<TITLE>

A thesis written at

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and submitted to

KETTERING UNIVERSITY

in partial fulfillment
of the requirements for the
degree of

BACHELOR OF SCIENCE IN <DEGREE>

by

<STUDENT NAME>

<Month & year of graduation>

Author

Employer Advisor

Faculty Advisor

DISCLAIMER

This thesis is submitted as partial and final fulfillment of the cooperative work experience requirements of Kettering University needed to obtain a Bachelor of Science in Degree.

The conclusions and opinions expressed in this thesis are those of the writer and do not necessarily represent the position of Kettering University or , or any of its directors, officers, agents, or employees with respect to the matters discussed.

PREFACE

This thesis represents the capstone of my five years combined academic work at Kettering University and job experience at . Academic experiences in proved to be valuable assets while I developed this thesis and addressed the problem it concerns.

Although this thesis represents the compilation of my own efforts, I would like to acknowledge and extend my sincere gratitude to the following persons for their valuable time and assistance, without whom the completion of this thesis would not have been possible:

1. <When filling out this section, include all professional titles> If the acknowledgement uses up more than one full line, single-space within.

2.

3.

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LIST OF ILLUSTRATIONS

I. INTRODUCTION

Following a brief introductory paragraph, the introduction chapter requires six headings titled the following: Problem Topic, Background, Criteria and Parameter Restrictions, Methodology, Primary Purpose, and Overview. Each heading should be margin flush, bold and underlined (APA level 3 heading). A description of what is to be written under each heading is indicated below.

Problem Topic

Under the heading, Problem Topic, bring into focus in a single clear statement, the exact problem addressed and the nature of the end result sought. The problem itself must not be stated in terms of a desirable goal or solution but rather as a current or potential negative situation, result, etc. that the employer would like to eliminate or avoid. If sub-problems are involved, they should be stated here.

Background

Under the heading, Background, provide a helpful orientation regarding the problem addressed by the thesis. It may be necessary to clarify the situation in which the problem arose. The nature of the student's experience with that situation might also be appropriate information to include. Concerns expressed by managers, customers, or others may be relevant background. All the material presented should enable the reader to understand the exact nature of the problem and is importance especially to the employer organization. The background should not give elaborate overly-generalized, obvious, or nonessential information. Facts that should be reporte din a later chapter should not be included. If a history of the employer organization is relevant, it should be placed in an appendix.

Criteria and Parameter Restrictions

Under the heading Criteria and Parameter Restrictions, identify the criteria and parameters imposed, if the thesis project concerns the creation of a design. (Sometimes parameters are also briefly identified earlier under the heading Problem Topic, as part of the problem or the problem situation.) If the thesis prject does not concern the creation of a design, the heading may simply be Criteria or perhaps Standards. For all topics, criteria or standards should be identified as the basis for judging the data later presented in supporting (developing) chapters. The appropriateness of each criterion or standard must be briefly justified.

Methodology

Under the heading Methodology, give the major specific steps of the procedure used in solving the problem, so the reader will immediately know that the solution was achieved in a systematic and valid way. Identify the general types of data sources, e.g., the writer's direct observations, tests, department records, technical publications.

Primary Purpose

Under the heading Primary Purpose, state that the thesis presents the results of the investigation. One sentence will suffice.

Overview

Under the heading Overview, briefly summarize in sentences in a concluding paragraph the content and order of subsequent thesis chapters.

II. CONCLUSIONS AND RECOMMENDATIONS

The Conclusions & Recommendations chapter can be placed either directly after the Introduction chapter (traditional location for a business report) or as the last chapter of the thesis (traditional location for a strictly academic thesis). Students should make sure both advisors agree on this format choice before the Preliminary Thesis is submitted.

After a brief introductory paragraph, the chapter should achieve the following goals clearly and concisely: (1) answer the main question or issue pertinent to the problem posed in the first chapter, (2) identify the major reasons for the validity of that answer (i.e., the conclusions that support it), and (3) state the course(s) of action justified by the conclusions. Here are some further considerations:

1. Focus – After a brief introductory paragraph, the section of Conclusions should be opened by first directly giving the "big answer" conclusion to the major problem. The reader understands the subsequent supporting elements best when the overall outcome conclusion is first made clear. Each supporting conclusion statement listed must clearly stand as a reason for the validity of the "big answer" initially provided.

