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WIP: Resolving Systemic Tensions in Scalable First-Year Engineering: A Mixed-Methods Assessment and Integrative Redesign Framework

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1 Introduction: The Challenge of the Integrated, Large-Enrollment Gateway Course

This Work-in-progress paper reports on a formal, mixed-methods, multi-year course assessment designed to review curricular goals, identify course strengths and challenges, and make recommendations for improvement in the First-year Engineering (FYE) Program at a large University (the University). FYE programs must equip students with foundational disciplinary knowledge, applied skills, and professional competencies, often within the constraints of massive enrollment and heterogeneous student preparation. In efforts to meet this challenge, many FYE programs integrate lectures on physical sciences with labs, in addition to modules on other topics and skills such as ethics, project management, engineering design, teamwork, communication, and algorithmic thinking [1-3]. This structure creates inherent tensions between content breadth and depth, theoretical and applied learning, and scalable delivery and consistent, high-quality instruction [4, 5].

This study was guided by the following research question: *What systemic tensions characterize a large-enrollment, integrated first-year engineering course, and how can a triangulated assessment methodology—combining instructor survey data, longitudinal student evaluations, and structured reflections—inform a replicable redesign framework to address these tensions?*

The study employs: 1) a survey of course instructors, 2) longitudinal analysis of student course evaluations, and 3) structured reflections by cross-functional assessment contributors. We present a replicable assessment model, analyze preliminary findings that reveal systemic trade-offs, and propose a phased redesign framework. The lessons are directly applicable to any institution balancing rigor, relevance, and scale in foundational engineering courses. This method utilizes data that is easily obtained without massive efforts coordinated across course sections or the department, and can therefore be readily implemented without significant lead-time.

2 Methodology

At the University, the FYE Program (the Program) exemplifies the challenge described above. In this work, a course assessment was performed on one of the courses in the Program. An account of the Program is given below followed by a description of the course assessment design.

2.1 First-year Engineering Program Structure

The FYE Program courses (the Courses) in the College of Engineering are intended to operate in a larger degree-plan framework. These courses should contribute to the preparation of first-year students to be good sophomore students in their majors. The Program serves more than 3,000 students annually. The Courses' curricular goals and their integration into the overall objectives of the FYE Program are established by the Program Director and the Senior Associate Dean for Academic Affairs in consultation with the Department Heads of all departments within the College of Engineering. Based on the courses' curricular goals, the Course Curriculum

Committee determines the scope, content, and delivery methods for all the courses.

The Program sequence comprises three courses: 1) **ENGR 102**, a computer programming course intended for completion in the first semester; 2) **ENGR 216** (also listed as PHYS 216), an engineering mechanics course intended for completion in the second semester; and 3) **ENGR 217** (also listed as PHYS 217), an electricity and magnetism course intended for completion in the third semester.

ENGR 102 meets twice weekly for two-hour sessions, comprising one hour of lecture and three hours of lab time. ENGR 216 and ENGR 217 serve as the second and third courses in the sequence and as companion laboratories for PHYS 206 (kinematics) and PHYS 207 (electricity and magnetism), respectively. Both courses blend bi-weekly labs with weekly lectures that support the laboratory experiences while also emphasizing engineering ethics, statistics, data analysis, applied engineering, and project management. For all three courses, class meetings and assessments are facilitated by Course Instructors and Class Peer Teachers. For ENGR 216 and ENGR 217, lab activities are directed by Lab Coordinators, with lab sessions and assessments conducted by Lab Peer Teachers.

This work pertains to ENGR 217 (the Course), the final course in the Program sequence intended to be taken during the first semester of a student's sophomore year. The Course faces challenges typical of large gateway engineering courses as well as unique challenges related to positioning within the Program and content overlap with other courses, presenting a diverse array of opportunities for improvement. The Course review process comprised the collection and analysis of data in the following three categories: 1) Instructor Survey, 2) Selected Student Evaluation Data, and 3) Reflections on the course. These categories are described below.

2.2 Instructor Survey

In the current work, the Course was assessed with reference to class and laboratory content, assessment, class structure, peer teacher and instructor collaboration, student enrichment, and the alignment of the course outcomes with the course description. A survey of course instructors was conducted following the Fall 2024 semester to measure attitudes, opinions, and perceptions using a Google Forms questionnaire that included six Likert-scale and nine narrative-feedback prompts. The full text of the instructor survey can be found in Appendix A.

2.3 Selected HelioCampus (Student Course Evaluation) data

Four key questions on learning outcomes, critical thinking, organization, and evaluating diverse perspectives from three-years of HelioCampus Student Course Evaluation (SCE) data (calendar years 2021-2023) were selected for analysis with benchmarking against the other two FYE courses (ENGR 102 and ENGR 216). The text of these questions is reproduced in Section 3.2. Data from calendar year 2024 was not yet available at the time of this analysis.

