National University of Sciences & Technology (NUST)
School of Electrical Engineering and Computer Science (SEECS)
Department of Electrical Engineering

EE-222 Microprocessor Systems

Course Code:	EE-222	**Semester:**	Spring 2022
Credit Hours:	3+1	**Pre-requisite:**	Digital Logic Design
Instructor(s):	Dr. Arbab Latif	**Discipline:**	Electrical Engineering
Office:	Knowledge Hub 1	**Telephone:**	
Lecture Days:	(see schedule for timings)	**E-mail:**	arbab.latif@seecs.edu.pk
Class Room:	(see schedule for location)	**Office Hours:**	TBA
Knowledge Group:	DSSP	**Update on LMS:**	After Lecture or by the end of week

Course Description:

The course covers the architectural aspects and assembly language programming of general purpose processors based on either CISC (intel 80x86) or RISC (ARM, MIPS, RISC-V, etc.) architecture. The course also includes the study of one of the micro-controllers architecture (like 8051, AVR, PIC, ARMCortex M, etc) and developing real time applications with them. The skills acquired can be used in the areas of electronics, communications, embedded system and Industrial Automation design.

Course Learning Outcomes

CLO	Description	BT Level	PLOs
1.	Understand the basic concepts of micro-controller/microprocessor, memory interfacing and interrupts.	C2	1
2.	Use Assembly and C language for micro-processor/microcontrollers.	C3	1
3.	Conduct experiments as well as analyze and interpret experimental data.	P4	4
4.	Design and implement real time systems using 8051, AVR, ARM Cortex or similar micro-controllers.	P4	5
5.	Exhibit good professional and ethical behavior. Adhere to lab safety rules.	A3	8
6.	Function effectively both individually and as a member of a team.	A4	9

Mapping of CLO to Program Learning Outcome

PLOs/CLOs	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5	CLO 6
PLO 1 (Engineering Knowledge)	X	X				
PLO 2 (Problem Analysis)						
PLO 3 (Design/Development of Solutions)						
PLO 4 (Investigation)			X			
PLO 5 (Modern tool usage)				X		
PLO 6 (The Engineer and Society)						

PLO 7 (Environment and Sustainability)						
PLO 8 (Ethics)					X	
PLO 9 (Individual and Team Work)						X
PLO 10 (Communication)						
PLO 11 (Project Management)						
PLO 12 (Lifelong Learning)						

Assessment Modules, Weightages, and Mapping to CLOs

Assessments/CLOs	**CLO 1**	**CLO 2**	**CLO 3**	**CLO 4**	**CLO 5**	**CLO 6**
Quizzes: 10% of the theory part	X	X				
Assignments: 10% of the theory part	X	X				
OHTs: 30% of the theory part	X	X				
Labs: 25% of the course			X	X	X	X
End Semester Exam:50% of theory part	X	X				

Books

Textbooks	1. The AVR Microcontroller and Embedded Systems: Using Assembly and C by Mazidi et al., Prentice Hall 2. Computer Organization and Design The Hardware/Software Interface (RISC-V Edition) by Hennessy and Patterson, Morgan Kaufmann 3. The Intel Microprocessors, 8086/8088, 80XXX & Pentium series Architecture, Programming and Interfacing by Barry B. Brey, 8 th edition, published by Prentice Hall.
Reference Books	1. Some Assembly Required; Assembly language programming with the AVR microcontroller by Margush, CRC 2. The 8051 microcontroller and Embedded Systems using Assembly and C (Second Edition) by Mazidi et al.

Lecture Breakdown

Week	**Topics**	**Readings**
1	Lecture 1: Introduction to Computing Systems I Lecture 2: Introduction to Computing Systems II Lecture 3: History of AVR microcontrollers **Lab 01: Intro to AVR Programming, Simulation and Design Flow**	Mazidi 0.4, Chap 1
2	Lecture 4: AVR Architecture (Load and Store) Lecture 5: AVR Assembly Programming I (Load and Store) Lecture 6: AVR Assembly Programming II (Addressing Modes) **Lab 02: Memory Operations**	Mazidi 2.1, 2.2, 2.3 2.4, 2.5, 2.6, 6.2, 6.3

