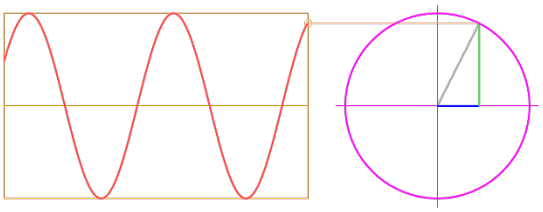


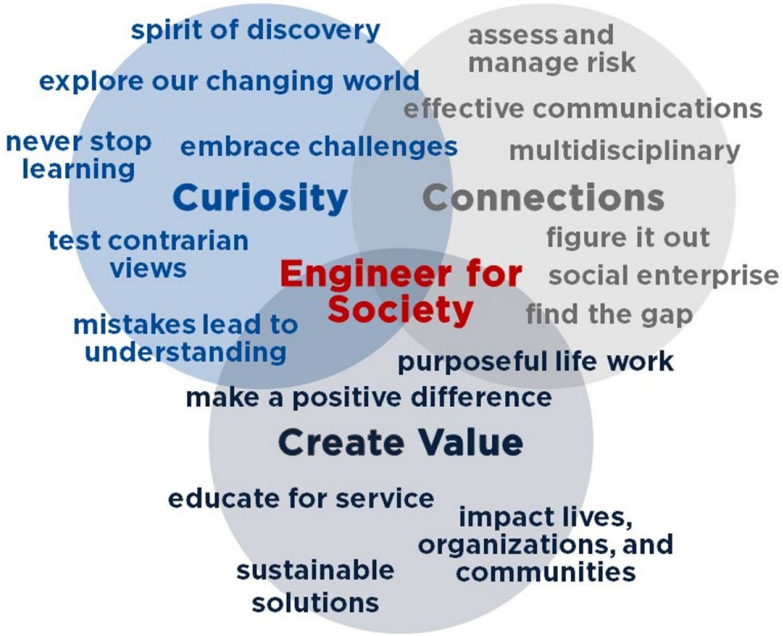
Welcome to
Engineering Superpower Training
(Mathematics for Physics)
PHY120
Dr. Kurt DeGoede

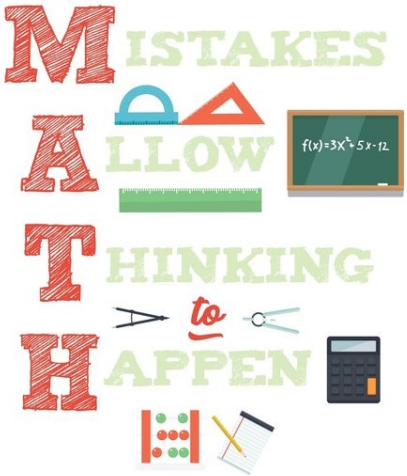
What is this course all about?

To become engineers who can take opportunities and transform them into solutions with impact - creating value for society, we need to develop a toolkit up for that challenge. As engineers our toolkit starts with a foundation in mathematics and analytical science. Math is our superpower as engineers!

Let's talk Mindset. The Etown Engineering Mindset: Engineering for Society

Just like Uncle Ben said – "with great powers come great responsibilities." As we develop our superpowers, we also want to hone our ability to channel that power to live lives of purpose – serving others and making a positive impact in our society. Our Etown Engineering Mindset starts with approaching all things with curiosity about our changing world, making connections to integrate information from many sources, and create value: economic, environmental, and societal value. **Educate for Service – Engineer for Society.**





One key to building this Mindset – Learn to persist through and learn from failure.

We learn by doing, exploring, asking questions, figuring out why and how. We will make mistakes; that's a GOOD thing! Mistakes allow thinking to happen. We need to challenge ourselves and keep learning from every attempt and failure. Every mistake is an opportunity to gain insight!