2.4 Reflections on the Course

Reflections were sought from the committee members, the Program Director, and the Senior Associate Dean for Academic Affairs. This enabled synthesis of insights from both teaching and non-teaching faculty, providing an integrated, strategic perspective.

3 Analysis of Results

3.1 Instructor Survey

Instructors' feedback from the Likert-scale and narrative-feedback prompts in the conducted survey is analyzed below. The full instructor survey can be found in Appendix A.

3.1.1 Likert-scale prompts

Mean ordinal responses for each of the six Likert-scale prompts are presented in Figure 1. The mean ordinal response to all six prompts was greater than 3, indicating agreement from the responding instructors. Mean responses to prompts regarding Lab content and Weekly assessments were the highest (4.125), and lowest to the prompt regarding the Final Exam (3.375). Qualitatively, values of some ordinal responses from individual instructors did not seem to agree with responses to narrative-feedback prompts, indicating a greater agreement with prompts than suggested by suggestions or problems identified through narrative-feedback comments.

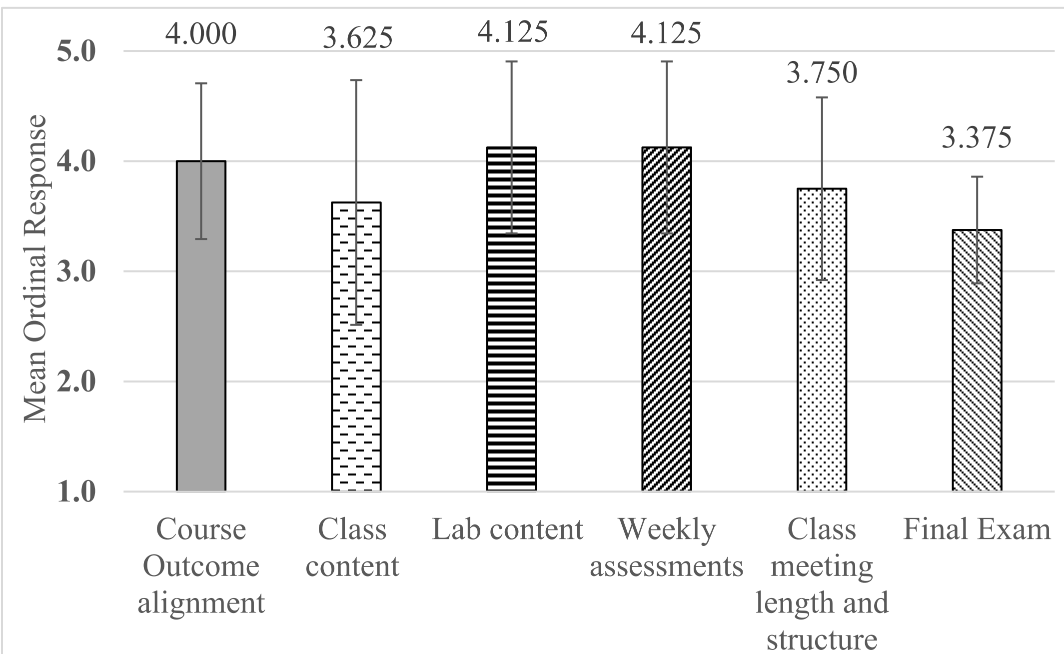

Figure 1. Mean ordinal response (with a response of 1 corresponding to Strongly Disagree, and 5 corresponding to Strongly Agree) to Likert-scale prompts from n = 8 instructor responses

3.1.2 Narrative-feedback prompts

A summary of comments and themes emerging from instructor responses to narrative-feedback prompts follows.

Course learning outcome language should be updated to include action verbs in place of references to levels of Bloom's taxonomy of learning. In order to more accurately describe enrolled students, the Course should be referred to as part of the “general engineering” sequence of laboratory courses, as opposed to the “freshman sequence”.

The list of topics covered in the Course is long, and should be reviewed and potentially condensed. Specifically, instructors recommend that the topics of Measurement, Error Propagation, and Data Analysis should be removed from the Course and taught only in ENGR 216 to avoid extensive topic overlap. The relevance and connection to the course goals of the topics of Ethics, Project Management, and Art & Engineering should be reviewed. If determined to be relevant, these topics should be integrated with engineering and magnetism topics more closely to improve course cohesion.

Instructors suggest that a team engineering project (or projects) incorporating project management, engineering design method, business model, presentation, and electricity/magnetism should be added as experiential learning and assessment of course content. Instructors should be encouraged to assign impactful activities and assessments, designed with course learning outcomes in mind. Methods of assessment should be aligned with weekly target learning outcome.

Students currently complete just six labs per semester - fewer than one every two weeks. This low frequency may be insufficient and warrants review. Furthermore, both the lab designs and equipment should be evaluated for alignment with course learning outcomes and redesigned as appropriate. This evaluation should include consideration of different or additional equipment to better support the intended learning objectives. Students’ main point of contact related to the laboratory experiments are the laboratory peer teachers. While knowledgeable and helpful, peer teachers are not instructors, and have low levels of experience teaching. Increasing the degree of instructor involvement with labs has a potential for positive impact on student experience and mastery of course learning outcomes. The grading of lab reports is very relaxed, to the point that most students receive nearly all of the points available regardless of the quality of their submissions, rewarding and encouraging low effort work, reducing the ability for students to achieve mastery of course learning outcomes.

