ME 4405 Fundamentals of Mechatronics (Elective)

Catalog Description: ME 4405 Fundamentals of Mechatronics (2-3-3)

Prerequisites: ME 3017 System Dynamics and ME 3057 Experimental Methods Laboratory (with concurrency)

Focuses on fundamentals of microcontrollers, analog and digital electronics, sensors, actuators, and their applications to modern mechatronics systems and intelligent manufacturing. Knowledge gained from lectures will be used to complete lab exercises.

Textbook: Sabri Cetinkunt, *Mechatronics*, Wiley, 2006.

Topics Covered:

1. Digital arithmetic
   a) Binary and hexadecimal
   b) Floating point representation and cost
2. Logic gates
3. Microcontrollers
   a) Overview of different types of microcontrollers
   b) Choice of a microcontroller for a specific application and cost implications
4. 8-bit microcontroller
   a) Introduction
   b) Hardware overview
   c) Programming in assembly and machine languages
   d) Programming in C language
   e) Conversion of C to assembly and to machine language
   f) On-chip subsystems: parallel I/O, analog to digital converter, interrupts, timers/pulse accumulator, pulse width modulation, and synchronous communication interface
5. Analog and digital devices
   a) Operational amplifier
   b) Analog to digital converter
   c) Digital to analog converter
   d) Transistors
   e) Diodes and photodiodes
   f) Thermistors, triacs, opto-isolators, thyristors, and phototransistors
6. Sensors and transducers
   a) Linear variable displacement transducer
   b) Accelerometer
   c) Laser interferometer
7. Mechatronic systems applications in
   a) Manufacturing, smart robotics, transportation, smart homes, medicine, sports, defense, space exploration, and sanitation applications
8. Laboratory exercises
   a) Three electronic exercises (individual effort)
   b) Four regular laboratory exercises (group effort)
9. Optional topics
   a) Actuators: DC motors

Course Outcomes:

Outcome 1: Teach students about different types of microcontrollers and how to choose an appropriate microcontroller for a specific design, and to emphasize the need to keep learning.

1.1 Students will demonstrate their abilities to seek and learn new materials outside the class examples through the completion of individual and group homework problems. The amount and depth of new material identified and used by students are measurable indicators of their performances.

Outcome 2: Teach students how to program the microcontroller in assembly and C languages.

2.1 Students will demonstrate their abilities to program their microcontroller in assembly and C languages in order to accurately control their lab set-ups and obtain valid results.

Outcome 3: Teach students how to integrate microcontrollers, electronic components, sensors, actuators, and computer software to produce an electromechanical system or a smart product.

3.1 Students will demonstrate their abilities to integrate the microcontroller with relevant actuators, sensors, electronic components, passive components, and software in order to successfully complete each of their lab exercises, including technical reports and presentations.

Outcome 4: Teach students how to prepare and make oral presentations before a large audience.

4.1 Student groups will be coached to give class lectures on some selected class lecture topics (optional).

Correlation between Course Outcomes and Student Outcomes:

ME 4405											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	X			X				X	X	X	
Course Outcome 2.1	X			X							X
Course Outcome 3.1	X	X		X	X		X				X
Course Outcome 4.1				X			X				

GWW School of Mechanical Engineering Student 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 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 life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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