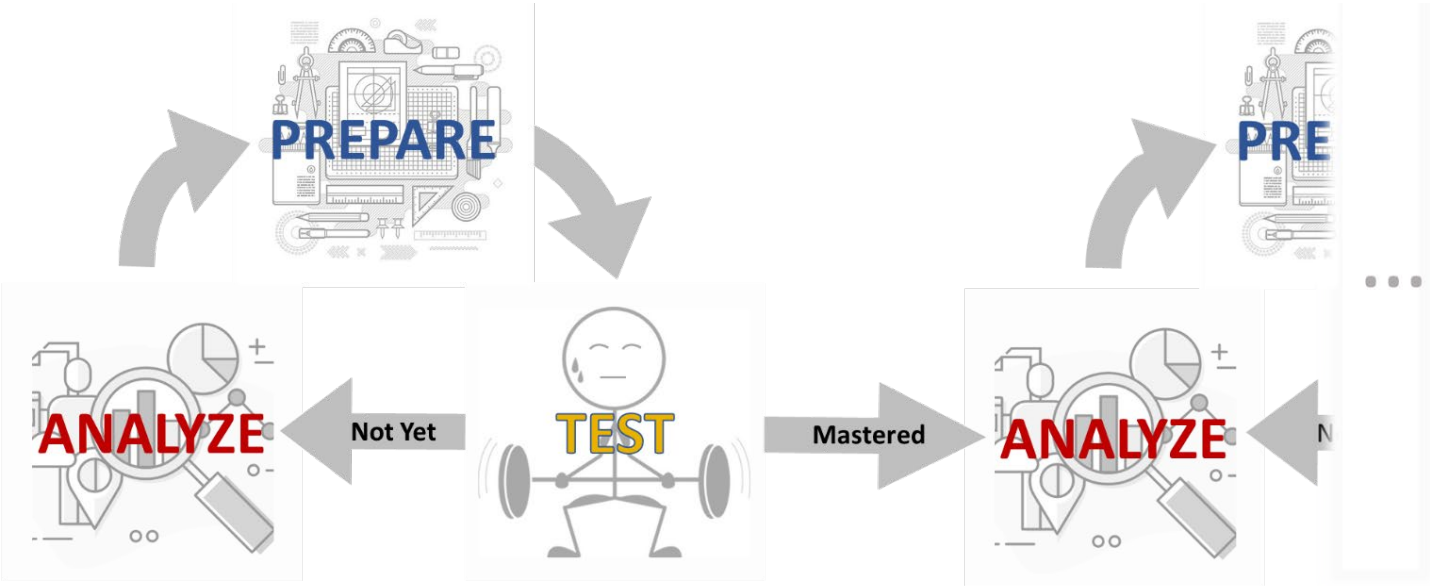
This course is designed to help us develop our ability to learn to persist through the challenges of learning new skills while we master several key analytical skill sets.

This mindset will drive our daily work in this course and will model an approach that will serve you well in any of your courses and as a professional. When something does not work as planned: a poor result on an exam or a project at work that did not meet expectations, figure out where it went wrong and start again with this new insight. Asked if after years of failed attempts to build an electric lightbulb Eddison felt like a failure, he replied "I have not failed. I've just found 10,000 ways that won't work."

In this course we will look at each skill set together, do a bit of guided practice, then work together in small groups to dig in and solve a set of 40-60 problems applying these skills. We'll solve as many of these problems as many times as needed to master the skills; sometimes working several of the problems multiple times. After that investment, we will test ourselves with a Quiz on that skill. If we're not quite there yet, we will analyze what when wrong:

- where do we need more practice?
- what are we not understanding?
- what can our mistakes teach us?
- what aspects of the skill have we not yet mastered?

and dig back in for more practice. Once we've mastered that skill, we will connect that mastery to the next skill set and repeat the process. Each tool in our tool belt provides skills for learning later skills and solving more complex engineering problems.



What can I expect class sessions to look like?

Our class sessions will each take one of three forms. On Presentation days we will all work together exploring one of the skills in the course and doing some guided problem solving together. We will all work together in these sessions no matter which skills you have mastered to date. This ensures that all students explore all the topics in the course and will be ready to dig into deep practice on each topic when they are ready. Many of the skills will also reinforce earlier skills because they do tend to build on each other.

On Coaching days, you will work in small groups on one of the skills in the course. You will work problems between class sessions and should bring problems that have been giving you trouble to class to discuss with your classmates and with me. I will rotate from table to table during these sessions helping you understand difficult analyses.

On Power Up days you can test yourself and demonstrate mastery of new skills.

