Making Opportunity Affordable in Texas:

A Student-Centered Approach

Tuning of Mechanical Engineering

Texas Higher Education Coordinating Board

Austin, Texas

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Tuning Oversight Council for Engineering

Mechanical Engineering Committee

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Table of Contents

Definition of Tuning

"Tuning" is a faculty-led pilot project designed to define what students must know, understand, and be able to demonstrate after completing a degree in a specific field, and to provide an indication of the knowledge, skills, and abilities students should achieve prior to graduation at different levels along the educational pipeline – in other words, a body of knowledge and skills for an academic discipline in terms of outcomes and levels of achievement of its graduates.

Tuning provides an expected level of competency achievement at each step along the process of becoming a professional: expectations at the beginning of pre-professional study, at the beginning of professional study, and at the transition to practice. It involves seeking input from students, recent graduates, and employers to establish criterion-referenced learning outcomes and competencies by degree level and subject areas. Through Tuning, students have a clear "picture" of what is expected and can efficiently plan their educational experience to achieve those expectations. The objective is not to standardize programs offered by different institutions but to better establish the quality and relevance of degrees in various academic disciplines. An overview of Lumina Foundation for Education's "Tuning USA" Initiative is available at: http://www.luminafoundation.org/; an overview of Tuning work to date in Texas is available at: http://www.thecb.state.tx.us/tuningtexas.