A short class period limits the ability of instructors to facilitate activities that enhance student learning. Extending the class period could provide time to teach all of the course topics while allowing for active learning that will contribute to student mastery of course learning outcomes.

3.2 Selected HelioCampus (Student Course Evaluation) data

In this analysis, the HelioCampus data for four key questions were used The full text of these questions is reproduced in Appendix B, but shortened summaries are presented below.

Question 3. Achieve course outcomes: 1 – No; 4 – Definitely
Question 4. Think critically: 1 – Never; 4 – Frequently.
Question 5. Course organization: 1 – Not organized; 4 – Very well organized.
Question 6. Evaluated diverse perspectives: 1 – Strongly disagree; 5 – Strongly agree.

Results of the analysis for calendar years (CY) 2021, 2022, and 2023 are presented in Figure 2. Full data for CY 2021, CY 2022, and CY 2023 can be found in Appendix B in Table B1, Table B2, and Table B3, respectively.

For CY 2021, responses to all four questions for the Course were much lower compared to responses for either of the other courses in the Program (ENGR 102 and ENGR 216). Over the next two years mean responses for ENGR 217 trended higher for all four questions, and the magnitude of difference in mean response between ENGR 217 and the other courses was reduced for CY 2022, and then fully eliminated for CY 2023.This suggests a progressive improvement in student perception of these course attributes, which may be due to progressive improvement in course delivery. A more detailed or different analysis could help understand the specific improvements or other factors that may have contributed to these mean response increases.

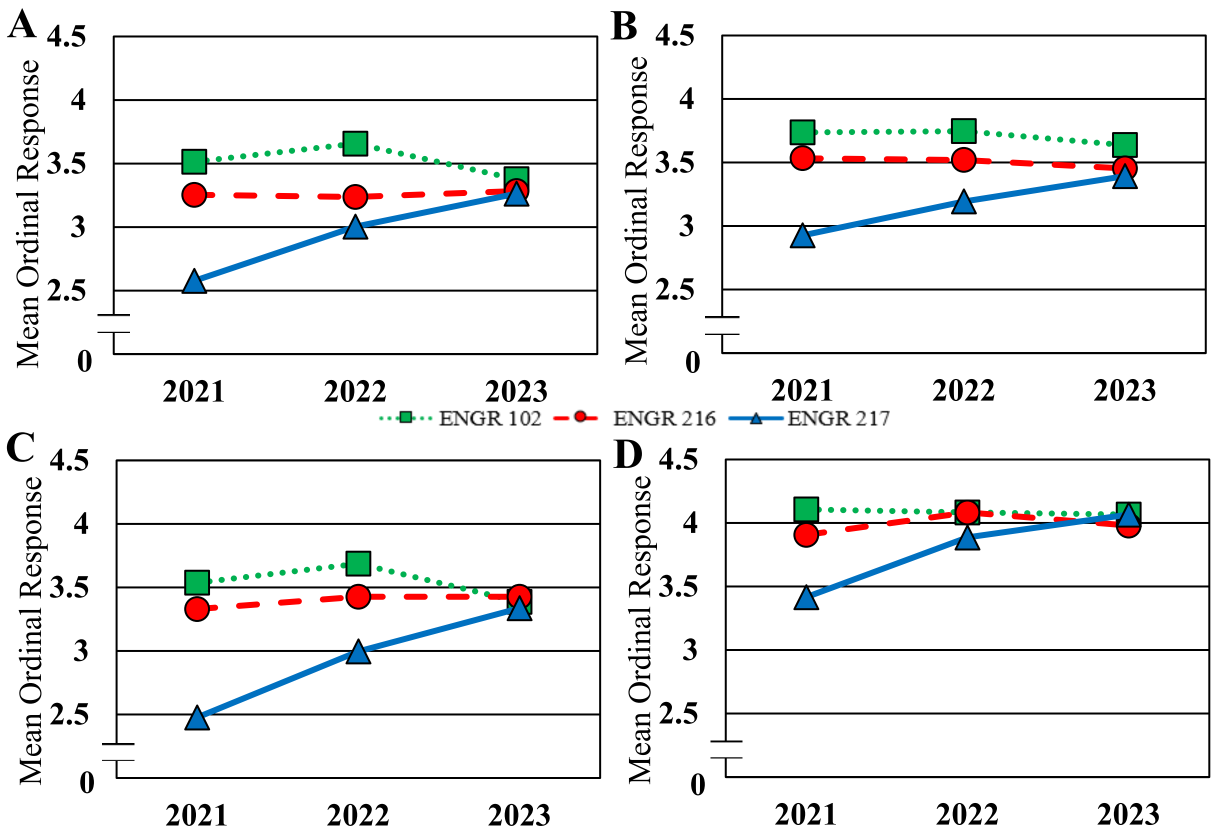

Figure 2. Mean ordinal responses to selected Student Course Evaluation questions. (A) Question 3 regarding achievement of the course outcomes, (B) Question 4 regarding critical thinking, (C) Question 5 regarding course organization, (D) Question 6 regarding evaluation of diverse perspectives.