About your professor: I earned my BS in Engineering Physics from Hope College (Holland Michigan), my MS in Mechanical Engineering from Case Western Reserve University (Cleveland), and my PhD in Mechanical Engineering from the University of Michigan (Ann Arbor). I spent 3 years as a project manager at Ford Motor Company between degrees. I've been at Etown for 23 years and have taught at all levels of the curriculum. I have been married for over 30 years and my wife and I have two children. My wife works at the Lancaster Redevelopment Authority and Homelessness Coalition, my son is a PhD student at Cornell, and my daughter is a senior journalism major at Hofstra. I also mentor the cross-country and track teams – running with the team 2-3 times each week, I play tenor saxophone in the jazz band, and I commute by bike about 32 miles/week year-round.

My research expertise is in human performance and injury biomechanics. I also run a short-term cross-cultural study abroad experience in The Gambia, West Africa, and study engineering teaching methods and run workshops across the country on Mastery Based Assessments.

You can find me on campus in my office:

- **160E Esbenshade Hall**
- (717) 361-1380, anytime
- **degoedek@etown.edu**, anytime
- Cell: (717) 419-9568 (text only)
  - 9:00 AM – 9:00 PM
  - no messages between 1:00 PM Saturday and 4:00 PM on Sunday please
- **Student Hours ("Help me!" sessions):**
  - **M 3:00 – 4:00**
  - **T 2:00 – 3:30**
  - **W 11:00 – 12:00**
  - **H 1:00 – 2:00**
  - **F 9:30 – 11:00**

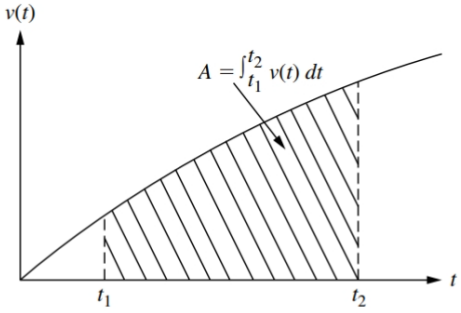
Please feel free to stop by my office anytime, if I am not available when you stop by, please leave a note on the whiteboard.

When and where do we meet?
Section A: MWF 8:00 – 9:20 **Section B:** MWF 12:30 – 1:50.
Both sections meet in Esbenshade room 164 (The Design Lab)

Do I need a book?
There is no textbook required for this course. Open-source resources are readily available for all course topics (www.mathsisfun.com). If desired, these texts cover most of the topics covered in the course: Technical Mathematics with Calculus by Calter and Calter and Introductory Mathematics for Engineering Applications by Rattan and Klingbeil. A third option is good and less expensive but does not cover as many of the topics in the course (it does cover the most important topics): Just-in-Time Algebra and Trig for Calculus by Mueller and Brent.

What exactly will we be studying?

This course is designed to prepare students for success in the engineering curriculum by (1) developing a foundation in applied mathematics. Students will (2) master essential analytical skills prerequisite for the study of calculus, physics, and engineering science (see list of specific skills below). Students will (3) develop the study skills required throughout the engineering curriculum. *(ABET Outcomes 1 and 7).*



We will be building the following specific skills:

Foundational Skill:

F1 – Simplifying: Fractions, rationalization, exponents, and Logarithms.

Primary Skills (Must master F Skills before moving to P skills)

P1 – Solving Equations (Algebra)
P2 – Lines, Circles, and Parabolas
P3 – Functions
P4 – Trigonometric Analysis

