EEE308 MICROPROCESSORS

Course Code	Course Name		Semester	
EEE308	MICROPROCESSORS		Fall ☒ Spring ☐ Summer ☐	
Hours			**Credit**	**ECTS**
Theory	**Practice**	**Lab**	3	4
2	0	2		

Course Details	
Department	ELECTRICAL & ELECTRONICS ENGINEERING
Course Language	English
Course Level	Undergraduate ☒ Graduate ☐
Mode of Delivery	Face to Face ☒ Online ☐ Hybrid ☐
Course Type	Compulsory ☒ Elective ☐
Lecturer(s)	Dr. Hüseyin KÖSE
Course Objectives	The aim of this course is to explain the instruction set architectures of microprocessors (assembly and c commands, addressing modes, command formats, run times etc.), internal structure of microprocessor, memory hierarchy and programming input/output ports. PIC microcontroller family is to be investigated as sample.
Course Content	Microprocessor based systems. An introduction to the PIC microprocessor family. Software Architecture: addressing modes. Data transfer instructions. Arithmetic, logical, bit manipulation, program transfer, and processor control instructions. Software and hardware interrupts. An introduction to the programming. Programming applications. Hardware architecture: hardware details of the PIC. Memory system design. I/O system design. Special hardwares (ADC / DAC / PWM / UART / I2C / INTERRUPTS) of PIC/dsPIC family. Communication programming with RS232 / RS485 / TCP-IP / MODBUS.
Course Method/ Techniques	Lecture ☒ Question & Answer ☒ Presentation ☒ Discussion ☒
Prerequisites/ Corequisites	C Programming, Digital Design

Work Placement(s)	In Classroom, In Laboratory

Textbook/References/Materials

- 1. "Embedded C Programming Techniques and Applications of C and PIC MCUS", by Mark Siegesmund, 1st Edition - September 19, 2014.
- 2. CCS C Compiler Manual, November 2021, online free pdf.
- 3. Design reference notes and data sheets of Microchips.
- 4. Lecturer presentations and notes.

Course Category				
Mathematics and Basic Sciences	☒		Education	☐
Engineering	☒		Science	☐
Engineering Design	☒		Health	☐
Social Sciences	☐		Profession	☒

Weekly Schedule

No	Topics	Materials/Notes
1	PIC microcontrollers: History and features of Microchip and PIC/dsPIC series microcontrollers. General Description of a microprocessor system, working principles, logic algorithms, environment units.	Presentations, Lecturer notes
2	C Compilers and Development System: An introduction to MPLAB C and CCS C. How to use a C compiler to program a microchip. Remembering C language.	Presentations, Lecturer notes
3	PIC Architecture & Programming: Hardware description of PIC18F and dsPIC30F/dsPIC33EP series. RAM, ROM, MIPS, other important hardware design features. Reading a microprocessor datasheet effectively.	Presentations, Lecturer notes
4	I/O Port Programming: Programming input or output ports. Port forwarding, register mapping, pin assignments, direct accessing to registers. Bit manipulation commands. 8bit, 16bit, 32bit variables, hexadecimal and decimal values. Sample programs.	Presentations, Lecturer notes
5	ADC and DAC: Reading an analog value from input ports using ADC unit of microprocessors. ADC and DAC hardware, working principles, register settings. Understanding sampling frequency, calculation period, average and rms calculations. Understanding DAC unit and working principles. Sample programs.	Presentations, Lecturer notes
6	Timers and Interrupts: Understanding Timers, working principles, timer interrupts, interrupt routines, interrupt vector definitions, priorities of interrupts, semaphore technique.	Presentations, Lecturer notes