3.3 Reflections by committee members

The following presents a concise summary of key conclusions derived from reflections on the course. The full text of Committee Member reflections can be found in Appendix C.

3.3.1 Reflection by Committee Member 1 (key conclusions)

The reflection argues that ENGR 217's scope and curricular role require program-level, not instructor-led, review. It identifies a core structural issue: the Course duplicates PHYS 207 content in a compressed format, creating a mismatch that causes cognitive overload for underprepared students and redundancy for proficient ones. This is compounded by structural limitations—heterogeneous enrollment, misaligned rigor for advanced students, and insufficient instructional time—that collectively obscure learning objectives. The recommendations are to formally align the curriculum with PHYS 207, implement prerequisite competency checks, and strategically reduce lecture content to better match the lab's scope.

3.3.2 Reflection by Committee Member 2 (key conclusions)

Based on experience with the parallel ENGR 216 course and committee discussions, the reflection identifies a fundamental lack of clarity in purpose for both ENGR 216 and ENGR 217. The core issue is that attempting to incorporate all intended course goals within a limited time frame dilutes their focus and compromises student achievement of the outcomes.

3.3.3 Reflection by Committee Member 3 (key conclusions)

Drawing on teaching experience since 2021, this reflection affirms ENGR 217's critical role as a bridge between PHYS 207 theory and practical engineering application. It highlights a fundamental instructional challenge: significant variability in student preparedness due to diverse pathways for completing the PHYS 207 prerequisite (including external institutions and multiple available course modalities). This results in many students lacking proficiency in foundational skills like unit conversions and numerical interpretation, which ENGR 217 is uniquely positioned to address as the last required foundational course.

The analysis identifies three primary, addressable constraints that hinder the Course: (1) a wide scope of topics limits depth within the (2) highly constrained 50-minute weekly lecture format, and (3) inconsistent and slow grading of lab reports, which constitute 50% of the Course grade, undermines assessment validity and student experience.

3.4 Interpreting the Dissonance:

The improving student ratings contrast with the deep, structural criticisms from instructors. This suggests tactical fixes are improving satisfaction, but strategic flaws remain in design and delivery, threatening long-term learning outcomes.

The Course in its current form is tasked with accomplishing many diverse goals. It serves as the third and final course in the FYE Program sequence and is intended to help bridge the gap between introductory and discipline-specific engineering content. However, students are not expected to take the Course during their first year, and instead during the first semester of their second year, at which time many will also be taking their first discipline-specific courses. Because of this somewhat awkward mesh of the Program sequence with the broader discipline-specific degree plans, and the lack of post-requisite courses, many students delay taking the Course well past the intended third semester, resulting in heterogenous levels of content mastery. Even further difficulty is introduced by the Course's goal of serving as the laboratory companion course to PHYS 207. Balancing content mastery in the physics of electricity and magnetism with introductory and applied engineering topics, as well as the desire for an accessible FYE program, places undue strain on the course.

3.5 Synthesis: From Findings to Leverage Points

The three data sources—instructor survey, student evaluations, and committee reflections—were triangulated to identify recurring themes and, from them, derive actionable leverage points for redesign. This synthesis process followed a structured analytic approach:

Step 1: Thematic Coding. Independent reviews of the narrative responses from the instructor survey (Section 3.1.2) and committee reflections (Section 3.3) revealed recurring codes. Initial codes included "content overload," "topic redundancy," "insufficient class time," "lab grading inconsistency," "peer teacher variability," and "disconnected professional skills."

Step 2: Theme Aggregation. Related codes were grouped into broader thematic categories. For example, "content overload," "topic redundancy," and "disconnected professional skills" coalesced under a theme of *curricular incoherence and excessive breadth*. Similarly, "insufficient class time" and "lab grading inconsistency" pointed to *structural and systemic delivery constraints*.

Step 3: Mapping Themes to Leverage Points. Each aggregated theme was then mapped to a corresponding domain of intervention—content, pedagogy, or instructional infrastructure—forming the basis for the three actionable leverage points: Sharpen Content and Prerequisite Alignment,Restructure Time and Pedagogy, and Fortify the Instructional System. Please refer to Table D1 in Appendix D for an illustration of this mapping.

This systematic process ensured that the proposed redesign framework is grounded in the evidence collected, rather than emerging from anecdotal observation. Each leverage point directly addresses a cluster of related findings, providing a coherent and defensible pathway for improvement.