3	Lecture 7: AVR Assembly Programming III (Arithmetic and Flags I) Lecture 8: AVR Assembly Programming IV (Arithmetic and Flags II) Lecture 9: AVR Assembly Programming V (Jumps and Branches) **Lab 03: Memory and Arithmetic Operations**	Mazidi 5.1, 5.2 5.3, 5.4, 5.5 3.1
4	Lecture 10: AVR Assembly Programming V (Procedure Calls and Stack) Lecture 11: AVR I/O Port Programming I Lecture 12: AVR I/O Port Programming II (Bit Addressability) **Lab 04: Functions, Branches & Delays with GPIOs**	Mazidi 3.2, 3.3 Chap 4 6.5
5	Lecture 13: AVR Internal Memory Manipulation Lecture 14: Programming AVR Timers I Lecture 15: Programming AVR Timers II **Lab 05: Timers**	Mazidi 2.7, 2.8 6.4, 6.6 9.1, 9.2
6	OHT-1	
7	Lecture 16: Programming AVR Interrupts I Lecture 17: Programming AVR Interrupts II Lecture 18: Programming AVR Interrupts III **Lab 06: External & Timer Interrupts**	Mazidi Chap 10
8	Lecture 19: AVR Programming in C I Lecture 20: AVR Programming in C II Lecture 21: AVR Timers and Interrupt Programming in C **Lab 07: AVR Programing in C**	Mazidi Chap 7, Chap 10
9	Lecture 22: Programming AVR Serial Port I (in C) Lecture 23: Programming AVR Serial Port II (in C) Lecture 24: AVR Sensor Interfacing-ADC I (in C) **Lab 08: UART Communication**	Mazidi Chap 11 13.1
10	Lecture 25: AVR Sensor Interfacing-ADC II (in C) Lecture 26: PWM Programming and DC Motor Control I Lecture 27: PWM Programming and DC Motor Control II **Lab 09: Analog-to-Digital Converter**	Mazidi 13.2, 13.3 16.1, 16.4
11	Lecture 28: SPI Protocol and Programming I Lecture 29: SPI Protocol and Programming II Lecture 30: I2C Bus Protocol **Lab 09: Analog-to-Digital Converter**	Mazidi 17.1, 172.2 18.1
12	OHT-2	
13	Lecture 31: Getting to know Intel Microprocessors, 8086/8088, 80XXX Lecture 32: 8086/8088, 80XXX Architecture I Lecture 33: 8086/8088, 80XXX Architecture II **Lab 11: 8086/8088 Programming I**	Barry B. Brey Chap 2, Chap3

14	Lecture 34: 8086/8088, 80XXX Instruction Formats Lecture 35: 8086/8088, 80XXX Assembly I Lecture 36: 8086/8088, 80XXX Assembly II **Lab 12: 8086/8088 Assembly Programming II**	Barry B. Brey Chap 8
15	Lecture 37: Getting to know RISC-V Lecture 38: RISC-V Assembly I Lecture 39: RISC-V Assembly II **Lab 13: RISC-V Assembly Programming I**	P&H 2.1, 2.2 , 2.3, 2.6, 2.7 , 2.8
16	Lecture 40: RISC-V Instruction Formats Lecture 41: Compiler, Assembler, Linker, Loader I Lecture 42: Compiler, Assembler, Linker, Loader II **Project Demos**	P&H 2.5, 2.10 , 2.12
17	Lecture 43: Future Directions in Computing I Lecture 44: Future Directions in Computing II Lecture 45: Future Directions in Computing III **Project Demos**	
18	ESE	

Important Instructions	
Quizzes Policy	The quizzes are a mandatory component of the overall assessment. The purpose of quizzes is to keep the students up-to-date with the lecture material and test basic understanding of the course concepts. There will be 5 or more unannounced quizzes conducted in the class any time during the lecture. Each quiz will consist of questions that target specific topics from the most recent as well as previous week lectures.
Assignments	To give sufficient practice and comprehensive understanding of the subject Assignments will be given, on submitting you must declare that which questions you attempted yourself. The evaluated assignment is an individual effort and no hints will be posted on forum. Only declared questions by individual student will be evaluated. If the declared question done by you is found a copy of other then you may lose all the marks in assignments and get zero in assignments category. The questions in assignments will be challenging to give students the confidence and enable them to prepare for the exams well. Home works will be submitted at the beginning of class on the due date. The students are advised to do the assignment themselves. Copying of assignment is highly discouraged, taken as cheating case and dealt accordingly. Late submissions will also loose marks.

Conduction of Labs	The labs will be conducted for three hours each week. For the conduct of lab the students will be divided into groups with 2 students per group. A lab handout comprising pre-lab, in-lab, and post-lab report parts will be provided to students for study and analysis during the week preceding each lab session. The students are expected to complete pre-lab work before lab starts and come prepared for the lab. Any student failing to complete pre-lab will not be allowed to attend lab session. The students will be evaluated during each lab based on demonstration, oral viva, and lab report submitted by them individually on completion of lab work. The students are required to be punctual in the lab; latecomers will not be allowed in the lab. No make-up provisions for the missed labs. Each lab is evaluated by Lab Engineer by taking a Lab Quiz and lab report.
Plagiarism Policy	Plagiarism is the unacknowledged use of other's work, including the copying of Assignments and laboratory results from the other students. Plagiarism is considered a serious offence by the university and severe penalties apply. Therefore, all the students must display originality of efforts and avoid plagiarism in any form.
Classroom Etiquettes	It is the collective responsibility of all the students to make the class environment conducive for learning. To create and maintain a friendly atmosphere, the following standards of class room behavior will be observed, 1. Students will be punctual for the class. The teacher considers late comers disrespectful of those who manage to be on time. 2. If a student decides to attend the class, he or she will not disrupt class by leaving before the lecture has ended. 3. All the cell phones must be switched OFF prior to entering the class room.
Tools/Software	Atmel Studio 7.0 is used for programming AVR in assembly language and implementation. Online simulator, Venus (https://www.kvakil.me/venus/) will be used for RISC-V based labs and/or assignments.