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September 6, 2018

Curriculum Committees  
University of Utah

Dear Members of the Curriculum Committees,

I write this letter in support of the University of Utah College of Engineering's Department of Mechanical Engineering's application to approve two new degree-emphasis areas: 1) Industrial and Systems Engineering, and 2) Sustainable Energy.

This request is warranted for numerous reasons, including:

- Utah's strong technology-innovation and manufacturing base needs employees with this background
- Current societal trends push for scientific and engineering approaches that prioritize the good of society and of the environment, which are the subjects of these emphasis areas
- There has been a request and strong support from alumni who lead local industry
- According to 2012 data, ISE programs attract and graduate more females than any other area of engineering
- Since there is no Industrial-Engineering curriculum within the Utah System of Higher Education (USHE), this offering should keep promising students in the state

For the reasons stated above, I believe that approving the Department of Mechanical Engineering's request to add these two emphases is justified and will benefit present and future students and employers in Utah. I strongly encourage you to support this proposal.

Sincerely,

Richard B. Brown  
Dean

September 6, 2018

Dear University Administration and Trustees:

I write this letter in support of the Department of Mechanical Engineering's petition to approve two new degree-emphasis areas: 1) *Industrial and Systems Engineering* and 2) *Sustainable Energy*.

This request is warranted for numerous reasons. These reasons include:

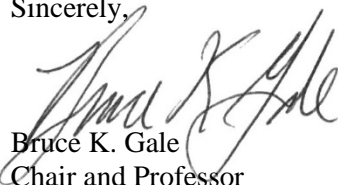
- To prepare ME students to design, develop, implement, and improve integrated systems that include people, materials, information, machinery, and energy.
- Their education will include the study of such efficient and advanced systems, operations, manufacturing, mathematics and statistics, and the human-element considerations within
- The relatively large portion of female students entering Industrial and Systems Engineering (ISE) (20.2%) versus Mechanical Engineering (8.3%)
- According to 2012 data, ISE programs draw in—and graduate—more females than any other area of engineering
- The quality, competencies, and experiences of present ME faculty members as well as the scope of existing ME EN upper-division courses are ample to meet the needs of a rigorous and respectable ISE-emphasis curriculum
- This initial emphasis approval could eventually lead to the establishment of an undergraduate degree in Industrial Engineering within the ME Department at a later time since several ME EN and ISE curricula at the same institution vary by only a few courses when researched while writing this proposal \*\*\*

At present, the Department of Mechanical Engineering (ME) offers twelve emphasis areas. These two new emphasis areas will complement existing ME emphasis areas. In fact, it is conceivable that students in the proposed emphases areas could supplement efforts of the ME Department's Manufacturing Extension Partnership (MEP) Center.

As indicated above, the approval of these new emphases should require no significant additional resources. The necessary faculty and courses already exist.

In closing, for the reasons stated above, I believe that approving the Department of Mechanical Engineering's request to add an emphasis for Industrial and Systems Engineering and for Sustainable Energy is justified and will benefit present and future residents of the State of Utah as well as the University of Utah.

Sincerely,



Bruce K. Gale  
Chair and Professor

Director, State of Utah Center of Excellence for Biomedical Microfluidics

## Summary of New and Updated Emphasis Requirements for the B.S. Mechanical Engineering Degree

### **Aerospace Engineering** (same title; updated requirements)

Choose one from the following:

- ME EN 5710 Aerodynamics
- ME EN 5830 Aero- propulsion

Choose one from the following:

- ME EN 5300 Advanced Strength of Materials
- ME EN 5510 Intro. Finite Element
- ME EN 5520 Mechanics of Composite Materials

Choose one from the following:

- ME EN 5400 Vibrations
- ME EN 5410 Intermediate Dynamics
- ME EN 5200 Classical Control
- ME EN 5205 System Dynamics
- ME EN 5210 State Space Control

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### **Biomechanics** (same title; updated requirements)

Required: ME EN 5535 Introduction to Biomechanics

Choose two of the following:

- ME EN 5100 Ergonomics
- ME EN 5510 Introduction to Finite Elements
- ME EN 5530 Introduction to Continuum Mechanics
- ME EN 5540 Biomechanics II/Soft Tissue Mechanics
- ME EN 7120 Musculoskeletal Functional Anatomy for Engineers (with permission—graduate course)
- BIOEN 4301 Introduction to Modern Biomaterials
- BIOEN 6240 Movement Analysis (with permission—graduate course)

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### **Design and Manufacturing** (same title; updated requirements)

Choose one of the following:

- ME EN 5010 Principles of Manufacturing Processes
- ME EN 5035 Design of Experiments

Choose two of the following:

- ME EN 5050 Fundamentals of Micromachining Processes
- ME EN 5055 Microsystems Design & Characterization
- ME EN 5060 Sustainable Products & Processes
- ME EN 5080 Tribology & Contact Mechanics
- ME EN 5110 Introduction to Industrial Safety
- ME EN 5510 Introduction to Finite Elements