Advanced Skills (Must master P skills before moving on to A skills.)**:**

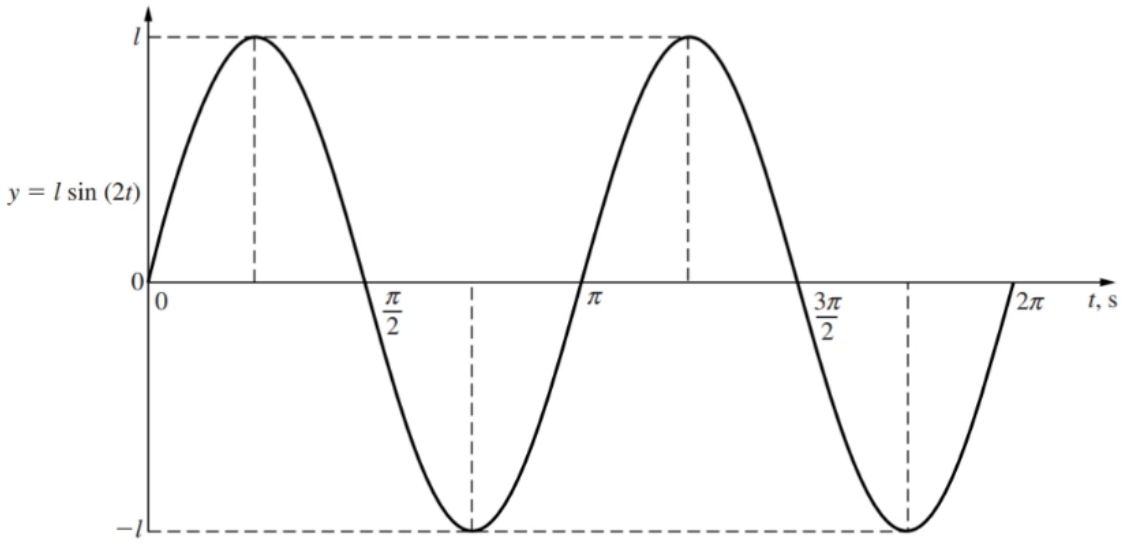
A1 – Advanced Equations
A2 – Vectors
A3 – Complex Numbers

Computational Skills (Must pass all P skills before moving on to C skills):

C1 – Systems of Equations
C2 – Derivatives
C3 – Integrals
C4 – Differential Equations

Mastery of highlighted Skills has been demonstrated as critical for success in Calculus I (Huff, J et.al., *Strengthening Math Skills of Incoming Engineering Freshmen through a Bridge Program*, FYEE Conference 2019, State College PA).

You will also use each of these + the remaining advanced and computational skills throughout your professional work as an engineer.



Course Outline

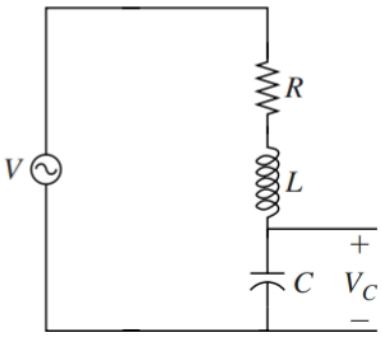
Monday	Wednesday	Friday
August 21		
Welcome **F1** Introduction	**F1** Presentation	Coaching
28		
P1 Presentation	Coaching	**Power Up Day**
September 4		
No Class - Labor Day	**P2** Presentation	Coaching
11		
P3 Presentation	Coaching	**Power Up Day**
18		
P4 Presentation	Coaching	Coaching
25		
Power Up Day	**A1** Presentation	Coaching
October 2		
Power Up Day	**A2** Presentation	Fall Break
9		
Coaching	Coaching	**Power Up Day**
16		
A3 Presentation	Coaching	Coaching
23		
Power Up Day	**C1** Presentation	Coaching
30		
Power Up Day	**C2** Presentation	Coaching

Monday	Wednesday	Friday
November 6		
Power Up Day	**C3** Presentation	Coaching
13		
Power Up Day	**C4** Presentation	Coaching
20		
Power Up Day	Coaching	Thanksgiving
27		
Power Up Day	Coaching	Coaching
Dec 4		
Power Up Day Section B (12:30) Monday 12:30 – 2:00		**Power Up Day Section A (8:00)** Friday 8-9:30

How is this course assessed and graded?

In this course you are assessed based on the number of skills you master by the end of the semester. Some students may take a little longer on some skills. That is OK. The important thing is to master each skill as you progress through the material, so you have the skills needed to tackle each new skill and the mathematics and engineering you will see in future coursework and projects.

Power Ups (Assessments): You demonstrate mastery of a skill with an average of at least 80% on the assigned 5 analyses/problems in a proctored environment. Power up problems are assessed as correct (1 point) or incorrect (0 points). All Power Up problems will be randomly sampled from assigned HW sets (34-60 problems each) – numerical values are randomized. Some multi-part problems may have partial credit. You can also appeal a wrong answer by submitting a written appeal. If you can successfully make the case that the error on a problem was not conceptual (minor and the work on that problem indicates that you have mastered the skill), you will be awarded ½ credit for that problem.



<u>You may retake Power Ups as many times as necessary to achieve Mastery without penalty.</u>

All Power Ups will be taken without any reference materials. Students will work out problems on blank paper and submit their work at the end of the assessment. The use of any other electronic device (calculators, cell phones, smartwatches, etc.) is strictly prohibited, except as noted in the Calculator Policy below.

