American International University-Bangladesh (AIUB)
Faculty of Engineering
Department of Electrical and Electronic Engineering
Undergraduate Program

PART A

1.	Course No/Course Code	EEE 4103
2.	Course Title	Microprocessor and Embedded Systems
3.	Course Type	Core Course
4.	Year/Level/Semester/Term	Fourth Year (10th Semester)
5.	Academic Session	Spring 2023-24
6.	Course Teachers/Instructors	Prof. Dr. Engr. Muhibul Haque Bhuyan (Course Coordinator), Dr. Md. Rukonuzzaman, Dr. Gour Chand Mazumder, Ali Noor, Tahseen Asma Meem, Sujan Howlader, Md Sajid Hossain, Protik Parvez Sheikh, Md. Shaoran Sayem, Niloy Goswami
7.	Pre-requisite (If any)	EEE 3101: Digital Electronics, CSC 2207: Programming Language 2
8.	Credit Value	3 credit hours
9.	Contact Hours	2 hours of 1 theory and 3 hours of 1 lab classes per week
10.	Total Marks	100
11.	The mission of the EEE Department	• Educate young leaders for academia, industry, entrepreneurship, and public and private organizations through theory and practical knowledge to solve engineering problems individually and in teams. • Create knowledge through innovative research and collaboration with multiple disciplines and societies. • Serve the communities at national, regional, and global levels with ethical and professional responsibilities.
12.	The vision of the EEE Department	To become a front-runner in preparing Electrical and Electronics Engineering graduates to be nationally and globally competitive and thereby contribute value to the knowledge-based economy and welfare of the people of the world.
13.	The rationale of the Course (Course Description)	This is a core course of the Electrical and Electronic Engineering & Computer Engineering program that presents the fundamental principles of microprocessors and embedded systems that are commonly used in engineering research and science applications. The course aims to enhance the skills of the students in solving complex engineering problems related to systems implementations based on embedded systems as well.
14.	Course Content	The course is designed to provide students with: • Introduction to microprocessors and microcontrollers, understanding their basic differences and applications. • Introduction to embedded systems and their applications. • Understanding principles of operation of microcontrollers, including assembly language programming as well as the internal architecture of processors and microcontrollers. • Learning about hardware-software interfacing and different interfacing techniques. • The basic knowledge of studying datasheets of popular processors. • Introduction to the commonly used modules of a microcontroller: interrupt, timers, serial communication interface, PWM. • Processor unit designing and control logic designing for micro-operations based on arithmetic and logical instructions.

15. Course Outcomes (CO)/Course Learning Outcomes (CLOs):

Upon completion of this course, students should be able to –

CO/ CLO Number	CO/CLO Statement	K	P	A	Assessed Program Outcome Indicator	BNQF Indicator	Teaching-Learning Strategy	Assessment Strategy
1	Apply knowledge of microprocessors and microcontrollers to configure different modules of a microprocessor or microcontroller-based system as per given specifications and perform in-depth analysis to optimize the performance of the designed system utilizing the basic concepts and properties of a microcontroller.	K4	P1, P3, P7		P.a.4.C.3	FS.2	Lecture/ Discussion /Q&A	Midterm Quiz/ Midterm Assignment 2/ Midterm Exam
2	Apply knowledge of common modern microcontrollers to select an appropriate platform to perform some dedicated functions as per given specifications.	K4	P1, P3, P7		P.a.4.C.3	FS.2	Lecture/ Discussion /Q&A	Midterm Assignment 1
3	Apply knowledge of digital logic to design the central processing unit of a microprocessor with necessary logical deductions and an in-depth analysis of system requirements writing microprograms and computing the values for peripheral device configurations of the microcontroller.	K4	P1, P3, P7		P.a.4.C.3	FS.2	Lecture/ Discussion /Q&A	Final Assignment/ Final Exam
4	Apply concepts of communication protocols of a microcontroller to perform an in-depth analysis of interfacing microprocessors with peripherals and configure necessary communication modules to interface the designed system with peripherals.	K4	P1, P3, P7		P.a.4.C.3	FS.2	Lecture/ Discussion /Q&A	Final Quiz

