DEPARTMENT OF TECHNOLGY EDUCATION,IER
UNIVERSITY OF THE PUNJAB, LAHORE-PAKISTAN
Course Outline

Programme	BS Technology Education	Course Code	BSTE318	Credit Hours	3
Course Title	Introduction to Embedded System				

Course Introduction

This course provides an overview of embedded systems, including their architecture, design, and applications. Students will learn about microcontrollers, interfacing techniques, programming, and real-time operating systems. The course includes hands-on projects to reinforce theoretical concepts and develop practical skills.

Learning Outcomes

On the completion of the course, the students will:

1. Understand the fundamentals of embedded systems and their applications.
2. Describe the architecture and components of embedded systems.
3. Program microcontrollers using C/C++.
4. Interface various peripherals with microcontrollers.
5. Develop and debug embedded systems using development tools.
6. Implement basic real-time operating system (RTOS) concepts.

Course Content		Assignments/Readings
Week 1	**Introduction to Embedded Systems** **Unit 1.1**: Overview of Embedded Systems	Reflective essay on the importance of embedded systems in modern technology
	Unit 1.2: Embedded System Applications	
Week 2	**Embedded System Architecture** **Unit 2.1**: Components of Embedded Systems	Diagram and describe the components of a simple embedded system
	Unit 2.2: Microcontrollers vs. Microprocessors	
Week 3	**Introduction to Microcontrollers** **Unit 3.1**: Basics of Microcontrollers	Research and write a report on a popular microcontroller (e.g., Arduino, PIC, AVR
	Unit 3.2: Microcontroller Architecture	
Week 4	**Programming Microcontrollers** **Unit 4.1**: Basics of C/C++ for Embedded Systems	Write simple C programs for microcontroller-based

	Unit 4.2: Development Tools and Environments	tasks
Week 5	**Interfacing and Peripherals** Unit 5.1: Digital and Analog Interfacing Unit 5.2: Communication Protocols (UART, SPI, I2C)	Interface an LED and a sensor with a microcontroller
Week 6	**Timers and Interrupts** Unit 6.1: Understanding Timer Unit 6.2: Handling Interrupts	Write a program using timers for precise delay
Week 7	**Real-Time Operating Systems (RTOS)** Unit 7.1: Introduction to RTOS Unit 7.2: Basic RTOS Concepts	Research and present on the role of RTOS in embedded systems
Week 8	**Sensors and Actuators** Unit 8.1: Types of Sensors and Their Applications Unit 8.2: Working with Actuators	Interface a temperature sensor with a microcontroller
Week 9	**Embedded System Design** Unit 9.1: Design Considerations Unit 9.2: Power Management	Develop a design plan for an embedded system project
Week 10	**Debugging and Testing** Unit 10.1: Debugging Techniquess Unit 10.2: Testing Embedded Systems	Use debugging tools to troubleshoot a microcontroller program
Week 11	**Wireless Communication in Embedded Systems** Unit 11.1: Introduction to Wireless Communication Protocols Unit 11.2: IoT and Embedded Systems	Implement wireless communication between two microcontrollers using Bluetooth or Wi-Fi
Week 12	**Advanced Topics in Embedded Systems** Unit 12.1: Low-Power Embedded Systems Unit 12.2: Embedded Systems in Automotive Applications	Research and present on techniques for reducing power consumption in embedded systems
Week 13	**Security in Embedded Systems** Unit 13.1: Security Challenges Unit 13.2: Implementing Security Measures	Write a report on common security challenges in embedded systems
Week 14	**Case Studies and Industry Applications**	Analyze a case study of an

	Unit 14.1: Case Studies of Successful Embedded Systems	embedded system project
	Unit 14.2: Industry Applications	
Week 15	**Final Projects** **Unit 15.1**: Project Development and Planning	Develop a comprehensive project proposal for an embedded system application
	Unit 15.2: Project Implementation	
Week 16	**Course Review and Final Assessment** **Unit 16.1**: Review of Key Concepts and Themes	Group presentation summarizing key learnings from the course
	Unit 16.2: Comprehensive Final Exam	

Textbooks and Reading Material

1. Textbooks.

- o Embedded Systems: Introduction to ARM Cortex-M Microcontrollers by Jonathan W. Valvano

2. Suggested Readings

- o Introduction to Embedded Systems: Using Microcontrollers and the MSP430 by Manuel Jiménez, Rogelio Palomera, and Isidoro Couvertier

Teaching Learning Strategies

1. **Lectures:** To introduce and explain key concepts and theories.
2. **Hands-on Labs:** To provide practical experience with robotics components and programming.
3. **Assignments and Projects:** To reinforce learning and encourage application of concepts in real-world scenarios.
4. **Group Discussions:** To facilitate peer learning and collaborative problem-solving.

Assessment

Sr. No.	Elements	Weight age	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.

| 3. | Final Assessment | 40% | Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc. |