### **Dynamics Systems and Control** (same title, updated requirements)

Required: ME EN 5205 System Dynamics

Choose one of the following:

- ME EN 5200 Classical Control Systems
- ME EN 5210 State Space Control

Choose one of the following:

- ME EN 5400 Vibrations
  - ME EN 5410 Intermediate Dynamics
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### **Ergonomics and Safety** (unchanged)

Required: ME EN 5100 Ergonomics

Choose two of the following:

- ME EN 5035 Design of Experiments
  - ME EN 5110 Introduction to Industrial Safety
  - ME EN 5130 Design Implications
  - ME EN 5960 Product Safety
  - ME EN 7100 Advanced Ergonomics: Occupational Biomechanics (with permission—graduate course)
  - ME EN 7110 System Safety (with permission—graduate course)
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### **Fluid Systems Engineering** (formerly Fluid Mechanics)

Required: ME EN 5700 Intermediate Fluid Dynamics

Choose two of the following:

- ME EN 5650 Intermediate Heat Transfer
  - ME EN 5710 Aerodynamics
  - ME EN 5730 Microfluidic Chip Design & Fabrication
  - ME EN 5740 Wind Energy
  - ME EN 5810 Thermal Systems Design
  - ME EN 6720 Computational Fluid Dynamics (with permission)
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### **Industrial Engineering** (NEW)

Required: ME EN 5025 Introduction to Optimization

Choose one of the following:

- ME EN 5010 Principles for Manufacturing Processes
- ME EN 5035 Design of Experiments
- ME EN 5040 Quality Assurance Engineering

Choose one of the following:

- ME EN 5100 Ergonomics
- ME EN 5110 Industrial Safety
- ME EN 5050 Introduction to Product Safety and Engineering Ethics
- ME EN 7100 Systems Safety (with permission)

### **Mechatronics** (same title; updated requirements)

Choose three of the following:

- ME EN 5200 Classical Control Systems or ME EN 5210 State Space Control
  - ME EN 5205 System Dynamics
  - ME EN 5250 Object-Oriented Programming for Interactive Systems
  - ME EN 6240 Advanced Mechatronics (with permission)
  - ECE 5670 Control of Electric Motors
  - ECE 5780 Embedded System Design
  - PHYS 3610 Electronics for Scientific Instrumentation
  - PHYS 3620 Data Acquisition for Scientific Instrumentation
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### **Micro/Nanoscale Engineering** (unchanged)

Required: ME EN 5050 Fundamentals of Micromachining

Choose two of the following:

- ME EN 5051 Microsensors
  - ME EN 5053 Micro Actuators
  - ME EN 5055 Microsystems Design & Characterization
  - ME EN 5080 Tribology & Contact Mechanics
  - ME EN 5620 Fundamentals of Microscale Engineering
  - ME EN 5630 Nanoscale Heat Transfer
  - ME EN 5730 Microfluidics Chip Design & Fabrication
  - ECE 5201 Physics of Nano-Electronics and Related Devices
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### **Modeling** (eliminated)

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### **Robotics and Control** (same title; updated requirements)

Required: ME EN 5220 Robotics

Choose two of the following:

- ME EN 5200 Classical Control Systems
  - ME EN 5205 System Dynamics
  - ME EN 5210 State Space Control
  - ME EN 5230 Introduction to Robot Control
  - ME EN 5250 Object Oriented Programming
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### **Solid Mechanics** (unchanged)

Choose three of the following:

- ME EN 5300 Advanced Strength of Materials
- ME EN 5500 Engineering Elasticity
- ME EN 5510 Introduction to Finite Elements
- ME EN 5520 Mechanics of Composite Materials
- ME EN 5530 Introduction to Continuum Mechanics
- Either ME EN 5400 Vibrations or ME EN 5410 Intermediate Dynamics

### **Sustainable Energy Engineering (NEW)**

Required: ME EN 5800 Sustainable Energy Engineering

Choose two of the following:

- ME EN 5600 Intermediate Thermodynamics
  - ME EN 5740 Wind Energy
  - ME EN 5810 Thermal Systems Design
  - ME EN 5820 Thermal Environmental Engineering
  - ME EN 5840 Energy Systems Analysis
  - ECE 5074 Photovoltaic Materials & Solar Cells
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### **Thermal Systems Engineering** (formerly Thermal Science and Energy Engineering)

Choose one of the following:

- ME EN 5600 Intermediate Thermodynamics
- ME EN 5650 Intermediate Heat Transfer

Choose two of the following:

- ME EN 5600 or 5650
- ME EN 5630 Nanoscale Heat Transfer
- ME EN 5800 Sustainable Energy Engineering
- ME EN 5810 Thermal Systems Design
- ME EN 5820 Thermal Environmental Engineering
- ME EN 5830 Aerospace Propulsion
- ME EN 5840 Energy Systems Analysis

## Sample 4 Year Plan--Sustainable Energy Engineering Emphasis

Emphases comprise 3 of the 4 required technical electives listed below so this plan is an example of a 4 year plan for a student completing this emphasis (although they have several options for their technical electives).