7	PWM and CCP: PWM signal generating, duty-cycle, dead-time, PWM modes, SPWM, SVPWM. Capture and Compare hardware, register setting, programming CCP. Sample programs.	Presentations, Lecturer notes
8	Midterm Exam	
9	I2C and SPI: I2C and SPI interfaces of microprocessors. USB communication hardware. EEPROM, RTC, and other I2C or SPI communicated environment devices. Sample programs.	Presentations, Lecturer notes
10	LCD and Keypad Interface: Interfacing with an LCD. LCD hardware, working principle, library code examples. Using a button or keypad. Sample programs.	Presentations, Lecturer notes
11	Serial Port Programming: UART hardware description. Serial communication between microprocessors. RS232/RS485/TCP-IP hardware and MODBUS protocol. Sample programs	Presentations, Lecturer notes
12	Sensor and other Applications: Industrial sensors, feedbacks, optocoupler circuits, closed loop control applications with microprocessors, PLC programming, other microprocessor applications like DSP Texas, ARM, AVR, intel, Raspberry kits, Arduino kits etc…	Presentations, Lecturer notes
13	Examples	Presentations, Lecturer notes
14	Examples	Presentations, Lecturer notes
15	Examples	Presentations, Lecturer notes
16	Final Exam	

Assessment Methods and Criteria		
In-term studies	**Quantity**	**Percentage**
Attendance		
Lab	14	20
Practice		
Fieldwork		
Course-specific internship		
Quiz/Studio/Criticize		
Homework		
Presentation / Seminar		
Project		
Report		
Seminar		
Midterm Exam	1	20
Final Exam	1	60
	Total	**100%**
Contribution of Midterm Studies to Success Grade		
Contribution of End of Semester Studies to Success Grade		
	Total	**100%**

ECTS Allocated Based on Student Workload			
Activities	**Quantity**	**Duration (Hrs)**	**Total Workload**
Course Hours	14	2	28
Lab	14	2	28
Practice			
Fieldwork			
Course-specific Work Placement			
Out-of-class study time			
Quiz/Studio/Criticize			
Homework			
Presentation / Seminar			
Project			
Report			
Midterm Exam and Preparation for Midterm	1	30	30
Final Exam and Preparation for Final Exam	1	30	30
Total Workload			**108**
Total Workload / 25			**108/25**
ECTS Credit			**4.08**

Course Learning Outcomes	
No	**Outcome**
L1	Know the instruction set architecture, registers, ROM or RAM usage
L2	Can use assembly or c commands and write their own programs.
L3	Understand the internal structure and hierarchy of PIC/dsPIC/others.
L4	Can program input / output ports and ADC / PWM / UART /I2C units.
L5	Can make a project using microprocessor / microcontroller.

Contribution of Course Learning Outcomes to Program Competencies/Outcomes

Contribution Level: 1: Very Slight, 2: Slight, 3: Moderate, 4: Significant, 5: Very Significant

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**					**Total**
L1	5		5	5	5											20
L2	5		5	5	5											20-
L3	5		5	5	5											20-
L4	5		5	5	5											20-
L5	5		5	5	5											20-
															Total	100-

i. Sufficient knowledge in the fields of mathematics, natural sciences, and related engineering disciplines; the ability to apply theoretical and practical knowledge in solving complex engineering problems.

ii. The ability to identify, formulate, and solve complex engineering problems; the ability to select and apply appropriate analysis and modeling methods for this purpose.

iii. The ability to design a complex system, process, device, or product to meet specific requirements under realistic constraints and conditions; the ability to apply modern design methods for this purpose.

iv. The ability to select and use modern techniques and tools required for the analysis and solution of complex problems encountered in engineering applications; the ability to effectively use information technologies.

v. The ability to design experiments, conduct experiments, collect data, analyze results, and interpret findings for the investigation of complex engineering problems or discipline-specific research topics.

vi. The ability to work effectively in intra-disciplinary and multidisciplinary teams; the ability to work independently.

vii. The ability to communicate effectively both orally and in writing; proficiency in at least one foreign language; the ability to write effective reports, understand written reports, prepare design and production reports, make effective presentations, and give and receive clear and understandable instructions.

viii. Awareness of the necessity of lifelong learning; the ability to access information, track developments in science and technology, and continuously renew oneself.

ix. Acting in accordance with ethical principles, knowledge of professional and ethical responsibilities, and the standards used in engineering applications.

x. Knowledge of business practices such as project management, risk management, and change management; awareness of entrepreneurship and innovation; knowledge of sustainable development.

xi. Knowledge of the impact of engineering practices on health, environment, and safety at global and societal levels, and awareness of contemporary engineering issues; awareness of the legal consequences of engineering solutions.