4 Recommendations — A Framework for Redesigning Scalable First-Year Courses

This assessment demonstrates that evaluating a large-scale course requires looking beyond student satisfaction scores to uncover structural tensions between content, time, pedagogy, and scalable delivery. This paper proposes a redesign framework *(The Three Leverage Points for Change)* as a pathway to transform these tensions into a coherent, rigorous, and scalable educational experience. Additionally, the Program faces a scalability paradox. The Course uses Peer Teachers to manage scale, but under-investment in this system creates its greatest weaknesses (grading inconsistency). The solution is not less scaling, but smarter investment in the human infrastructure of the Course.

4.1 The Three Leverage Points for Change

- **Lever 1: Sharpen Content and Prerequisite Alignment** — Remove redundant topics. Integrate or decisively cut "disconnected" professional skills. Formalize PHYS 207 competency checks.
- **Lever 2: Restructure Time and Pedagogy** — The bold proposal: Shift from a topic-centric to a project-centric model. Adopt the "sequential project-based approach", integrating physical sciences, design, ethics, and AI tools. This requires the recommended increase of class time.
- **Lever 3: Fortify the Instructional System** — Appoint a Course Coordinator for

consistency. Overhaul PT training with standardized rubrics and accountability. Increase lab PT numbers to improve grading quality and feedback speed.

5 Future Work

For the next phase of this work, we plan to continue longitudinal data collection through later years. HelioCampus student evaluation data for calendar years 2024 and 2025 will be added to the data set and reanalyzed. Additionally, the Instructor Survey has been refined and reformatted based on lessons learned to promote a higher instructor response rate and improve the ability of instructors to provide their perspectives in a clear and useful manner. This new version of the survey has been sent to the Course instructors during the Fall 2025 semester, and responses will be combined with current data set for analysis. For the narrative feedback prompt responses, a rigorous thematic analysis using the methodology described by Braun and Clark (2006) will be completed [6]. Finally, committee member reflections will be revised and updated, and reflection statements from the FYE Program Director and the Senior Associate Dean for Academic Affairs will be obtained. The impact of short-term changes (e.g., coordinator appointment, PT training, content adjustment) on instructor narrative feedback, lab grade consistency, and student evaluations will be monitored. Collectively, these analyses and reflections will further the development of the final redesign framework for enhancing the FYE Program overall and the ENGR 217 course specifically.

In longer term future work, the course assessment process would benefit greatly from greater specificity of data regarding student perception of the Course and their mastery of course topics and skills. The authors hope to design and implement pre- and post-course student surveys that would provide valuable information on the success of the course [7].

6 Conclusion

This study demonstrates that effective assessment of large-scale foundational courses must move beyond surface-level student satisfaction metrics to diagnose deeper structural tensions. An analysis of the Course assessment results revealed critical friction between comprehensive curricular goals, constrained instructional time, and the demands of scalable delivery. In response, this work proposes a three-part redesign framework *(1. sharpening and aligning core content, 2. restructuring pedagogy around integrated, project-based learning, and 3. fortifying the instructional support system)* as a pathway to convert these inherent tensions into a coherent and rigorous educational experience. The assessment methodology and integrative framework presented offer a transferable model for engineering programs navigating the universal challenge of reconciling ambitious learning outcomes with the practical realities of foundational education at scale.

7 Acknowledgment

We are grateful to the course instructors for their valuable insights. Their direct engagement with students provided a critical, first-hand perspective on the course's impact. We also extend our appreciation to the FYE Program leadership for their support and guidance.

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Appendices

Appendix A ENGR 217 Course Assessment Instructor Survey

Dear Instructor,
Your feedback is sought in order to enable continuous improvement in ENGR/PHYS 217 course. This is to assess if the course is meeting its curricular goals, determine areas of strength and weakness, and make recommendations for improvement of the course for the coming academic year. It should be kept in mind that all these courses operate in a larger degree-plan framework, and should contribute to the preparation of our students to be good students in their majors.
To provide your feedback please refer to **Course Description**, **Learning Outcomes**, and **List of Topics** in this document<hyperlink> and then answer all the following questions.

The 'Course Learning Outcomes' are aligned with the 'Course Description'.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

If the 'Course Learning Outcomes' diverge from the 'Course Description', please explain the specific difference(s).

____

Class content meets the course Learning Outcomes.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

Class content: Please make suggestions that would make the course more effective. Please be detailed and specific. Make reference to the List of Topics and suggest for every topic which specific content should be modified, improved, or removed.

____

Lab content meets the course Learning Outcomes.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

Lab content: Please make suggestions that would make the course more effective. Please be detailed and specific.

____

Weekly assessments help the students achieve the course Learning Outcomes.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

Weekly assessments: Please make suggestions that would make the course more effective. Please be detailed and specific.

____

Class meeting length and structure help the students achieve the course Learning Outcomes.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

Class meeting length and structure: Please make suggestions that would make the course more effective. Please be detailed and specific.

