meetings are a formal activity that does not contain work. We further need to instill in students that most project work should be performed in the absence of the group.
2	1, 1, 1	--------- I do not see evidence of information generated through work accomplished being shared in any meeting minutes.	I will double check the websites. Need to emphasis to students The importance and need for proper record keeping. --------- Along with holdings actual meetings students need more practices in what should be discussed at a meeting and what should be documented in a meeting

3	1, 3, 2	Group 1 website is not informative. Groups 2 and 3 invested in success of the project. --------- Group 1 did not have meeting and as such did not set deliverables with dates. Group 2 shows some evidence of setting deliverables with dates. Group 3 set deliverables, but did not set dates.	Need to emphasis team members' participation in team Weekly meetings and recording of the minutes to better Reflect members contributions. ---------
4	NA	No access to logbooks has limited the ability to effectively assess this indicator. There is very limited information available on team website showing progress towards project goals. --------- Group 1 only has work, does this count as between meetings when they have no reported meetings. Group 2: There is no reports of completed work Group 3 shows some evidence of reports on work done	To be reviewed in the future assessment cycle. --------- Hopefully this information exists in the notebooks, it should be reported in the meetings, but be documented in the lab books in more detail

Improvements for Student Outcome (d).

Improvement
From 3090 Reduce the number of indicators
From 3090 Have the students Abet - assess each others work
From 4800 The website should contain a fully detailed copy of the minutes
From 4800 Further discuss what belongs in a laboratory notebook.