Assessments are to be taken without communication, except for problem clarification from the instructor. During testing, students are not allowed to access any resources beyond those explicitly permitted by the instructor, including but not limited to online materials and books/note/study guides. Students will not be permitted to leave the classroom during assessments. Exceptions will be granted at the professor's discretion.

Each report (C1, C2, C3 and C4) is scored on a 4-point scale. Any Skills not submitted or for which you do not pass the practicum will be scored as a 0 in this Average.

$$\text{Average} = \frac{C1 + C2 + C3 + C4}{4}$$

(Rounded up)

The final grade is raised by Average/3 of a letter grade (e.g., if Average = 3, the final grade is raised by 1 full letter grade say from C+ to B+).

Calculator Policy:

- F1 and P-skills: No calculators permitted.
- A-skills: you may use an NCEES Approved calculator (https://ncees.org/exams/calculator/).
- C-skills: you will complete the projects with MATLAB®.

Building your Superpowers (Grades):

A strong foundation in Mathematics is your superpower as an engineering student. This course is designed to provide you with the opportunity to build your analytical powers.

Master the F skill	Krypto (F1)		F
Master one P skill	Robin (P1)		D-
Master two P skills	Rocket (P2)		D
Master three P skills	Groot (P3)		D+
Master all four P skills	Storm (P4)		C-
Master one A/C skills	Supergirl (A1)		C
Master two A/C skills	The Flash (A2)		C+
Master three A/C skills	Batman (A3)		B-
Master four A/C skills	Wonder Woman (C1)		B
Master five A/C skills	Iron Man (C2)		B+
Master six A/C skills	Scarlet Witch (C3)		A-
Master all seven A/C skills	Spiderman (C4)		A

Adjustment 1: This will be a fast-paced course and it is critical for your success to attend every class session. If you have more than 2 unapproved absences your course standing will be reduced by one hero rank (1/3 of a letter grade).

Adjustment 2: Participating in daily out-of-class work is essential to your success in this course. If you do not satisfactorily complete 80% of daily discussion assignments, your grade will be reduced by one hero rank (1/3 of a letter grade).

Bonus Opportunities: On up to 2 of the A/C skills that you have mastered, you may complete a 2-page technical report (>750 words) detailing engineering applications of that skill with proper citations and formatting (see style guide). These count as wild-card skills that you can apply to any other A or C skill.

To help us all expand our cultural understanding and compassion for each other, I ask that you join me in attending at least one Diversity, Equity, and Belonging event this semester (not required for any other course). To unlock the bonus skill opportunities, you must attend one of these events and submit a 150-word reflection on the experience.

Ethics: Students are to act in accordance with the Pledge of Integrity:

> I pledge to respect all members of the Elizabethtown College community and to act as a responsible member of the College community. I pledge to respect the free exchange of ideas both inside and outside the classroom. I pledge to represent as my work only that which is indeed my own, refraining from all forms of lying, plagiarizing, cheating, and academic dishonesty.
>
> As members of the Elizabethtown College community, we hold each other responsible for the maintaining of these values.

and the NSPE code of ethics (Cannons attached, with Etown Engineering Professional Obligations)

Students will be asked to reaffirm their commitment to the pledge and the code with their signature on each exam. Dishonest practice can result in failure of the course and possibly expulsion from the college.

All work should represent each student's individual efforts. **Students are encouraged to discuss assignments with other students and/or the instructor, however submitted assignments should reflect the student's own work and understanding.**

All work obtained from any source should be properly referenced.

This includes AI. In this course, students shall give credit to AI tools whenever used, even if only to generate ideas rather than usable text or illustrations. When using AI tools on assignments, add an appendix showing (a) the entire exchange, highlighting the most relevant sections; (b) a description of precisely which AI tools were used (e.g. ChatGPT private subscription version or DALL-E free version), (c) an explanation of how the AI tools were used (e.g. to generate ideas, turns of phrase, elements of text, long stretches of text, lines of argument, pieces of evidence, maps of the conceptual territory, illustrations of key concepts, etc.); (d) an account of why AI tools were used (e.g. to save time, to surmount writer's block, to stimulate thinking, to handle mounting stress, to clarify prose, to translate text, to experiment for fun, etc.). Students shall not use AI tools during in-class

examinations, or assignments unless explicitly permitted and instructed. Overall, AI tools should be used wisely and reflectively with an aim to deepen understanding of subject matter.