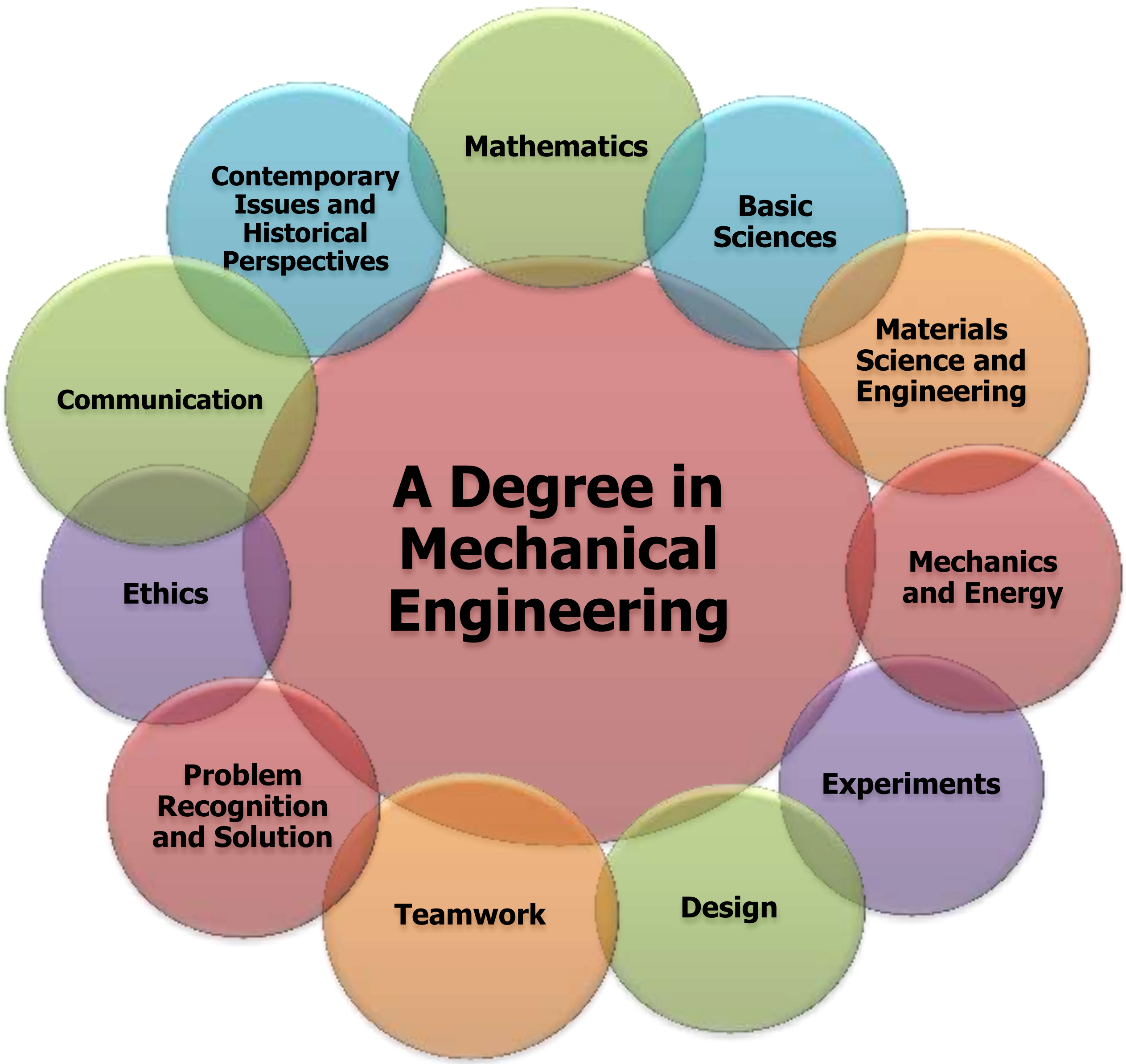
Definition of Mechanical Engineering

Mechanical engineering is a branch of engineering that applies principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations) for modeling, analysis, design, and realization of physical systems, components, or processes. Mechanical engineering curriculum also prepares students to work professionally in both thermal and mechanical systems areas. Mechanical engineering is one of the oldest and broadest engineering disciplines.

The lead society of this engineering discipline is the American Society of Mechanical Engineers (ASME) with a webpage at http://www.asme.org/.

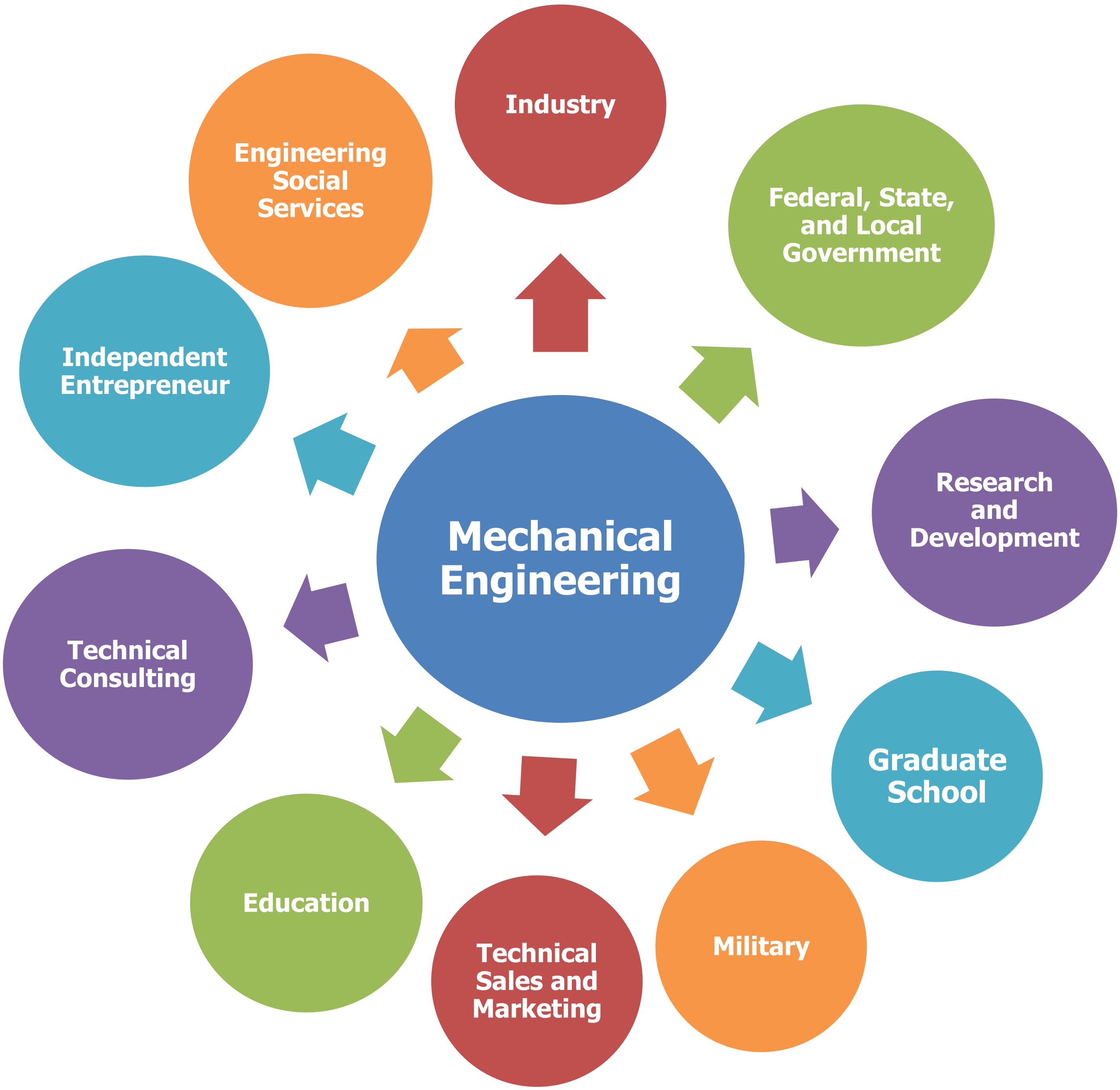
Mechanical Engineering Expertise Profile

