Devi Ahilya University, Indore, India Institute of Engineering & Technology				**III Year B.E. (Electronics and Instrumentation)**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
6EIRL4 ROBOTICS AND SYSTEM DESIGN	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	-	**-**	**1**	**-**	**-**	**1**	**1**
Duration of Theory Paper: 3 Hours							

Course Objective:

The course is designed

1. To understand the basics of Robotics and its application.
2. To understand the Concept AVR Microcontroller and its application in Robotics.
3. To Study various Sensors and Actuators used for designing Robotic based System
4. To Study and implement various algorithms for Programming ATMEGA Microcontroller.
5. To create utility based robotic applications for usage across variety of applications such as: agriculture, manufacturing, defence, home, city maintenance and services industries.

Prerequisites: AVR Microcontroller Programming

COURSE CONTENTS

List of Practical Assignments:

Following Experiments to be performed on Firebird V Robotic Platform:

1. The aim of this experiment is to get you familiar with I/O Ports of Atmega 2560 microcontroller, when used as output ports. In this experiment, you will interface an output device (bar graph LED) with the microcontroller. Bar graph LED comprises of 10 LEDs included in a single module and is connected to PORT J of Atmega 2560 microcontroller.

Your task is to turn on and turn off a set of 4 LEDs connected to upper nibble of Port J and then turn on and turn off another set of 4 LEDs connected to lower nibble of Port J, alternately with an ON time of 1 second.

2. The aim of this experiment is to get you familiar with I/O Ports of Atmega 2560 microcontroller, when used as input ports. In this experiment you will interface an input device (boot switch) with the microcontroller. The boot switch is located right beside the reset switch on the Firebird V robot.

Your task is to implement a "Push to ON" indicator using a set of 4 LEDS (part of the Bar graph LED) connected to upper nibble of Port J and a boot switch connected to Port E pin number 7. These 4 LEDs will turn ON and remain ON as long as the boot switch is pressed and turn off as soon as the boot switch is released.

3. The aim of this experiment is to get you familiar with LCD interfacing on the ATmega 2560 based Firebird V robotic kit. In this experiment, you will write program code to interface a 16x2 LCD with Atmega 2560 microcontroller. The 16x2 LCD is connected to Port C of Atmega 2560.

Your task is to display "**IET**" on the LCD, starting from the 1st line 4th column and "**DAVV**" starting from the 2nd line 2nd column of the LCD.

4. The aim of this experiment is to get you familiar with LCD interfacing on the ATmega 2560 based Firebird V robotic kit. In this experiment you will write a program code to display an up counter on the LCD.

Your task is to display the text "**Counter**" starting from the 1st line 1st column of the LCD and an up counter going from **00** to **25** on the 2nd line 1st column of the LCD. The counter should increment by 1 after every **second** and should stay at **25** once that count is reached.

5. The aim of this experiment is to get you familiar with Timer/Counter module on the Atmega 2560 based Firebird V robotic kit. In this experiment, you will write code to display an integer counter going from "00" to "10" (base 10).

Your task is to display the text "**Counter**" starting from the 1st line 1st column of the LCD. An up counter going from "**00"** to "**10"** should be displayed on the 2nd line 2nd column of the LCD. After every 2 seconds, the counter should incremented by 2, i.e. starting with **00**, the next value will be **02**, **04**, and so on. Once the counter reaches "**10**", it should stop counting, retain this value and turn ON the buzzer for 1 second to indicate this. The delay between counter increments has to be generated using **Timer1**.

Note: Buzzer control pin is connected to Pin no. 4 of Port C (PC3). You may use inbuilt delay function to turn buzzer ON for 1 second.

6. The aim of this experiment is to get you familiar with Timer/Counter module on Atmega 2560 and bargraph LED present on Firebird V robotic kit.

In this experiment, you have to write a program to represent counter from '0' to '8' by turning ON one bargraph LED segment at an interval of **1 second** to represent the corresponding counter value. For example, a zero will be indicated with all the LEDs of bargraph turned OFF and '8' will be represented by turning ON all the LEDs of bargaraph. The sequence will start from the bottom LED of the bargraph. You have to generate the turn ON delay between the two LEDs of bargraph with help of **Timer 1.** Once all the LEDs are turned ON, buzzer should be turned ON for 1 second to indicate the end of experiment.

Note: There are a total of 10 bargraph LEDs, of which 8 are connected to PORTJ and remaining 2 are not connected. Check Jumper "J3", it should be connected/shorted, otherwise bargraph LED will remain disabled.

7. The aim of this experiment is to get you familiar with DC motor interfacing on the Atmega2560 based Firebird V robotic kit. In this experiment, you will write program code to control DC motor with Atmega2560 microcontroller. The DC motor is connected to **L293D** (motor driver IC) and the pins of **L293D** are connected to **Port A** and **Port L** of Atmega2560.

1. Four Pins for Direction control are connected at **PORT A**.
    A. **PA0** -Left Motor Control
    B. **PA1** -Left Motor Control
    C. **PA2** -Right Motor Control
    D. **PA3** -Right Motor Control

2. Two Pins for Enabling Motor Driver IC are connected at **PORT L**.
   A. **PL3** -Left Channel Enable
   B. **PL4** -Right Channel Enable

Your task is to trace the shape of alphabet "**L**", using the path traversed by the Firebird V.

8. The aim of this experiment is to get you familiar with **Pulse Width Modulation (PWM)** using Atmega2560 microcontroller.

Your task is to decelerate the robot using **PWM** and indicate this on the bargraph LEDs. Bargraph LEDs are connected to **Port J** of Atmega2560.

1. Robot velocity is proportional to the values passed in the Output Compare Registers (**OCR5AL & OCR5BL**). Divide the entire velocity range (**maximum–minimum**) into approximately **8** equal parts.
2. The robot should start with **maximum** velocity and with all the bargraph LEDs turned ON.
3. Decrease the velocity by an equal amount and with each decrement switch OFF one of the bargraph LEDs starting from the top i.e. Pin no. 8 (MSB) of **Port J**.
4. All the bargraph LEDs should be turned OFF when the **minimum** velocity is reached.
5. This experiment has to be completed in a maximum of **30 seconds**; hence the time after which a velocity decrement occurs has to be selected appropriately.

9. Experiments on ADC, White Line sensor and Front IR Sensor.

Course Outcome:

Students earned credits will develop ability to

CO.No.	CO	PO
CO1	Working on various Robotic Platforms available in Laboratory.	PO-1, PO-2
CO2	Programming and Interfacing of Various Sensors and Actuators to FIREBIRD-V Robotic Platform	PO-1, PO-2
CO3	Integrating Multiple I/O Devices to FIREBIRD-V Robotic Platform.	PO-3, PO-4, PO-5
CO4	Problem Analysis and Solution Identification for variety of applications such as: agriculture, manufacturing, defence, home, services industries etc.	PO-2, PO-3, PO-4, PO-9
CO5	Prototyping and Model development to provide Standalone Solution to the Problem.	PO-2, PO-3, PO-4, PO-6, PO-7, PO-9, PO-11

CO-PO Relationship

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO1	3	3										
CO2	2	2										
CO3			2	2	3							
CO4		2	2	3					2			
CO5		2	2	3		2	2		2		3	

BOOKS RECOMMENDED:

[1] https://elsi.e-yantra.org/resources