2. Integration – Next, the concluding elements should be grouped in a way that is most useful to the reader. For example, individual conclusions, key findings, and recommendations that are directly related to each other should be kept together and appropriately identified as such. Thus those elements should not just be separated under headings of "Findings," "Conclusions," etc. If some recommendations are not specific responses to a particular conclusion, they may be presented under the heading General Recommendations as the final section of the chapter.

3. Content of recommendations – This is of major importance to the Conclusions and Recommendations chapter. Each recommendation should be stated as one or more action steps to be taken, not merely as a goal to be achieved. Certainly a recommendation may be expressed as the means that would likely achieve a desirable goal, or would likely advance toward achieving such a goal. Also, the probable implications of implementing each recommendation should be noted, with some brief identification of the benefits that may be expected from it, as well as its cost. If a more lengthy discussion of these matters is appropriate, it should

be placed in an appendix, with a reference to it provided at the end of the recommendation. Extensive information and guidance for implementing a recommendation should also be provided in an appendix and so noted.

4. Subheadings – Any subheadings needed should be used to clearly group related items. In most instances, the headings should be phrased in terms of the appropriate portions of the subject matter with which they dealt.

5. Lists – Listing is usually desirable, but the relationships of listed items must be clear.

6. Linking of facts to conclusions – This is of major importance to the Conclusions and Recommendations chapter. Each supporting conclusion must be explicitly linked to its key supporting facts. State them briefly and cite their page numbers in parenthesis from one or more developing chapters. Those key facts must be thereby correlated to the text in developing chapters where they are presented in more detail. This strategy allows the reader to turn directly to the full evidence that supports any conclusions that may be questioned. Each criterion identified in Chapter I must also be clearly identified again here and explained as the basis for generating a conclusion, in order to clarify its validity.

7. Graphics – Comparative findings can best be summarized in a table. Graphs and other illustrations can also be used to give a condensed overall view of the evidence in a figure. The paragraph text must introduce and briefly explain the key information in a table or a figure. For example, suppose alternative solutions were considered. A table would be constructed so that one axis indicated the alternatives and the other axis indicated the criteria used. The degree to which each criterion was met would appear in the resulting “boxes.” The text discussing the table would emphasize the respects in which the recommended alternative was best.

8. Conclusions regarding a design – If the project deals with a design, the concluding elements will be somewhat modified. The conclusions will begin with the “big answer,” by indicating whether or not a successful design was evolved. The rest of the chapter briefly points out the major features that made the design satisfactory, or the obstacles that made it unsatisfactory. It specifically shows how each parameter and criterion was met, or not, generally in the order the criteria were listed in the Introduction. Reference should be made to the relevant key details in the description of the design, as well as the key facts that justify the inclusion of those details. Again, the key facts must be cited by page numbers in parenthesis, to correlate those facts to text in developing chapters where they are presented in more detail. If the design was tested, test results should be summarized.

III. SUPPORTING CHAPTERS (Please remove this as a chapter heading.)

The remaining supporting chapters should be introduced by a brief overview paragraph. The beginning-middle-end principle applies to the organization of the remaining content. Subsections, each logically and clearly developed, are marked off by headings (e.g., background, statement of general problem addressed in a chapter, statement of the phase of the investigation, steps in the solution, or categories of information). Supporting data and a full explanation of research procedures are needed by the reader to judge the validity of the main conclusions of the thesis. Thus the methodology used for collecting, processing, and interpreting data must be described adequately. The data must be relevant, accurate, specific, and conclusive, with both procedure and supporting data organized and presented in the most convenient and useful way. This requirement means that the reader should not have to reference and appendix frequently, or search for what elaborate arrays of data may signify. The main point is that the reader should be able to find, in detail, the significant steps taken and the facts gathered to generate the conclusions and recommendations presented in the thesis.

REFERENCES

Carter, A. W. (1997, December 17) [Letter to E.M. Brown].

Dulan, C. K. (1994). Technical writing: Sources of validity. Journal of Scientific Inquiry, 59(12), 13-21.

Engineering Analysis Department, Milo Corp. (1995). Daily index report (No. 23-873). Chicago: Author.