The expertise profile lists 11 types of course work necessary for the completion of a baccalaureate degree in mechanical engineering. Note: general undergraduate degree requirements, i.e., the core curriculum, are not considered for the purpose of tuning mechanical engineering and this report.



Mechanical Engineering Employment Profile

The employment profile lists potential employment pathways available for graduates of mechanical engineering programs.



Mechanical Engineering Competency Table

The Mechanical Engineering Tuning Committee has two sets of competency tables. The first table adopts the exact definitions stipulated in Criterion 3 - Student Outcomes (a) to (k) in Criteria for Accrediting Engineering Programs Effective for Evaluations During the 2011-2012 Accreditation Cycle. The corresponding webpage is http://www.abet.org. The second table adopts the eleven learning outcomes specific for mechanical engineering disciplines.

Both of the Mechanical Engineering competency tables have four levels of learning outcomes:

1. Secondary education competencies (HS)
2. Pre-engineering competencies (CC)
3. Baccalaureate-level competencies (BS)
4. Post-baccalaureate level competencies (PB)

The ABET Student Outcomes are listed as follows:

(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 multidisciplinary 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

Mechanical Engineering Key Competencies Profile

The key competencies profile is a schematic diagram that is derived from the competency table. It lists, for each learning outcome (columns), the required competency levels according to Bloom's taxonomy (rows) that must be gained at each of four educational levels: namely, HS, CC, BS, and PB.

The six competency levels according to Bloom's taxonomy are:

1. knowledge
2. comprehension
3. application
4. analysis
5. synthesis
6. evaluation

The level of response for each of the Bloom's taxonomy levels is described through active verbs; examples of verbs for each level can be found at:

<http://www.teach-nology.com/worksheets/time_savers/bloom/>

Mechanical Engineering Key Competencies Diagram

Lumina Foundation Grant Mechanical Engineering Committee

Evaluation		PB	PB				PB	PB		PB	
Synthesis		PB	BS		PB	PB	PB	PB		PB	
Analysis	PB	BS	BS	PB	PB	BS	BS	PB	PB	PB	PB
Application	BS	BS	BS	BS	BS	BS	CC	BS	BS	BS	BS
Comprehension	CC	CC	BS	CC	CC	BS	HS	CC	CC	CC	CC
Knowledge	HS	HS	CC	CC	CC	CC	HS	CC	CC	HS	CC
	Mathematics, Science, and Engineering	Experiments	System Design	Multidisciplinary Teamwork	Problem Recognition and Solution	Professional and Ethical Responsibility	Communication	Global Impact of Engineering Solutions	Lifelong Learning	Contemporary Issues	Engineering Tools