____

Final Exam helps the students achieve the course Learning Outcomes.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

Final Exam: Please make suggestions that would make the course more effective. Please be detailed and specific.

____

Peer teachers role, number per section, availability and accountability: Considering peer teachers role, number per section, availability and accountability, please make any suggestions that would make the course more effective.

____

Coordination and collaboration among Instructors: Considering coordination and collaboration among Instructors, please make any suggestions that would make the course more effective.

____

Student enrichment: Please make suggestions to improve the following:

a. Student engagement
b. Student learning
c. Student satisfaction
d. Student inspiration
e. Student preparation for major

____

Appendix B Selected HelioCampus (Student Evaluation) data

In this analysis, the HelioCampus data for four key questions were used. The text of these questions is reproduced below.

Question 3. This course helped me learn concepts or skills as stated in course objectives/outcomes.
Answers: 1 – Did not help; 4 – Definitely helped.

Question 4. I engaged in critical thinking and/or problem solving.
Answers: 1 – Never; 4 – Frequently.

Question 5. Organization of the course.
Answers: 1 – Not organized; 4 – Very well organized.

Question 6. I learned to critically evaluate diverse ideas and perspectives.
Answers: 1 – Strongly disagree; 5 – Strongly agree.

Selected SCE results for the selected questions for calendar years 2021, 2022, and 2023 are presented below.

Table B1. HelioCampus Student Course Evaluation CY2021 Data for ENGR 102, ENGR 216, ENGR 217.

Term	Course Number	Course Name	Enrollment	Responses	Response Rate	Range and Values	Q3	Q4	Q5	Q6	Average Course Grade
F21	ENGR 102	ENGR Lab I Computation	4754	2093	0.440	**Mean**	3.39	3.73	3.37	4.06	3.09
						SD	0.75	0.53	0.76	0.96	
Sp21	ENGR 102	ENGR Lab I Computation	316	114	0.361	**Mean**	3.55	3.68	3.40	3.94	2.737
						SD	0.61	0.52	0.68	0.95	
Su21	ENGR 102	ENGR Lab I Computation	60	25	0.417	**Mean**	3.60	3.80	3.84	4.32	2.866
						SD	0.75	0.49	0.37	1.01	
F21	ENGR 216	EX PHYS ENGR Lab I Mechanics	452	186	0.412	**Mean**	3.14	3.47	3.20	3.87	2.693
						SD	0.87	0.65	0.82	1.02	
Sp21	ENGR 216	EX PHYS ENGR Lab I Mechanics	1714	727	0.424	**Mean**	3.10	3.41	3.15	3.75	3.251
						SD	0.91	0.75	0.92	1.06	
Su21	ENGR 216	EX PHYS ENGR Lab I Mechanics	136	25	0.184	**Mean**	3.52	3.72	3.64	4.10	3.147
						SD	0.75	0.45	0.69	1.38	
F21	ENGR 217	EX PHYS ENGR Lab II Magn	1238	421	0.340	**Mean**	2.40	2.86	2.43	3.37	3.501
						SD	0.97	0.81	1.02	1.08	
Sp21	ENGR 217	EX PHYS ENGR Lab II Magn	360	101	0.281	**Mean**	2.68	2.92	2.59	3.48	3.525
						SD	0.99	0.69	1.00	1.11	
Su21	ENGR 217	EX PHYS ENGR Lab II Magn	92	17	0.185	**Mean**	2.65	3.00	2.41	3.40	3.423
						SD	0.97	0.91	1.03	0.95	

Table B2. HelioCampus Student Course Evaluation CY2022 Data for ENGR 102, ENGR 216, ENGR 217.

Term	Course Number	Course Name	Enrollment	Responses	Response Rate	Range and Values	Q3	Q4	Q5	Q6	Average Course Grade
F22	ENGR 102	ENGR Lab I Computation	5253	3322	0.632	**Mean**	3.42	3.71	3.43	4.07	3.103
						SD	0.75	0.53	0.73	0.91	
Sp22	ENGR 102	ENGR Lab I Computation	325	180	0.554	**Mean**	3.55	3.73	3.63	4.12	2.642
						SD	0.63	0.48	0.53	0.99	
Su22	ENGR 102	ENGR Lab I Computation	21	5	0.238	**Mean**	4.00	3.80	4.00	4.50	3.000
						SD	0.00	0.40	0.00	0.50	
F22	ENGR 216	EX PHYS ENGR Lab II Mechanics	659	251	0.399	**Mean**	3.18	3.46	3.42	4.10	3.387
						SD	0.82	0.68	0.72	0.92	
Sp22	ENGR 216	EX PHYS ENGR Lab II Mechanics	1823	770	0.422	**Mean**	3.21	3.46	3.32	4.00	3.601
						SD	0.83	0.66	0.84	0.93	
Su22	ENGR 216	EX PHYS ENGR Lab II Mechanics	51	28	0.549	**Mean**	3.32	3.64	3.54	4.15	3.459
						SD	0.60	0.60	1.02	1.21	
F22	ENGR 217	EX PHYS ENGR Lab II Magn	1346	643	0.477	**Mean**	2.73	3.08	3.02	3.61	3.387
						SD	1.04	0.86	0.95	1.15	
Sp22	ENGR 217	EX PHYS ENGR Lab II Magn	460	160	0.348	**Mean**	3.17	3.28	3.36	3.93	3.601
						SD	0.94	0.81	0.85	0.98	
Su22	ENGR 217	EX PHYS ENGR Lab II Magn	77	18	0.234	**Mean**	3.11	3.22	2.61	4.12	3.459
						SD	0.63	0.71	0.87	0.63	