16. Mapping Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs)

CLO Number	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
1	FS.2											
2	FS.2											
3	FS.2											
4	FS.2											

PART B

17. Course plan:

Time Frame	Topic	Teaching Learning Strategy	Corresponding CO/CLO	Assessment Tool
Week 1	Mission & Vision, Dept. of EEE; OBE Assessment, Objective of Microprocessor and Embedded System Course. Comparison between microprocessors and microcontrollers, the contrast of Harvard architecture and von Neumann architecture, (introduction, components, classification of) embedded systems and popular boards and groups of embedded systems,	Lecture/ Discussion/ Q&A/Tutorial	2	Midterm Assignment 1
Week 2	Applications and real-life examples of embedded systems. The architecture of a modern microcontroller (Arduino), Learning about the Arduino launch pad, Learning the ATMega IC chip (Pin configuration, Internal architecture, register file, memory organization)	Lecture/ Discussion/ Q&A/Tutorial	1	Assignment 2/Midterm Exam
Week 3	Introduction to Timers, implementation of a simple program using Timer, Architecture of the basic Timer circuit (Block diagram, Information flow, and logic flow, The timer registers), 16-bit timer	Lecture/ Discussion/ Q&A/Tutorial	1	Midterm Quiz/ Assignment 2/Midterm Exam
Week 4	Introduction to debouncing, Necessity of debouncing. Interrupts and traps, Interrupts in an Intel processor, Basic interrupt Processing, Hardware interrupts, Interrupts in a modern microcontroller (Software interrupt, External hardware interrupt), Implementation of interrupts in the microcontroller, Information flow, and logic flow, Rules of interrupt implementation, Interrupt modules, Necessary resources for interrupts, Programming an interrupt, Performance analysis with and without interrupts	Lecture/ Discussion/ Q&A/Tutorial	1	Midterm Quiz/ Assignment 2/Midterm Exam
Week 5	Oscillator/clock of a microprocessor and the power saving modes, Clock generator in Intel processors, Different available oscillators in a microcontroller (clock generation, information flow, and logic flow in the clock circuit), features, active modes, power saving modes (low power mode, sleep mode, etc.)	Lecture/ Discussion/ Q&A/Tutorial	1	Midterm Quiz/ Assignment 2/Midterm Exam
Week 6	Introduction to assembly language and its advantages, Comparison of assembly with high-level languages, the assembly process (assembler, compiler, etc.), Instruction set, Applications of assembly language, learning to write simple programs using assembly, Performance analysis	Lecture/ Discussion/ Q&A/Tutorial	1	Midterm Quiz/ Assignment 2/Midterm Exam
Week 7	Revision class	Discussion/ Q&A/Tutorial	1, 2	Midterm Exam Script
Week 8	**MIDTERM EXAM WEEK (THEORY)**			
Week 9	Introduction to serial interfaces in a microprocessor, Different bus interfaces in Intel microprocessors, an RS-232 communication protocol for serial communication, synchronous and asynchronous communication, different serial interfaces in microcontrollers (UART, USART, I2C, SPI), Comparison between different interfaces (UART and USART)	Lecture/ Discussion/ Q&A/Tutorial	4	Final Quiz
Week 10	The theory of PWM, Application of PWM, Implementation of PWM using a microcontroller, Architecture of the module, Generation of the PWM signal, Calculations, and examples, learning to drive a DC motor with PWM	Lecture/ Discussion/ Q&A/Tutorial	4	Final Quiz