PB	post-baccalaureate-level competencies
BS	baccalaureate-level competencies
CC	pre-engineering competencies
HS	secondary education competencies

Mathematics, Sciences, and Engineering

Mathematics deals with the science of structure, order, and relation that has evolved from counting, measuring, and describing the shapes of objects. It uses logical reasoning and quantitative calculation, and is considered the underlying language of science. The principal branches of mathematics relevant to mechanical engineering are arithmetic, geometry, algebra, trigonometry, analysis, calculus, differential equations, numerical methods, linear algebra, probability and statistics, and optimization.

Underlying the professional role of the mechanical engineer as the master integrator and technical leader is a firm foundation in the natural sciences. Physics and chemistry are two disciplines of the natural sciences that have historically served as basic foundations. Additional disciplines of natural science are also assuming stronger roles within mechanical engineering.

Physics is concerned with understanding the structure of the natural world and explaining natural phenomena in a fundamental way in terms of elementary principles and laws. Many areas of mechanical engineering rely on physics for understanding governing principles and for obtaining solutions to problems. Chemistry is the science that deals with the properties, composition, and structure of substances (elements and compounds), the reactions and transformations they undergo, and the energy released or absorbed during those processes. Chemistry is concerned with atoms as building blocks, everything in the material world, and all living things.

Additional breadth in such natural science disciplines as biology and ecology will eventually be required to prepare the mechanical engineer of the future. Mechanical engineers should have the basic scientific literacy that will enable them to be conversant with technical issues pertaining to environmental systems, public health and safety, durability of structural materials, and other such subjects.

The mechanical engineering graduate solves problems in mathematics, calculus-based physics, chemistry, and one additional area of natural science through differential equations and *applies* this knowledge to the solution of engineering problems. The mathematics, physics, chemistry, and breadth in natural sciences required for mechanical engineering practice must be learned at the undergraduate level and should prepare students for subsequent courses in engineering and engineering practice.

MATHEMATICS, SCIENCE, AND ENGINEERING			
Core Competencies Needed to enter Higher Education in Mechanical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	Post-Baccalaureate Level Engineering Competencies
Define key concepts and factual information using algebra, trigonometry, and algebra-based physics and chemistry	Explain key concepts and problem-solving processes using mathematics through differential equations, calculus-based physics, chemistry, linear algebra	Solve mechanical engineering problems using differential equations, calculus-based physics, chemistry, probability and statistics	Resolve a complex mechanical engineering problem into components to determine its relevant mathematical and scientific principles, then apply that knowledge accordingly

Experiments

Experimentation can be defined as "an operation or procedure carried out under controlled conditions in order to discover an unknown effect or law, to test or establish a hypothesis, or to illustrate a known law."

Mechanical engineers frequently design and conduct field and laboratory studies, gather data, create numerical simulations and other models, and then analyze and interpret the results. Individuals should be familiar with the purpose, procedures, equipment, and practical applications of experiments spanning more than one of the technical areas of mechanical engineering. They should be able to conduct experiments, report results, and analyze results in accordance with the applicable standards in or across more than one technical area. In this context, experiments may include field and laboratory studies, virtual experiments, and numerical simulations.

The mechanical engineering graduate analyzes the results of experiments and evaluates the accuracy of the results within the known boundaries of the tests and materials in or across more than one of the technical areas of mechanical engineering.

EXPERIMENTS			
Core Competencies Needed to enter Higher Education in Mechanical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Post-Baccalaureate Level Engineering Competencies**
Identify the procedures and equipment necessary to conduct experiments: knowledge of the scientific method	Explain the purpose, procedures, equipment, and practical applications of engineering experiments	Design and conduct mechanical engineering experiments according to established procedures and report, analyze, and interpret results	Design a mechanical engineering experiment to meet a need, conduct the experiment, and analyze and interpret results
			Evaluate the effectiveness of an experiment and its value for solving a problem

System Design

Design is an iterative process that is often creative and involves discovery and the acquisition of knowledge. Such activities as problem definition, the selection or development of design options, analysis, detailed design, performance prediction, implementation, observation, and testing are parts of the engineering design process.