Re-Grading: Written requests, with full rationale, for re-grading of all coursework will be accepted the next class period after original materials are returned to the students.

Disabilities Statement

Religious Observance

Fine Print: The preceding information represents the *intent* of the course and is subject to change at the discretion of the instructor.

Elizabethtown Engineering Program Code of Ethics

I. Hold paramount the safety, health, and welfare of fellow students.
II. Perform project tasks and assignments only in the areas of their competence.
III. Submit assignments only in an objective and truthful manner.
IV. Act for team members, instructors, or employers as faithful agents or trustees.
V. Avoid deceptive acts.
VI. Conduct themselves responsibly, ethically, lawfully, and in line with the integrity policy so as to enhance the honor, reputation, and usefulness of the profession and college's engineering department.

Professional Obligations (Etown Engineering Students)

1. **Engineering students shall be guided in all their relations by the highest standards of honesty and integrity.**
   A. Be honest about your mistakes.
   B. Do not cheat on exams or assignments.
   C. Do not plagiarize or falsify data.
   D. Do not aid or abet another student in unethical behavior.
2. **Engineers shall at all times strive to gain the knowledge to serve the public's interest.**
   A. Your goal in class should be to gain knowledge to justify your intended degree, not just to obtain a high grade.
   B. Work for the advancement of society and the profession by engaging in the community and recruiting youth to the engineering profession.
   C. Inform professors of unethical requests from other students.

3. **Engineers shall avoid all conduct or practice that deceives other students, instructors, or the public.**
   A. In lab work, be truthful with ALL data, even if it is not favorable.
   B. All assignments should be your own original work unless otherwise noted.
   C. Do not finish and submit team projects without the approval of ALL your other team members.
4. **Engineers shall not disclose confidential information concerning their own group work to any person outside of their group except for the professor.**
   A. Do not put individual assignments in your public folder.
   B. Do not spread the word of quiz questions or unannounced assignments to later sections of a course.
   C. Engineering students who are or have been a TA shall not disclose information about tests and grades of other students.
   D. Do not disclose or use information learned from the internships that have to do with processes, or techniques of production.
5. **Engineering students shall not be influenced in their scholastic duties by conflicting interests.**
   A. Do not attempt to receive a favorable grade or recommendation by establishing an unprofessional relationship with a professor.
   B. In peer assessments or as a TA, do not allow friendships or grades to sway judgment
   C. Do not attempt to gain favor in class or for assignments through flattery of professors.
6. **Students should not attempt to gain advancement by downgrading other students' work or by other questionable methods.**
   A. Credit should be awarded where it is deserved when submitting group work.
   B. If another student does exceptional work, do not take credit for it if it is not your work.
   C. If another student is performing inadequate work, calmly confront them about it before addressing it to the professor.
   D. Students shall not sabotage the projects or advancements done by other students.
   E. Do not blame group members for their own behavior.
   F. Do not blame professors or staff for their grades.
7. **Engineering students should not attempt to injure the reputation of the engineering department or the reputation of professors and engineers in the department.**
   A. If other engineering students are injuring the reputation of the department, you should inform the head of the department or the professor of their actions.
   B. Every student in the department's actions should coincide with the integrity policy of the college to avoid degrading the department.
   C. Students shall report malicious activities to the Head of the Engineering Department, or appropriate instructor. Yet, the student shall not tell others of the issue.

8. **Engineering students should accept personal responsibility for all of the work they do for the department and for their group.**
   A. Students shall act truthfully when accused of misconduct.
   B. Blame for violations of the integrity policy should not be placed on the department or professors, but rather on the individual who committed them.
   C. Students should also accept the blame if their group submits unethical work because it is their responsibility to ensure any submission with their name on it is held to high ethical standards.

9. **Engineering students shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interests of others.**
   A. Students shall not steal programs or work from other engineers or students from the internet through illegal networks.
   B. Students shall properly cite information in all manners of presentation such as research papers, essays, PowerPoints, etc.

Obligations written by Etown Engineering students Class of 2021
Cannons adapted from: https://www.nspe.org/resources/ethics/code-ethics