DISCIPLINE SPECIFIC CORE COURSE- 19: Embedded Systems and Robotics (INDSC7A)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Embedded Systems and Robotics (INDSC7A)	04	02	-	02	Course admission eligibility	Basic Electronics

Learning Objectives

The Learning Objectives of this course are as follows:

- Understand Embedded Systems: Learn the architecture, features, and applications of embedded systems, including RISC vs. CISC and Von-Neumann vs. Harvard architectures.
- Explore Microcontrollers: Get familiar with Arduino and AVR microcontroller (ATMega32) architecture and programming.
- Arduino Programming: Set up Arduino IDE and program digital inputs/outputs, analog inputs, and serial communication.
- Sensor and Actuator Integration: Interface sensors (e.g., temperature, light) and actuators (e.g., motors, servos) with Arduino.
- Robotics Basics: Understand robotics, motor control, and sensor integration to build basic robots and robotic arms using Arduino.

Learning Outcomes

After successful completion of the course, students will be able to:

- Embedded System Knowledge: Ability to describe the features, architecture, and applications of embedded systems, including key microcontroller architectures.
- Microcontroller Proficiency: Gain proficiency in programming and interfacing with Arduino and AVR microcontrollers (e.g., ATMega32).
- Arduino Programming Skills: Demonstrate the ability to program Arduino for handling digital/analog inputs, outputs, and serial communication.
- Sensor and Actuator Control: Successfully interface and control sensors and actuators (e.g., motors, temperature sensors) using Arduino.
- Robotics Application: Design and program basic robotic systems, including motor and sensor integration, using Arduino.

SYLLABUS OF DSC- 19

UNIT-I **(8 hours)**

Basic Concepts of Embedded Systems: Introduction to computer, microprocessor and microcontrollers. Characteristics, Requirements and Applications of Embedded Systems. Overview of Von- Neumann and Harvard architecture, RISC and CISC microcontrollers .

UNIT-II **(6 hours)**

Introduction to Arduino : Functional Block Diagram of Arduino, Functions of each Pin. Overview of the Integrated development environment (IDE), I/O Functions, Looping Techniques, Decision Making Techniques. ATMega32 microcontroller internal architecture, instruction set and addressing modes

UNIT-III **(8 hours)**

Programming with Arduino: Basic Programming with Sensors and Actuators. Serial Communication: Sending and receiving data with a peripheral (USART) . Interfacing : DC motors, servo motors, and stepper motors with Arduino and other Hardwares Seven Segment Display, LCD, Buzzer ,and Relays.

UNIT-IV **(8 hours)**

Introduction to Robotics: Origin of automation, types of Robot, robot joints, Forward and reverse kinematics , Basics of Electronics for Robotics , robotics skills with sensor integration, Basic interfacing programming concept

Practical component: **(60 hours)**

1. To analyze the block diagram of an embedded system and identify its components.
2. Setting up Arduino Environment, Install the Arduino IDE, understand its interface, and upload a "Blink LED" program.
3. Write a program and design a circuit to turn an LED on and off using a push button.
4. Write a program for reading analog Inputs and monitoring outputs.
5. Write a program to interface Temperature Sensors with Arduino.
6. Write a program to interface motors and control speed.
7. Write a program to interface Pressure Sensor Arduino
8. Write a program to interface Current Sensor with Arduino.
9. Write a program to Interface pH Sensor with Arduino for Water Quality Monitoring
10. Write a program to do serial communication to send and receive data between Arduino and a computer.
11. Write a program Controlling DC Motors with H-Bridge, speed using L293D motor driver IC.

12. Write a program to interface ultrasonic sensors to detect obstacles and control a motorized robot.
13. Any one of the following mini projects or on similar concepts incorporating data acquisition from sensors/ input device, data analysis & control and display of result on any output device: Digital Thermometer, Light-Activated Lamp, Distance Measurement System, Traffic Light Simulation, Line-Following Robot. Automatic Plant Watering System, Solar Power Monitoring System, Energy Consumption Tracker, Water Quality Monitoring System, Automatic Irrigation System, Smart Street Lighting System, Air Quality Monitoring, CO2 Emission Tracker, Temperature and Humidity Logger, Smart Fish Tank Monitoring System, Biodiversity Protection System, Waste Segregation System, Smart Composting Bin, Smart Factory Prototype, Smart Health Monitoring System, Indoor Air Quality Monitor

Essential/recommended readings

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson education Asia, New Delhi (2007), 2nd Edition.
2. Michal Mc Roberts “Beginning Arduino” Second Edition, Technology in Action
3. Massimo Banzi, “Getting started with Arduino” 2nd Edition, Orelly 2011
4. Richard Blum, “Arduino Programming in 24 Hours”, Pearson Education, 1st
5. edition, 2015.
6. James M. Fiore, Embedded Controllers using C and Arduino, 2019
7. https://docs.arduino.cc/learn/

Suggestive readings

1. Raj Kamal: Microcontrollers, Architecture, Programming, System Design, 2nd Edition, Pearson.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 20: Industrial Automation using PLC and SCADA (INDSC8A)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		