Design problems are often ill-defined, so defining the scope and design objectives and identifying the constraints governing a particular problem are essential to the design process. The design process is open-ended and involves a number of likely correct solutions, including innovative approaches. Successful design requires critical thinking, an appreciation of the uncertainties involved, and the use of engineering judgment. Consideration of risk assessment, societal and environmental impact, standards, codes, regulations, safety, security, sustainability, constructability, and operability are integrated at various stages of the design process.

The mechanical engineering graduate designs a system or process to meet desired needs within such realistic constraints as economic, environmental, social, political, ethical, health and safety, constructability, and sustainability.

SYSTEM DESIGN			
Core Competencies Needed to enter Higher Education in Mechanical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Post-Baccalaureate Level Engineering Competencies**
Intentionally left blank	Describe designs for systems, components, or processes that incorporate economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability considerations	Summarize and explain crucial issues and regulations in designs of systems, components, or processes with considerations for economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability issues	Judge and appraise the value of different design options for systems, components, and/or processes with the consideration of economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability needs
		Apply a particular engineering solution with the compliance of realistic economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints	
		Break down the components of the design to illustrate the practicality and function of the system, component, or process with the consideration of economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability needs	
		Write a cohesive research proposal to clarify, demonstrate, and justify the development of a system, component, or process with the consideration of economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability needs	

Multidisciplinary Teamwork

Licensed mechanical engineers must be able to function as members of a team. This cooperation requires understanding team formation and evolution, personality profiles, team dynamics, collaboration among diverse disciplines, problem solving, time management, and being able to foster and integrate diversity of perspectives, knowledge, and experiences.

A mechanical engineer will eventually work within two different types of teams. The first is intra-disciplinary and consists of members from within the mechanical engineering sub-disciplines—for example, a structural engineer working with a geotechnical engineer. The second is multidisciplinary and is a team composed of members of different professions—for example, a mechanical engineer working with an economist on the financial implications of a project or a mechanical engineer working with local elected officials on a public planning board. Multidisciplinary also includes a team consisting of members from different engineering sub-disciplines—sometimes referred to as a cross-disciplinary team—for example, a mechanical engineer working with an electrical engineer.

The mechanical engineering graduate functions effectively as a member of an intra-disciplinary team. At the undergraduate level, the focus is primarily on working as members of an intra-disciplinary team—that is, a team within the mechanical engineering sub-discipline. Examples of opportunities for students to work in teams include design projects and laboratory exercises within a course and during a capstone design experience.

MULTIDISCIPLINARY TEAMWORK			
Core Competencies Needed to enter Higher Education in Mechanical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Post-Baccalaureate Level Engineering Competencies**
Identify and list the key characteristics of effective intra-disciplinary and multidisciplinary teams	Explain the factors affecting the ability of intra-disciplinary and multidisciplinary teams to function effectively	Function effectively as a member of an intra-disciplinary team	Function effectively as a member of a multidisciplinary team

Problem Recognition and Solution

Mechanical engineering problem solving consists of identifying engineering problems, obtaining background knowledge, understanding existing requirements and/ or constraints, articulating the problem through technical communication, formulating alternative solutions—both routine and creative—and recommending feasible solutions.

Appropriate techniques and tools— including information technology, contemporary analysis and design methods, and design codes and standards to complement knowledge of fundamental concepts—are required to solve engineering problems. Problem solving also involves the ability to select the appropriate tools as a method to promote or increase the future learning ability of individuals.

The mechanical engineering graduate develops problem statements and *solves* well-defined fundamental mechanical engineering problems by *applying* appropriate techniques and tools. Mechanical engineers should be familiar with factual information related to engineering problem recognition and problem-solving processes. Additionally, mechanical engineers should be able to explain key concepts related to engineering problem recognition, articulation, and solving.