Time Frame	Topic	Teaching Learning Strategy	Corresponding CO/CLO	Assessment Tool
Week 11	Processor Bus Organization, Brief Discussion on Scratchpad Memory, Design of Arithmetic Unit,	Lecture/ Discussion/ Q&A/Tutorial	3	Final Assignment/ Final Exam
Week 12	Design of Logic Unit (Revision of K-Map), Design of the combined ALU, Processor Unit, and Status Registers	Lecture/ Discussion/ Q&A/Tutorial	3	Final Assignment/ Final Exam
Week 13	Design of Status Register and Shifter. Design of Processor unit with control variables, Micro operations for the processor	Lecture/ Discussion/ Q&A/Tutorial	3	Final Assignment/ Final Exam
Week 14	Flowchart, State diagram, and Micro-programmed Control Unit Design for addition/subtraction of signed numbers. Flowchart, State diagram, and Micro-programmed Control Unit Design for calculating the number of 1's and 0's in a register, Develop processor and control logic for arithmetic and logic instructions	Lecture/ Discussion/ Q&A/Tutorial	3	Final Assignment/ Final Exam
Week 15	Revision Class	Lecture/ Discussion/ Q&A/Tutorial	3, 4	Final Term Exam Script
Week 16	**FINAL TERM EXAM WEEK (THEORY)**			

* The faculty reserves the right to change, amend, add, or delete any of the contents.

PART C

18. Assessment and Evaluation

1. **Assessment Strategy:**

	CO/CLO 1 (marks)	CO/CLO 2 (marks)	CO/CLO 3 (marks)	CO/CLO 4 (marks)	Marks for Grading
Quiz 1 (Mid)	**QZ1 (10)**				**10**
Quiz 2 (Mid)	**QZ2 (10)**				**10**
Quiz 3 (Mid)	**QZ3 (10)**				**10**
Assignment 1 (Mid)		**ASG1 (10)**			**10**
Assignment 2 (Mid)	**ASG2 (20)**				**20**
Presentation (Mid)					
Viva (Mid)					
Project (Mid)					
Lab Report (Mid)					
Setup Test (Mid)					
Midterm Exam	**ME (40)**				**40**
Quiz 4 (Final)				**QZ1 (10)**	**10**
Quiz 5 (Final)				**QZ2 (10)**	**10**
Quiz 6 (Final)				**QZ3 (10)**	**10**
Assignment (Final)			**ASG (20)**		**30**
Presentation (Final)					
Viva (Final)					
Project (Final)					
Lab Report (Final)					
OEL (Final)					
Final Exam			**FE (40)**		**40**

* QZ=Quiz, ASG=Assignment, ME=Midterm Exam, FE=Final Exam, TP=Setup Test Performance, SIP= Setup Test Individual Performance, Q=Question, VQ=Viva-Voce Question, OELSP=Open-Ended Lab Setup Test Performance, OELGP=OEL Group Performance.

2. Table of Specification (TOS)

Mid-Term Exam

Topics	CO No.	No. of Days	No. of Items	No. of COs	Level of Bloom's Taxonomy																		POI
					Remember			Understand			Apply			Analyze			Evaluate			Create			
					Item No.	Test Type	Marks	Item No.	Test Type	Marks	Item No.	Test Type	Marks	Item No.	Test Type	Marks	Item No.	Test Type	Marks	Item No.	Test Type	Marks	
Timer based design	CO1	1	1								1	PS	10										P.a.4.C3
Microcontroller-based System Design	CO1	2	1								1	PS	10										P.a.4.C3
Interrupt and debouncing	CO1	1	1								1	PS	10										P.a.4.C3
Assembly language program + flowchart	CO1	2	1								1	PS	10										P.a.4.C3
Total											4		40										

Final Exam

Topics	CO No.	No. of Days	No. of Items	No. of COs	Level of Bloom's Taxonomy																		POI
					Remember			Understand			Apply			Analyze			Evaluate			Create			
					Item No.	Test Type	Marks	Item No.	Test Type	Marks	Item No.	Test Type	Marks	Item No.	Test Type	Marks	Item No.	Test Type	Marks	Item No.	Test Type	Marks	
Serial communication	CO3	1	1								1	PS	10										P.a.4.C3
PWM	CO3	1	1								1	PS	10										P.a.4.C3
Processor logic design	CO3	3	1								1	PS	10										P.a.4.C3
Control logic design	CO3	2	1								1	PS	10										P.a.4.C3
											4		40										

