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 Lab
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	Simulate laboratory experiments using microcontrollers, sensors, actuators switches, display devices, etc., and a suitable simulator related to the fields of electrical and electronic engineering for the prediction of system behavior under various conditions and constraints as if the problems are complex in nature.		P1, P4, P5		P.e.2.P4	FS.6	Practical demonstration Flip Class Lecture Discussion	Lab Report OEL Reports Performance Test Report
2	Develop a survey for implementing a capstone project considering cultural and societal concerns.	K5	P1, P3, P7		P.c.2.C6	PS.2	Discussion	Course Project Proposal Form
3	**Demonstrate a course project using microcontrollers, sensors, actuators, switches, display devices, etc. that can solve a complex engineering problem in the electrical and electronic engineering discipline through appropriate research.**	**K8**	**P1, P3, P7**		**P.d.1.P3**	**FS.3**	**Discussion**	**Course Project Report (Literature Review)**
4	**Explain the complex engineering activities of a course project solving a complex engineering problem of the electrical and electronic engineering discipline through an effective presentation.**			**A1, A2**	**P.j.3.A4**	**SS.2**	**Discussion**	**Course Project Presentation**
5	Apply the information and concepts in basic principles of embedded system design with the familiarity of issues for the solution of complex electrical and electronic engineering systems	K4			P.a.4.C.3	FS.2	Lab Class Lecture	Midterm and Final Lab Quizzes

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.6							
2			PS.2									
3				FS.3								
4										SS.2		
5	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. **Experiment 1:** Familiarization with a microcontroller, study of LED blink test, and implementation of a simple traffic light control system using microcontrollers	Lecture/ Discussion/ Demonstration Q&A/Tutorial	1	Lab Report
Week 2	**Experiment 2:** Introduction to STM32 microcontroller (system configuration and implementation of a simple traffic light control system)	Lecture/ Discussion/ Demonstration Q&A/Tutorial	1	Lab Report
Week 3	**Experiment 3:** Study of LED blink test, and implementation of a simple traffic control system using Timer0 of microcontroller.	Lecture/ Discussion/ Demonstration Q&A/Tutorial	1	Lab Report
Week 4	**Experiment 4:** Study of a Digital Timer using the millis() function of Arduino	Lecture/ Discussion/ Demonstration Q&A/Tutorial	1	Lab Report
Week 5	**Experiment 5:** Familiarization with the assembly language programs using an Arduino microcontroller	Lecture/ Discussion/ Demonstration Q&A/Tutorial	1	Lab Report
Week 6	Performance Test (Based on Proteus Simulator)	Discussion/ Q&A	1	Performance Test Report
Week 7	Course Project Proposal Submission Midterm Laboratory Exam	Discussion/ Q&A	2, 5	Capstone Project Proposal Form and Midterm Lab Exam Script
Week 8	**MIDTERM EXAM WEEK (THEORY)**			
Week 9	**Experiment 6:** Communication between two Arduino Boards using SPI	Lecture/ Discussion/ Demonstration Q&A/Tutorial	1	Lab Report
Week 10	**Experiment 7:** Interfacing the Arduino with an external sensor using serial communication protocol for implementing an obstacle detection system.	Lecture/ Discussion/ Demonstration Q&A/Tutorial	1	Lab Report
Week 11	**Experiment 8:** Implementation of a weather forecast system using the ADC modules of an Arduino	Lecture/ Discussion/ Demonstration Q&A/Tutorial	1	Lab Report
Week 12	**Experiment 9:** Implementation of a motor control system using Arduino's PWM output	Lecture/ Discussion/ Demonstration Q&A/Tutorial	1	Lab Report

Time Frame	Topic	Teaching Learning Strategy	Corresponding CO /CLO	Assessment Tool
Week 13	**Experiment 10:** Familiarization with the Raspberry Pi	Lecture/ Discussion/ Demonstration Q&A/Tutorial	1	Lab Report
Week 14	Open-Ended Laboratory (OEL) Experiment	Discussion/ Q&A	1, 5	OEL Report
Week 15	Final Laboratory Exam Course Project Demonstration, Report Submission, and Presentation Upload via TEAMS Special Channel.	Discussion/ Q&A	3, 4	Final Lab Exam Script Project Report Presentation Slides
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)	CO/CLO 5 (marks)	CO/CLO 6 (marks)	Marks for Grading
Presentation (Mid)							
Viva (Mid)							
Project (Mid)		**CPPF (30)**					**30**
Lab Report (Mid)	**LR (25)**						**25**
Performance Test (Mid)						**PT (15)**	**15**
OEL (Mid)							
Midterm Exam					**ME (20)**		**20**
Presentation (Final)				**CPP (10)**			**10**
Viva (Final)							
Project Report (Final)			**CPR (25)**				**25**
Lab Report (Final)	**LR (25)**						**25**
OEL (Final)	**OELR (10)**						**10**
Final Exam					**FE (20)**		**20**

* ME=Midterm Exam, FE=Final Exam, TP=Setup Test Performance, SIP= Setup Test Individual Performance, Q=Question, VQ=Viva-Voce Question, LR=Lab Report, CPPF=Course Project Proposal Form, CPR=Course Project Report, CPP=Course Project Presentation, CPD=Course Project Demonstration, 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	
Arduino platform program	CO5	3	3								3	PS	15										P.a.4.C3
STM32 platform program	CO5	1	1								1	PS	5										P.a.4.C3
Assembly language programming	CO5	1	2								2	PS	10										P.a.4.C3
Total											6		30										

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	
Raspberry Pi platform program	CO5	1	1								1	PS	4										P.a.4.C3
Arduino platform program	CO5	4	4								4	PS	16										P.a.4.C3
											5		20										

***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 Laboratory Classes (Midterm)	
Attendance	10%
Lab Report	25%
Performance Test	15%
Course Project Proposal	30%
Midterm Lab Quiz	20%
Total	**100%**

Marking System for Laboratory Classes (Final term)	
Attendance	10%
Lab Report	25%
OEL Performance and Report	10%
Course Project Demonstration and Report	25%
Course Project Presentation	10%
Final Lab Quiz	20%
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. The whiteboard 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,” 4th 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 Lab**		
Prepared by: …….. Prof. Dr. Engr. Muhibul Haque Bhuyan (Course Co-ordinator) Date: 23/09/2023	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: …….