PROBLEM RECOGNITION AND SOLUTION			
Core Competencies Needed to enter Higher Education in Mechanical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Post-Baccalaureate Level Engineering Competencies**
Describe and state the physical laws that govern mechanical engineering problems	Identify the correct physical laws applicable to a mechanical engineering problem	Utilize standard mathematical and graphical techniques to solve a mechanical engineering problem	Analyze a complex mechanical engineering problem to simplify and subdivide it into parts that can be solved with appropriate engineering techniques
			Develop new methods for solving mechanical engineering problems

Professional and Ethical Responsibility

Mechanical engineers in professional practice have a privileged position in society, affording the profession exclusivity in the design of mechanical systems ranging from heating, ventilating, and air conditioning (HVAC) units to various vehicles for transportation. This position requires each of its members to adhere to a doctrine of professionalism and ethical responsibility. This doctrine is set forth in the seven fundamental canons in the American Society of Mechanical Engineer's (ASME) Code of Ethics. The first canon states that mechanical engineers "…shall hold paramount the safety, health, and welfare of the public.…" By meeting this responsibility, which puts the public interest above all else, the profession earns society's trust.

Mechanical engineers aspire to be "entrusted by society to create a sustainable world and enhance the global quality of life." Therefore, current and future mechanical engineers, whether employed in public or private organizations or self-employed, will increasingly hold privileged and responsible positions.

The mechanical engineering graduate analyzes a situation involving multiple conflicting professional and ethical interests to determine an appropriate course of action. The undergraduate experience should introduce and illustrate the impact of the mechanical engineer's work on society and the environment. This experience naturally leads to the importance of meeting such professional responsibilities as maintaining competency and the need for ethical behavior.

PROFESSIONAL AND ETHICAL RESPONSIBILITY			
Core Competencies Needed to enter Higher Education in Mechanical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Post-Baccalaureate Level Engineering Competencies**
Intentionally left blank	Identify the professional codes of ethics/conduct and define ethical concepts	Explain ethical concepts in a personal and professional context	Integrate the responsibility for ethical decision making with the associated risks and costs to the individual, company, and society
		Apply ethical concepts to determine a professional response to a hypothetical situation	
		Analyze the possible implications and ramifications of ethics in engineering decision making	

Communication

Means of communication include listening, observing, reading, speaking, writing, and graphics. The mechanical engineer must communicate effectively with technical and nontechnical individuals and audiences in a variety of settings. Use of these means of communication by mechanical engineers requires an understanding of communication within professional practice. Fundamentals of communication should be acquired during formal education. Pre-licensure experience should build on these fundamentals to solidify the mechanical engineer's communication skills.

Within the scope of their practice mechanical engineers prepare and/or use calculations, spreadsheets, equations, computer models, graphics, and drawings—all of which are integral to a typically complex analysis and design process. Implementation of the results of this sophisticated work requires that mechanical engineers communicate the essence of their findings and recommendations.

The mechanical engineering graduate organizes and *delivers* effective verbal, written, virtual, and graphical communications. Communication can be taught and learned across the curriculum—that is, over years of formal education and in most courses.

COMMUNICATION			
Core Competencies Needed to enter Higher Education in Mechanical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Post-Baccalaureate Level Engineering Competencies**
Identify the main forms of communication important to the profession	Apply an appropriate form of communication and technique to present and discuss an engineering problem and its solution	Analyze and select the best form of communication and technique to present and discuss a specific engineering problem with its solution	Organize the effective presentation of engineering subjects
Understand the advantages and disadvantages of different forms of communication used to present a specific concept			Evaluate the quality and content of any form of engineering communication

Global Impact of Engineering Solutions

In today's engineering practice, the mechanical engineering graduate must consider the impact of engineering solutions in a global, economic, environmental, and societal context. In general, mechanical engineering students get this type of broad education through core undergraduate curriculum which includes engineering economics, computer science, and other requirements for subsequent engineering courses.