Felders, E. (1996, January 22). Testing equipment. Annual audit: Plant 2 (pp. 14-22). Yorkdale, NJ: Berko, Inc.

Ferguson, M. A. (1997, November 14). Jason Engineering Co., Chicago [Interview].

Kettering University – Formerly GMI. (September 5, 2002) Understanding the human dimension of corporate success [Online]. Available: www.news.kettering.edu/showpage.cfm?p=topstory

McQueen, J. L. (1997). Assessment of a total quality management program in a banking culture. Unpublished senior thesis, GMI Engineering & Management Institute, Flint, MI.

Olson, D. L. (1998a). Collaborative planning and transforming knowledge. Journal of Business Communication, 31, 1-9.

Olson, D. L. (1998b). Writing the scientific article. Journal of Business Communication, 31, 287-299.

Smart, T. (1993, October 4). Can Xerox duplicate its glory days? [Online]. Business Week, 61, 56-58. CompuServe. Lexis/Nexis. [1995, November 14].

Zen Society of Information Studies. (c. 1950). Reporting statistics. New York: Author.

GLOSSARY

Cross Slides:	Slide units that are mounted on one another and "cross." One slide moves in the direction of transfer and the other moves toward and away from the centerline of machine. Most commonly used for milling operations. See Figure 5.
Fixture:	Assembly that holds the part. May be in an idle or workstation. If in a workstation, the fixture contains clamps to hold the part while it is being machined. See Figure 1.
Head:	Consists of a head bracket that holds the motors, gears, idler gears, drills and/or taps, and other components necessary to turn the drill head(s) or tap head(s). See Figure 8 and Figure 1 "(4) Spindle Drill Head" for an example of usage.
Hundred Levels:	The "100" levels are part of the numbering system used to describe the levels and parts of the machine. Each 100 level indicates a particular assembly. For a more complete description of this system, refer to Appendix B.
Integral Bases:	Center bases and wing bases that are one unit instead of two or three separate entities. See Figure 2 and Figure 3 for an example of single-sided and double-sided respectively. See Figure 1 "Integral Base" for an example of an integral base in use.
Kit Build:	Process of building, supplying power to, validating, and shipping a station as though it is its own machine. Facilitates quicker build, validation, and installation on the customer's floor.
Machine Layout Design:	Also called "100 drawing." Layout of machine that also lists operations by station and major components used. See figure 9.

APPENDICES

APPENDIX A

TOPIC TITLE IS PLACED HERE

PLACE TOPIC TITLE HERE

Place content of the topic here.

APPENDIX B

ABET PROGRAM OUTCOMES

The Abet Program Outcomes is to be the last Appendix in your Appendices. Each degree program is listed alphabetically within this appendix. Please respond to the statements listed for your degree program by briefly explaining how your thesis project met each outcome. If you are earning a dual degree, include both. If an outcome statement does not apply to your thesis project, briefly state why it did not meet that outcome. (Delete this instructional paragraph.)

When typing your responses to the outcome statements be sure to keep at least two lines of your response text together, on the same page as the outcome. (Delete this instructional paragraph.)

DELETE ALL PROGRAM OUTCOMES FOR DEGREES THAT DO NOT APPLY TO YOU.

APPLIED PHYSICS STUDENT OUTCOMES
Applied Sciences Accreditation Board (AP Degree)

Applied Physics Student Outcomes (previously referred to as Program Outcomes by ABET) are the same as those indicated by ABET (a) - (k) criteria. Applied Physics degree follows the criteria established by the Applied Sciences Commission

A. An ability to apply knowledge of mathematics, science, and engineering.

B. An ability to design and conduct experiments, as well as to analyze and interpret data.

C. An ability to formulate or design a system, process, or program to meet desired needs.

D. An ability to function on multi-disciplinary teams.

E. An ability to identify and solve applied science problems.

F. An understanding of professional and ethical responsibility.

G. An ability to communicate effectively.

H. The broad education necessary to understand the impact of solutions in a global and societal context.

I. A recognition of the need for, and an ability to engage in lifelong learning.

J. A knowledge of contemporary issues.

K. An ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice.

PROGRAM OUTCOMES
CHEMICAL ENGINEERING

Upon graduation, students receiving the Bachelor of Science in Chemical Engineering Degree from Kettering University will have the following knowledge, skills, and abilities:

A. An ability to apply knowledge of mathematics, science and engineering.

B. An ability to design and conduct experiments, as well as 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.

D. An ability to function on multi-disciplinary teams.

E. An ability to identify, formulate, and solve engineering problems.

F. An understanding of professional and ethical responsibility.

G. An ability to communicate effectively.

H. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

I. A recognition of the need for, and an ability to engage in lifelong learning.

J. A knowledge of contemporary issues.

K. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

CHEMISTRY AND BIOCHEMISTRY
PROGRAM EDUCATIONAL OBJECTIVES AND OUTCOMES

PEO 1: The graduates of the Chemistry Degree Program will have a broad, fundamental and mathematically rigorous understanding of theoretical and experimental chemistry.

Outcome 1: Students will have a working understanding of basic chemistry concepts.

Outcome 2: Students will be competent in using modern instrumentation.

Outcome 3: Students will graduate with a sufficiently diverse academic background in theoretical and experimental chemistry.

PEO 2: The graduates of the Chemistry Degree Program will function effectively and ethically within an organization and society as professional chemists.

Outcome 4: Students will have an ability to apply knowledge of mathematics and science.

Outcome 5: Students will have an ability to conduct experiments, as well as to analyze and interpret data.

Outcome 6: Students will have an ability to design experiments.

Outcome 7: Students will have an ability to function as members of a work or research team.

Outcome 8: Students will have an understanding of professional and ethical responsibility.

Outcome 9: Students will have an ability to successfully access and use chemical information, including professional journals, abstracts, and databases.

Outcome 10: Students will be competent in using computers, including programming, data acquisition and use of data bases and application software.

PEO 3: The graduate of the Chemistry Degree Program will have the skills necessary to effectively communicate their chemical understanding to the general public and to the professional chemical community.

Outcome 11: Students will be competent in oral presentation of scientific work.

Outcome 12: Students will be competent in the writing of scientific papers and in other written presentations of scientific work.

PEO 4: The graduates of the Chemistry Degree Program will be familiar with health and safety concerns and the use of chemicals in industry.

Outcome 13: Students will have the broad education necessary to understand the impact of chemicals on industry, the environment, and the global economy.

Outcome 14: Students will be familiar with the handling of hazardous materials.

Outcome 15: Students will be familiar with fundamentals of toxicology.

Outcome 16: Students will have an understanding of environmental polices.

PEO 5: The graduates of the Chemistry Degree Program will be able to pursue an advanced degree.

Outcome 17: Graduates of the program will compare favorably with chemistry undergraduates from other institutions.

Outcome 18: Students will be adequately prepared for graduate studies.

Outcome 19: Students will be able to pursue independent research.

RELATIONSHIP TO COMPUTER ENGINEERING PROGRAM OUTCOMES

Each graduate of the Computer Engineering program will have demonstrated the ability to do each of the following:

Program Outcome 1. Assembly language. Analyze, design, develop, debug, and document structured assembly language programs for at least two different embedded-computer platforms, including at least one with a 32- or 64-bit architecture. Use appropriate techniques and modern embedded-computer development tools.

Program Outcome 2. High-level language. Analyze, design, develop, debug, and document programs in at least one structured high-level programming language. Use appropriate techniques and modern software development tools.

Program Outcome 3. Real-time operating systems. Develop, debug, and document a simple real-time operating system and design, develop, debug, and document application programs for it to implement a complete real-time system that meets specifications. Use appropriate techniques and modern embedded-computer development tools.

Program Outcome 4. Analyze, design, prototype, debug, and document combinational and sequential digital circuits. Use appropriate techniques and modern digital-systems development tools and implementation technologies.

Program Outcome 5. Computer architecture. Design and verify the operation of a basic central processing unit for a general-purpose computer. Use appropriate techniques and modern digital-systems simulation tools.

Program Outcome 6. Circuits, electronics, and systems. Model, analyze (at DC and AC steady state), and design electrical and electronic circuits and systems. Use modern electronic design and test equipment.

Program Outcome 7. Elective areas. Use understanding of basic principles and appropriate tools to analyze, design, develop, debug, and document simple systems in at least two of the following areas of computer engineering: computer networks, programmable logic controllers, expert systems, database systems, VLSI systems.