Table B3. HelioCampus Student Course Evaluation CY2023 Data for ENGR 102, ENGR 216, ENGR 217.

Term	Course Number	Course Name	Enrollment	Responses	Response Rate	Range and Values	Q3	Q4	Q5	Q6	Average Course Grade
F23	ENGR 102	ENGR Lab I Computation	5261	3258	0.619	**Mean**	3.41	3.72	3.45	4.11	3.073
						SD	0.75	0.51	0.70	0.91	
Sp23	ENGR 102	ENGR Lab I Computation	327	182	0.557	**Mean**	3.43	3.69	3.54	4.15	2.663
						SD	0.77	0.58	0.72	0.96	
Su23	ENGR 102	ENGR Lab I Computation	27	24	0.889	**Mean**	3.29	3.50	3.17	3.92	3.111
						SD	0.84	0.65	0.75	1.08	
F23	ENGR 216	EX PHYS ENGR Lab II Mechanics	607	278	0.458	**Mean**	2.95	3.35	3.25	3.91	3.023
						SD	0.89	0.74	0.83	1.02	
Sp23	ENGR 216	EX PHYS ENGR Lab II Mechanics	2343	1202	0.513	**Mean**	3.15	3.45	3.34	3.90	3.282
						SD	0.86	0.66	0.81	0.98	
Su23	ENGR 216	EX PHYS ENGR Lab II Mechanics	50	32	0.640	**Mean**	3.75	3.56	3.69	4.13	3.260
						SD	0.43	0.50	0.68	1.06	
F23	ENGR 217	EX PHYS ENGR Lab II Magn	1228	607	0.494	**Mean**	3.06	3.27	3.33	3.92	3.383
						SD	0.90	0.75	0.80	1.01	
Sp23	ENGR 217	EX PHYS ENGR Lab II Magn	319	157	0.492	**Mean**	3.19	3.32	3.25	3.97	3.482
						SD	0.88	0.79	0.89	0.99	
Su23	ENGR 217	EX PHYS ENGR Lab II Magn	93	37	0.398	**Mean**	3.54	3.59	3.43	4.31	3.333
						SD	0.72	0.54	0.82	0.75	

Appendix C Reflections by the committee members

C1 Reflection by the committee member 1

The determination of this course's scope and its curricular significance within the First-Year Engineering Program falls beyond the purview of individual instructors, necessitating administrative review at the departmental level. ENGR/PHYS 217, which requires PHYS 207 as a prerequisite, is designed exclusively to reinforce and operationalize foundational concepts from PHYS 207 through practical applications, not to expand upon the existing conceptual framework. The course curriculum comprises identical content to PHYS 207, albeit delivered in a condensed format. This pedagogical compression creates two distinct challenges: (1) students with incomplete mastery of prerequisite material may experience cognitive overload, while (2) proficient students encounter largely redundant content.

Three structural limitations further compromise course efficacy:

- The absence of downstream course dependencies and flexible completion timelines results in heterogeneous enrollment patterns across all undergraduate levels (freshman through senior).

- Advanced students frequently report misalignment between course rigor and their academic expectations.

- The current course structure does not allocate sufficient instructional time to adequately cover the required material while maintaining consistent student engagement for this diverse cohort.

These systemic issues collectively cause student perceptions of unclear learning objectives.

To rectify these concerns, the following measures are recommended:

- Comprehensive review of curricular alignment between PHYS 207 and ENGR/PHYS 217,

- Implementation of diagnostic assessment for PHYS 207 competency, and

- Strategic reduction of Electricity & Magnetism lecture content to achieve parity with laboratory scope.

C2 Reflection by the committee member 2

I have not taught ENGR/PHYS 217 previously, and I believe that the thoughts, comments, and recommendations of others who have previous experience teaching the course should be valued above mine. The following remarks are based on my own experiences with ENGR/PHYS 216 (a similarly structured course), the many conversations I have had with my fellow ENGR/PHYS

217 Course Review Committee members, and my interpretations of the comments and data received by other ENGR/PHYS 217 instructors.

I believe ENGR/PHYS 216 and ENGR/PHYS 217 suffer from a lack of clarity in their purpose.

The course goals are useful and important for students, but the need to incorporate all of them into the same time frame broadens and dilutes the purpose of the courses (ENGR/PHYS 217 & ENGR/PHYS 217) and compromises the ability of students to achieve the course outcomes.