Among other topics, an understanding of materials science and engineering is also required for the treatment of hazardous wastes and degradation of structural materials introduced in various mechanical engineering systems. Mechanical engineering includes elements of materials science and engineering, as well as the integration of components into a complete system.

GLOBAL IMPACT OF ENGINEERING SOLUTIONS			
Core Competencies Needed to enter Higher Education in Mechanical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Post-Baccalaureate Level Engineering Competencies**
Identify general impacts of solutions in a global, economic, environmental, and societal context	Explain key impacts of engineering solutions in a global, economic, environmental, and societal context	Ascertain the impacts of engineering solutions in a global, economic, environmental, and societal context	Analyze the pros and cons of impacts of engineering solutions in global, economic, environmental, and societal contexts
			Integrate the possible and probable impacts of engineering solutions in global, economic, environmental, and societal contexts
			Evaluate multiple options and determine the optimum solution based on the impacts of engineering solutions in global, economic, environmental, and societal contexts

Lifelong Learning

To be effective, professional mechanical engineers should constantly update their knowledge in engineering and related fields. In today's ever-evolving world, mechanical engineers must realize the need for and develop ability and skill in life-long learning. The tutorial materials available on the internet and different media should be utilized along with continuing education and training seminars. Conferences of different professional engineering societies and organizations are also important venues for disseminating and updating current issues and techniques in engineering fields.

The mechanical engineering graduate must appreciate the importance of lifelong learning. The habit and skill can be taught and learned across the engineering curriculum—that is, over years of formal education and in most courses.

LIFELONG LEARNING			
Core Competencies Needed to enter Higher Education in Mechanical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Post-Baccalaureate Level Engineering Competencies**
Define the evolution of knowledge and the demand for staying abreast of new developments in science and technology	Define the evolution of knowledge and the demand for staying abreast of new developments in engineering; articulate and defend the importance of professional development related to their disciplines	Find professional development opportunities that will help them keep abreast of developments in their disciplines	Analyze expositions of new developments in their disciplines to isolate their important aspects

Contemporary Issues and Historical Perspectives

To be effective, professional mechanical engineers should draw upon their broad education to analyze the impacts of historical and contemporary issues on engineering and analyze the impact of engineering on the world. The engineering design cycle illustrates the dual nature of this outcome. In defining, formulating, and solving an engineering problem, engineers must consider the impacts of historical events and contemporary issues.

Examples of contemporary issues that could impact engineering include the multicultural globalization of engineering practice; raising the quality of life around the world; the importance of sustainability; the growing diversity of society; and, the technical, environmental, societal, political, legal, aesthetic, economic, and financial implications of engineering projects. When generating and comparing alternatives and assessing performance, engineers must also consider the impact that engineering solutions have on the economy, environment, political landscape, and society.

The mechanical engineering graduate draws upon a broad education, *explains* the impact of historical and contemporary issues on the identification, formulation, and solution of engineering problems and *explains* the impact of engineering solutions on the economy, environment, political landscape, and society.

CONTEMPORARY ISSUES AND HISTORICAL PERSPECTIVES			
Core Competencies Needed to enter Higher Education in Mechanical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Post-Baccalaureate Level Engineering Competencies**
Define current engineering-related issues or problems and be aware of emerging technologies and engineering fields (ex., nanotechnology, biomedical, renewable energy,…)	Explain the key concepts that are related to current engineering issues as well as emerging engineering fields and technologies	Apply basic problem-solving skills to key aspects of current engineering problems as well as key aspects of emerging engineering fields and technologies	Analyze and integrate the key concepts related to current engineering issues as well as emerging engineering fields and technologies
			Develop new technologies and apply them to current engineering issues, and develop new technologies within emerging engineering fields
			Evaluate the validity of solutions being applied to current engineering problems; evaluate the validity of new technologies from emerging engineering fields

Engineering Tools

In current engineering practice, a variety of modeling and testing tools are at the disposal of mechanical engineers. In addition to engineering graphics and solid modeling software, simulation tools for electrical circuits, electronic devices, measurement and instrumentation in materials science and engineering as well as systems and controls are becoming more and more important.