Program Outcome 8. Teamwork. Work productively in a multidisciplinary team, in particular to carry out projects involving computer engineering.

Program Outcome 9. Ethics and professionalism. Act in a professional and ethical manner in the workplace.

Program Outcome 10. Written and oral communication. Communicate effectively through written reports and oral presentations appropriate for other computer engineers or for non-technical audiences, as required.

Program Outcome 11. Global and societal context. Understand the impact of engineering solutions in a global and societal context.

Program Outcome 12. Lifelong learning. Independently acquire the information and understanding necessary to complete projects or undertake other responsibilities in unfamiliar areas from appropriate sources such as books, training courses, technical documentation, and application notes.

Program Outcome 13. Contemporary issues. Understand contemporary issues, especially as they relate to employment as a computer engineer.

COMPUTER SCIENCE PROGRAM OUTCOMES

The Computer Science department at Kettering University set forth these four program objectives:

1. Computer Science graduates will have a broad, mathematically rigorous program in the fundamental areas of computer science that will allow them to continue their professional development and sustain a life-long career in computer science either through graduate study or continuing self-directed learning and development activities.

2. Computer Science graduates will have developed a sufficient depth of understanding in computer science, and the skill, confidence, professionalism, and experience necessary for successful careers in computer science and related fields.

3. Computer Science graduates will have the teamwork, communication, and interpersonal skills to enable them to work efficiently with interdisciplinary teams in industry, government, and academia.

4. The Computer Science faculty will provide its degree majors an excellent education experience through the incorporation of current pedagogical techniques, understanding of contemporary trends in research and technology, and hands-on laboratory experiences that enhance the educational experience.

RELATIONSHIP TO ELECTRICAL ENGINEERING PROGRAM OUTCOMES

Program Outcome a. An ability to solve electrical engineering problems by applying knowledge of such fundamental and advanced mathematics as calculus, differential equations, linear algebra, probability and statistics, and science and engineering principles.

Program Outcome b. An ability to design and conduct experiments in electrical engineering, as well as to collect, analyze and interpret data to reach appropriate conclusions.

Program Outcome c. An ability to design an electrical system, component, or process to meet desired technical, environmental, safety and economical specifications.

Program Outcome d. An ability to participate and contribute in multi-disciplinary team activities.

Program Outcome e. An ability to identify, formulate, and solve engineering problems.

Program Outcome f. An understanding of professional and ethical responsibility and the consequences of failing in it.

Program Outcome g. An ability to communicate effectively in both oral and written fashion.

Program Outcome h. The broad education necessary to understand the impact of engineering solutions in a global and societal context.

Program Outcome i. An appreciation for the need for, and preparedness to engage in life-long learning.

Program Outcome j. A knowledge of contemporary social, economical and political issues and their impact on engineering profession.

Program Outcome k. An ability and experience in using the techniques, skills, and modern engineering tools necessary for engineering practice.

Program Outcome l. A knowledge of computer science and computer engineering, and engineering sciences necessary to analyze and design systems containing hardware and software components.

ENGINEERING PHYSICS STUDENT OUTCOMES

Engineering Accreditation Board (EP Degree)

Engineering Physics Student Outcomes (previously referred to as Program Outcomes by ABET) are the same as those indicated by ABET (a) - (k) criteria. Engineering Physics degree has adopted criteria established by the Engineering Commission