***Test Type Legend**: **AS:** Assignment; **BQ**: Broad question; **SQ**: Short question; **D**: Derivation; **ES:** Essay; **EX:** Exercise; **GE:** Group Exercise; **ID:** Identification; **MC**: Multiple Choice; **MT**: Matching Type; **OB:** Observation; **PS**: Problem Solving; **SA**: Short Answer; **TF**: True or False; **VV:** Viva Voce; **Other please specify**:*

3. Marks Distribution:

The evaluation system will be strictly followed as per the AIUB grading policy. The following grading system will be strictly followed in this class.

Marking System for Theory Classes (Midterm)	
Attendance	10%
Midterm Assignment	30%
Midterm Quiz	20%
Midterm Exam	40%
Total	**100%**

Marking System for Theory Classes (Final Term)	
Attendance	10%
Final Assignment	30%
Final Quiz	20%
Final Exam	40%
Total	**100%**

Final Grade/ Grand Total	
Midterm:	40%
Final Term:	60%
Grand Total	**100%**

4. Grading Policy

Letter	Grade Point	Numerical %
A+	4.00	90-100
A	3.75	85-<90
B+	3.50	80-<85
B	3.25	75-<80
C+	3.00	70-<75
C	2.75	65-<70
D+	2.50	60-<65
D	2.25	50-<60
F	0.00	<50 (Failed)

5. Makeup Procedure:

Students who fail to maintain the requirements and deadlines needed to contact faculty with reasoning. Continuous assessments will be taken with agreement with the student and faculty. For the make-up of Summative assessments, students need to apply for the SET B exam according to the AIUB policy.

PART D

19. Learning Materials

Formal lectures will provide the theoretical base for the subject as well as cover its practical application. A set of lecture notes, and tutorial examples, with subsequent discussion and explanation, together with suggested reading will support and direct the students in their study.

Maximum topics will be covered from the textbook. For the rest of the topics, reference books will be followed. Some Class notes will be uploaded on the web. Whiteboards will be used most of the time.

In some cases, the multimedia projector will be used for the convenience of the students.

Students must study up to the last lecture before coming to the class and it is suggested that they should go through the relevant chapter before coming to the class. Just being present in the class is not enough- students must participate in classroom discussions.

Few assignments will be given to the students based on that class to test their class performance.

1. Recommended Readings (Textbook):

[1] Jeremy Blum, Exploring Arduino: Tools and Techniques for Engineering Wizardry.
[2] Ytha Yu, Charles Marut-Assembly Language Programming Organization of the IBM PC (1992).
[3] Barry B. Brey, “The Intel Microprocessors”, Fourth Edition, Prentice-Hall of India, ISBN 81-203-2158-8.
[4] Ytha Yu, “Assembly Language Programming and Organization IBM PC.”
[5] The ATMega328P datasheet.
[6] The STM32 F401RE datasheet.
[7] Morris Mano, “Microprocessors and Microcomputer based system design.”

2. Supplementary Readings (Reference Book):

[1] Douglas V. Hall, “Microprocessors and Interfacing – Programming and Hardware,” Second Edition, TATA McGraw-Hill, ISBN 0-07-463639-1.
[2] N. Senthil Kumar, M. Saravanan, and S. Jeevananthan, “Microprocessors and Microcontrollers.”

PART E

Verification: **EEE 4103 Microprocessor and Embedded Systems**		
Prepared by: ……... Prof. Dr. Engr. Muhibul Haque Bhuyan (Course Co-ordinator) Date: 25/01/2023	Checked and certified by: ..... Nafiz Ahmed Chisty Head (UG), Department of EEE, Faculty of Engineering Date:	Approved by: ..... Prof. Dr. A B M Siddique Hossain Dean, Faculty of Engineering Date: .....
	Moderated by: ……. Date: …….	Moderated by: ……. Date: …….