Perhaps the most important set of modeling tools for mechanical engineering is computational mechanics for fluid and solid mechanics and the coupling with thermodynamic issues. Mechanics in mechanical engineering encompasses the mechanics of continuous and particulate solids subjected to load, and the mechanics of fluid flow through pipes, channels, and porous media. These areas are of importance to environmental science and engineering. Areas of mechanical engineering that rely heavily on mechanics are design and manufacturing, mechanics of materials, and thermofluids. Sustainable provision of energy often refers to the utilization of wind, solar, geothermal, hydraulic, and other renewable sources without compromising the energy needs of future generations. In its original sense, mechanics refers to the study of the behavior of systems under the action of forces. Mechanics is subdivided according to the types of systems and phenomena involved. An important distinction is based on the size of the system. The Newtonian laws of classical mechanics can adequately describe those systems that are encountered in most mechanical engineering areas. However, for micro- and nano-devices, statistical mechanics and quantum mechanics must also be considered.

The mechanical engineering graduate must be familiar with current tools for mechanical engineering problems. The exposure and training of these experimental and modeling toolsets are implemented throughout the engineering curriculum—that is, over years of formal education and in most courses.

ENGINEERING TOOLS			
Core Competencies Needed to enter Higher Education in Mechanical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Post-Baccalaureate Level Engineering Competencies**
Identify different problem-solving toolsets, including both computer-based applications and traditional problem-solving techniques and skills	Compare a variety of problem-solving techniques, skills, and tools, and determine the most appropriate strategy	Use appropriate problem-solving strategies to solve engineering problems	Analyze complex problems and solve these problems using multiple tools, techniques, and skills in an appropriate and accurate manner

Community College Program of Study for Transfer to a Mechanical Engineering Program

FRESHMAN YEAR

First Semester (Fall)

Course		SCH
MATH 2413	Calculus I	4
CHEM 1311	General Chemistry	3
CHEM 1111	Chemistry I Laboratory	1
ENGR 1201	Introduction to Engineering	2
XXXX ####	Texas Core Curriculum Requirement	3
XXXX ####	Texas Core Curriculum Requirement	3
	Semester Credit Hours	**16**

Second Semester (Spring)

Course		SCH
MATH 2414	Calculus II	4
PHYS 2325	University Physics I	3
PHYS 2125	University Physics I Laboratory	1
ENGR 1304	Engineering Graphics	3
XXXX ####	Texas Core Curriculum Requirement	3
XXXX ####	Texas Core Curriculum Requirement	3
	Semester Credit Hours	**17**

SOPHOMORE YEAR

First Semester (Fall)

Course		SCH
MATH 2415	Multi-Variable Calculus (Calculus III)	4
PHYS 2326	University Physics II	3
PHYS 2126	University Physics II Laboratory	1
ENGR 2301	Engineering Mechanics: Statics	3
ENGR 2304	Programming for Engineers	3
or COSC 1436/1336	Programming Fundamentals	
XXXX ####	Texas Core Curriculum Requirement	3
	Semester Credit Hours	**17**

Second Semester (Spring)

Course		SCH
MATH 2320	Differential Equations	3
ENGR 2305	Electrical Circuits I	3
ENGR 2105	Electrical Circuits I Laboratory	1
ENGR 2302	Engineering Mechanics: Dynamics	3
XXXX ####	Texas Core Curriculum Requirement	3
XXXX ####	Texas Core Curriculum Requirement	3
	Semester Credit Hours	**16**

Notes:

1. Texas Common Course Numbers are used for all TCCN-numbered courses.
2. Some mechanical engineering programs require Chemistry II in addition to Chemistry I. The student is advised to check with the school to which he or she intends to transfer for specific requirements.
3. Some mechanical engineering programs will accept the course ENGR 1201 for transfer credit and as applicable to the engineering major, while others will accept the course for transfer credit only. The student is advised to check with the school to which he or she intends to transfer for specific applicability of this course to the engineering major.
4. Mechanical engineering programs will accept the course COSC 1436/1336 in place of ENGR 2304.

Prerequisite Flowchart