A. An ability to apply knowledge of mathematics, science, and engineering.

B. An ability to design and conduct experiments, as well as 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.

D. An ability to function on multi-disciplinary teams.

E. An ability to identify, formulate, and solve engineering problems.

F. An understanding of professional and ethical responsibility.

G. An ability to communicate effectively.

H. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

I. A recognition of the need for, and an ability to engage in lifelong learning.

J. A knowledge of contemporary issues.

K. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

PROGRAM OUTCOMES
INDUSTRIAL ENGINEERING

A. An ability to apply knowledge of mathematics, science, and engineering.

B. An ability to design and conduct experiments, as well as to analyze and interpret data.

C. An ability to design a system, component, or process to meet desired needs.

D. An ability to function on multi-disciplinary teams.

E. An ability to identify, formulate, and solve engineering problems.

F. An understanding of professional and ethical responsibility.

G. An ability to communicate effectively.

H. The broad education necessary to understand the impact of engineering solutions in a global and societal context.

I. A recognition of the need for, and an ability to engage in lifelong learning.

J. A knowledge of contemporary issues.

K. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

L. Understand and serve in Industrial Engineering roles.

M. Describe, model, and measure current processes and systems and identify areas of improvement.

N. Estimate current, and forecast future, resource requirements.

O. Design and organize work spaces and places.

P. Track the results of improvement efforts as part of a continuous improvement process.

PROGRAM OUTCOMES
MANAGEMENT

A. Students graduating with a Bachelor of Science Degree in Management will have a broad knowledge and understanding of business fundamentals so that they are academically prepared for a business career; compare favorably when evaluated on a national norm, and as alumni, are successful in advanced studies, other professional fields, or in advancing themselves within an organization.

B. Graduating undergraduate students will have the positive perspectives and skills that create productive employees and managerial leaders.

C. The undergraduate Business Program Faculty will demonstrate teaching effectiveness by using appropriate educational and learning techniques in the classroom.

PROGRAM OUTCOMES
MANUFACTURING ENGINEERING

A. An ability to apply knowledge of mathematics, science, and engineering.

B. An ability to design and conduct experiments, as well as to analyze and interpret data.

C. An ability to design a system, component, or process to meet desired needs.

D. An ability to function on multi-disciplinary teams.

E. An ability to identify, formulate, and solve engineering problems.

F. An understanding of professional and ethical responsibility.

G. An ability to communicate effectively.

H. The broad education necessary to understand the impact of engineering solutions in a global and societal context.

I. A recognition of the need for, and an ability to engage in lifelong learning.

J. A knowledge of contemporary issues.

K. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

L. Have proficiency in materials and manufacturing processes: understanding the behavior and properties of materials as they are altered and influenced by processing in manufacturing.

M. Have proficiency in process, assembly and product engineering: understanding the design of products and the equipment, tooling and environment necessary for their manufacture.

N. Have proficiency in manufacturing competitiveness: understanding the creation of competitive advantage through manufacturing planning, strategy and control.

O. Have proficiency in manufacturing systems design: understanding the analysis, synthesis and control of manufacturing operations using statistical and calculus based methods, *simulation, and *information technology.

P. Have proficiency in laboratory experience: graduates must be able to measure manufacturing process variables in a manufacturing laboratory and make technical inferences about the process.

APPLIED MATH PROGRAM OUTCOMES

A. An ability to apply knowledge of mathematics, science, and engineering.

B. An ability to design and conduct experiments, as well as to analyze and interpret data.

C. An ability to design a system, component, or process to meet desired needs.

D. An ability to function on multi-disciplinary teams.

E. An ability to identify, formulate, and solve engineering problems.

F. An understanding of professional and ethical responsibility.

G. An ability to communicate effectively.

H. The broad education necessary to understand the impact of engineering solutions in a global and societal context.

I. A recognition of the need for, and an ability to engage in lifelong learning.

J. A knowledge of contemporary issues.

K. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

PROGRAM OUTCOMES
MECHANICAL ENGINEERING
(Updated for 2008/09 Academic Year)

Upon graduation, students receiving the Bachelor of Science in Mechanical Engineering Degree from Kettering University will have the following knowledge, skills, and abilities:

L. An ability to apply knowledge of mathematics, science and engineering.

M. An ability to design and conduct experiments, as well as to analyze and interpret data.

N. 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.

O. An ability to function on multi-disciplinary teams.

P. An ability to identify, formulate, and solve engineering problems.

Q. An understanding of professional and ethical responsibility.

R. An ability to communicate effectively.

S. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

T. A recognition of the need for, and an ability to engage in lifelong learning.

U. A knowledge of contemporary issues.

V. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

W. Familiarity with statistics and linear algebra.

X. A knowledge of chemistry and calculus-based physics with a depth in at least one of them.

Y. An ability to model and analyze inter-disciplinary mechanical/electrical/hydraulic systems.

Z. An ability to work professionally in the area of thermal systems including the design and realization of such systems.

AA. An ability to work professionally in the area of mechanical systems including the design and realization of such systems.