C3 Reflection by the committee member 3

As an instructor who has taught ENGR/PHYS 217 since September 2021, I have had the opportunity to closely observe constraints and challenges faced by instructors and students. The scope of my observations and recommendations is limited to my experience with this course. The faculty more familiar with this class and the data collected as part of this course review indicate this course is intended to bridge the theoretical concepts of PHYS 207 with their practical engineering application in a structured lecture/laboratory setting. As such, this course is a valuable and necessary component of the engineering curriculum, serving as an engineering extension/supplement to PHYS 207.

Individual engineering programs and/or departments educate a capped number of students who have been auto- or holistically admitted through the Entry to a Major (ETAM) process. Conversely, the University College of Engineering's First Year Program educates the majority of an entering engineering student class across all campuses and the Engineering Academies. This presents challenges, logistical and instructional in scope, which are unique to the First Year Program courses, including ENGR/PHYS 217. Since logistical and human resource constraints cannot be immediately addressed, they are beyond the scope of this course review. However, implementation of small, concrete changes, can potentially improve the instructional quality and pedagogical effectiveness of ENGR/PHYS 217.

Importance of ENGR/PHYS 217

Regardless of their declared major, this course is highly valuable for all first-year students. In addition to teaching the engineering application of electricity and magnetism concepts learned in PHYS 207, this is the last foundational engineering course required for all engineering students. Based on my experience with the course, many students still require assistance with basic engineering skills such as unit conversions, dimensional analysis or interpretation of calculations.

Many of our students take PHYS 207 at other institutions or community colleges for financial reasons or convenience. The instructional rigor at these institutions may differ from that upheld by the University Department of Physics and Astronomy or by partner institutions (e.g. Engineering Academies) which are closely aligned with the expectations of our engineering program. As a result, students enrolled in ENGR/PHYS 217 have vastly different levels of understanding and proficiency with the fundamental concepts of electricity and magnetism covered in PHYS 207.

Moreover, a considerable number of students opt to take the "Don't Panic" version of PHYS

206/207. The instructional approach of “Don’t Panic” physics courses is less focused on numerical computation and concentrates on mathematical understanding through variable manipulation and equation derivation to solve problems. While this approach certainly has value and merit, omitting numerical computation and interpretation potentially hinders understanding for students with limited previous exposure to electricity and magnetism concepts (e.g. high school Advanced Placement (A.P.) physics courses).

Numerous students in my ENGR/PHYS 217 courses across all semesters have expressed appreciation for my attention to dimensional analysis, unit conversions and “common sense” interpretation of numerical answers. I have also observed that many students lack proficiency with basic skills such as recognizing unit prefixes (e.g. centi, milli, nano etc.) or converting between orders of magnitude. As the last foundational engineering course required for all students, ENGR/PHYS 217 presents an invaluable opportunity to teach our engineering students fundamental engineering skills including, but not limited to: mathematical analysis, calculation methods, dimensional analysis, interpretation of engineering calculations, and basic technical writing.

Course Challenges

There are varied challenges and constraints inherent to teaching a course with large student enrollments. The following include those which I consider are the most significant and need more immediate examination and evaluation.

Wide Scope of Topics - The course has a wide range of topics. This limits the amount of time dedicated to covering each topic during the (once) weekly lecture.

Limited Lecture Time – Currently, students meet for classroom instruction (lecture) only once per week for 50 minutes. This constrains the instruction of electricity and magnetism concepts and limits the implementation of varied classroom activities to enhance the learning environment and improve student retention.

Inconsistent Lab Report Grading – Laboratory reports are often graded in a lackluster manner by lab peer teachers (PTs) or graduate teaching assistants (GATs). Students express frustration with inconsistent grading of their reports, especially since the laboratory accounts for 50% of the course grade. Some peer teachers award nearly full credit, while others grade overly harsh, deducting high point values for random errors while providing little-to-no feedback. Slow grading of the reports is also a prevalent problem for both students and instructors, especially at the end of the semester.

Appendix D Synthesis: From Findings to Actionable Leverage Points

Table D1. Mapping of Findings to Redesign Leverage Points.

Aggregated Theme	**Representative Evidence**	**Corresponding Leverage Point**
Curricular incoherence and excessive breadth	"List of topics is long...should be condensed." "Topics...should be removed from the course and taught only in ENGR 216." "Ethics, Art & Engineering are currently disconnected."	**Lever 1: Sharpen Content and Prerequisite Alignment**
Temporal constraints limiting active/deep learning	"Class period is 50 minutes per week...limits ability to facilitate team projects." "Insufficient instructional time...for this diverse cohort."	**Lever 2: Restructure Time and Pedagogy**
Inconsistent instructional quality and assessment	"Grading of lab reports is very relaxed...rewarding low effort." "PT training...and a system of holding PTs accountable is needed."	**Lever 3: Fortify the Instructional System**