### First Year

<b>Fall Semester</b>	<b>CR</b>	<b>Spring Semester</b>	<b>CR</b>
ME EN 1000	3	ME EN 1010	3
MATH 1310	4	ME EN 2010	3
CHEM 1210	4	MATH 1320	4
CHEM 1215	1	PHYS 2210	4
General Education - WR2	3	General Education - AI	3
<b>Total Hours:</b>	<b>15</b>	<b>Total Hours:</b>	<b>17</b>

### Second Year

<b>Fall Semester</b>	<b>CR</b>	<b>Spring Semester</b>	<b>CR</b>
ME EN 2450	3	ME EN 2030	3
MSE 2160	3	ME EN 2550	3
MATH 2250	4	ME EN 2650	3
PHYS 2220	4	ECE 2210	3
General Education - BF	3	MATH 3140	4
<b>Total Hours:</b>	<b>17</b>	<b>Total Hours:</b>	<b>16</b>

### Third Year

<b>Fall Semester</b>	<b>CR</b>	<b>Spring Semester</b>	<b>CR</b>
ME EN 3220	3	ME EN 3000	3
ME EN 3300	4	ME EN 3230	4
ME EN 3400	3	ME EN 3710	3
		ME EN - Non-Emphasis Technical	
ME EN 3610	3	Elective	3
General Education - FF	3	General Education - HF	3
<b>Total Hours:</b>	<b>16</b>	<b>Total Hours:</b>	<b>16</b>

### Fourth Year

<b>Fall Semester</b>	<b>CR</b>	<b>Spring Semester</b>	<b>CR</b>
ME EN 4000	3	ME EN 4010	3
		ME EN 5600 or 5740 or 5820 or	
ME EN 4610	3	5840 - Technical Elective	3
ME EN 4650	3	General Education - FF	3
ME EN 5800 - Technical Elective	3	General Education - HF	3
ME EN 5810 - Technical Elective	3	Bachelor Degree - IR	3
General Education - BF/DV	3	<b>Total Hours:</b>	<b>18</b>
<b>Total Hours:</b>	<b>15</b>		

## Sample 4 Year Plan--Industrial Engineering Emphasis

Emphases comprise 3 of the 4 required technical electives listed below so this plan is an example of a 4 year plan for a student completing this emphasis (although they have several options for their technical electives).

### First Year

<b>Fall Semester</b>	<b>CR</b>		<b>Spring Semester</b>	<b>CR</b>
ME EN 1000	3		ME EN 1010	3
MATH 1310	4		ME EN 2010	3
CHEM 1210	4		MATH 1320	4
CHEM 1215	1		PHYS 2210	4
General Education - WR2	3		General Education - AI	3
<b>Total Hours:</b>	<b>15</b>		<b>Total Hours:</b>	<b>17</b>

### Second Year

<b>Fall Semester</b>	<b>CR</b>		<b>Spring Semester</b>	<b>CR</b>
ME EN 2450	3		ME EN 2030	3
MSE 2160	3		ME EN 2550	3
MATH 2250	4		ME EN 2650	3
PHYS 2220	4		ECE 2210	3
General Education - BF	3		MATH 3140	4
<b>Total Hours:</b>	<b>17</b>		<b>Total Hours:</b>	<b>16</b>

### Third Year

<b>Fall Semester</b>	<b>CR</b>		<b>Spring Semester</b>	<b>CR</b>
ME EN 3220	3		ME EN 3000	3
ME EN 3300	4		ME EN 3230	4
ME EN 3400	3		ME EN 3710	3
			ME EN 5010 or 5035 -	
ME EN 3610	3		Technical Elective	3
General Education - FF	3		General Education - HF	3
<b>Total Hours:</b>	<b>16</b>		<b>Total Hours:</b>	<b>16</b>

### Fourth Year

<b>Fall Semester</b>	<b>CR</b>		<b>Spring Semester</b>	<b>CR</b>
ME EN 4000	3		ME EN 4010	3
			ME EN - Non-emphasis	
ME EN 4610	3		Technical Elective	3
ME EN 4650	3		General Education - FF	3
ME EN 5025 - Technical				
Elective	3		General Education - HF	3
ME EN 5100 or 5050 -				
Technical Elective	3		Bachelor Degree - IR	3
General Education - BF/DV	3		<b>Total Hours:</b>	<b>18</b>
<b>Total Hours:</b>	<b>15</b>			