Program :	**Diploma in Electronics Engineering / Computer Engineering / Biomedical Engineering / Communication and Computer Networking / Electronics & Communication**
Course Code : **6209A**	Course Title: **Embedded Systems Lab**
Semester: **5** / **6 / 5**	Credits: **1.5**
Course Category: **Program Core / Elective**	
Periods per week: **3 (L:0, T:0, P:3)**	Periods per semester: **45**

Course Objectives:

To develop the ability to design microcomputer-based embedded systems. This class allows students to learn microcomputer interfacing from both a hardware and software perspective.

Course Prerequisites:

Topic	Course code	Course name	Semester
Familiarisation of Electronic devices and Components	2049	Electronics Tinkering Workshop	S2
Basic Programming skills	3045	Fundamentals of C programming	S3
Basics of Microcontroller architecture and programming	4041	Microcontroller and applications	S4

Course Outcomes:

On completion of the course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive level
CO1	Make use of AVR studioto exercise simple programs	9	Applying
CO2	Develop embedded C programs to interface various sensors and motors	9	Applying
CO3	Realize interfacing of display devices, keyboard and ADC/DAC converters	12	Applying
CO4	Realize I2C and SPI Communication interfaces with AVR	9	Applying
	Lab Exam	6	

CO-PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2					
CO2	3	2					
CO3	3	2					
CO4	3	2					

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline:

Module Outcomes	Name of Experiment	Duration (Hours)	Cognitive Level
CO1	**Make use of AVR studio to exercise simple programs**		
M1.01	Familiarize AVR studiofor AVR programming	1.5	Understanding
M1.01	Develop programs for LED blinking	3	Applying
M1.03	Read the status of a switch and display it on an LED	1.5	Applying
M1.04	Develop programs to drive a load using Relay	1.5	Applying
M1.05	Make use of AVR tointerface optocoupler.	1.5	Applying
CO2	**Develop embedded C programs to interface various sensors and motors**		
M2.01	Realize Temperature sensor interfacing with AVR	1.5	Applying
M2.02	Demonstrate interfacing of Humidity sensor with AVR	1.5	Applying
M2.03	Demonstrate DC Motor interface with AVR	1.5	Applying
M2.04	Illustrate Servo Motor Interfacing with AVR	1.5	Applying
M2.05	Realize Stepper Motor Interfacing with AVR	3	Applying
	Lab Exam – I	3	
CO3	**Realize interfacing of display devices, keyboard and ADC/DAC converters**		

M3.01	Realize Seven segment display interface with AVR	3	Applying
M3.02	Demonstrate LCD interfacing with AVR	3	Applying
M3.03	Illustrate Matrix Keyboard interfacing with AVR	3	Applying
M3.04	Realise ADC/DAC interfacing with AVR	3	Applying
CO4	**Realize I2C and SPI Communication interfaces with AVR**		
M4.01	Familiarize I2C and SPI interfacing with AVR	3	Understanding
M4.02	Develop programs for Real time clock interfacing	3	Applying
M4.03	Demonstrate ADC interfacing using I2C	3	Applying
M4.04	Demonstrate DAC interfacing with I2C		Applying
	* Any one program for I2C interfacing		
	Lab Exam II	3	

Text / Reference:

T/R	Book Title/Author
T1	K.V. Shibu, Introduction to Embedded Systems, 2e, McGraw Hill Education India, 2016.
T2	Rajkamal, Embedded Systems Architecture, Programming and Design, TMH, 2003
R1	Muhammad Ali Mazidi, SarmadNaimi, &SepehrNaimi, The AVR Microcontroller and Embedded Systems Using Assembly and C, Pearson Education
R2	Michael J. Pont, Embedded C, Pearson Education, Second Edition

Online Resources:

Sl.No	Website Link
1	https://www.studyelectronics.in/embedded-programming-tutorial-chapter-1-beginners/
2	https://www.tutorialspoint.com/embedded_systems/index.htm
3	https://embeddedschool.in/avr-microcontroller-programming/
4	https://www.electronicwings.com/avr-atmega/atmega1632-usart

5	https://www.exploreembedded.com/wiki/A6.AVR_Interfacing:_RTC_DS1307
6	https://www.electronicwings.com/avr-atmega/atmega1632-i2c

Suggested Open-ended Experiments:

I. Develop projects like

1. Automatic sanitizer dispenser
2. Automatic water level controller
3. Automatic glass door system
4. Temperature controlled DC fan
5. Line follower robot
6. Automated wheel chair with hand held control panel