Savitribai Phule Pune University Second Year of Artificial Intelligence and Data Science (2020 Course) 217531: Internet of Things Laboratory		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 04 Hours/Week	**02**	**Term Work (TW): 50 Marks** **Practical(PR): 25 Marks**

Prerequisite Courses: Programming and Problem Solving (110005),
Basic Electronics Engineering (104010)

Companion Course: Internet of Things (217529)

Course Objectives:

- Hardware platforms and operating systems commonly used in IoT systems.
- Help the students in providing a good learning environment and also work with real time problems faced in day to day life.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand IOT Application Development using Raspberry Pi/ Beagle board/ Arduino board

CO2: Develop and modify the code for various sensor based applications using wireless sensor modules and working with a variety of modules like environmental modules.

CO3: Make use of Cloud platform to upload and analyse any sensor data

Guidelines:

Lab Assignments: Following is list of suggested laboratory assignments for reference. Laboratory Instructors may design a suitable set of assignments for their respective course at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. The Inclusion of a few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorial may be as per guidelines of authority.

· **Term Work**: Term work is continuous assessment that evaluates a student's progress throughout the semester. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been achieved. It is recommended to conduct an internal monthly practical examination as part of continuous assessment.

· **Assessment:** Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.

·**Laboratory Journal:** Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journals may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

Suggested List of Laboratory Experiments/Assignments

Student should perform all assignments from Group A, at least 8 experiments with all experiments from group B and any 1 assignment from Group C. (Use suitable programming language/Tool for implementation)

List of Assignments
Group A
1. Study of Raspberry-Pi/ Beagle board/ Arduino and other microcontroller (History & Elevation)
2. Study of different operating systems for Raspberry-Pi /Beagle board/Arduino. Understanding the process of OS installation
3. Study of different GATES (AND, OR, XOR), Sensors and basic binary operations.
4. Study of Connectivity and configuration of Raspberry-Pi /Beagle board/Arduino circuit with basic peripherals like LEDS. Understanding GPIO and its use in the program.
Group B
5. Write a program using Arduino to control LED (One or more ON/OFF). Or Blinking
6. Create a program that illuminates the green LED if the counter is less than 100, illuminates the yellow LED if the counter is between 101 and 200 and illuminates the red LED if the counter is greater than 200
7. Create a program so that when the user enters ‘b’ the green light blinks, ‘g’ the green light is illuminated ‘y’ the yellow light is illuminated and ‘r’ the red light is illuminated
8. Write a program that asks the user for a number and outputs the number squared that is entered
9. Write a program to control the color of the LED by turning 3 different potentiometers. One will be read for the value of Red, one for the value of Green, and one for the value of Blue
10. Write a program read the temperature sensor and send the values to the serial monitor on the computer
11. Write a program so it displays the temperature in Fahrenheit as well as the maximum and minimum temperatures it has seen
12. Write a program to show the temperature and shows a graph of the recent measurements
13. Write a program using piezo element and use it to play a tune after someone knocks
14. Understanding the connectivity of Raspberry-Pi /Beagle board circuit / Arduino with IR sensor. Write an application to detect obstacle and notify user using LEDs
Group C
15. Study of ThingSpeak – an API and Web Service for the Internet of Things (Mini Project: Same can be done parallel with PBL)
16. Write an application to control the operation of hardware simulated traffic signals. (Mini Project: Same can be done parallel with PBL)
17. Develop a Real time application like smart home with following requirements: When the user enters into the house the required appliances like fan, light should be switched ON. Appliances should also get controlled remotely by a suitable web interface. The objective of this application is that students should construct complete Smart applications in groups. (Mini Project: Same can be done parallel with PBL)
18. Write an application for stopwatch or countdown timer. (Mini Project: Same can be done parallel with PBL)
Learning Resources
Text Books: 1. Alan G. Smith, “ Introduction to Arduino: A piece of cake” 2. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012. ISBN : 9781439892992
Reference Books: 1. Olivier Hersent, Omar Elloumi and David Boswarthick, “The Internet of Things: Applications to the Smart Grid and Building Automation”, Wiley, 2012, 9781119958345 3. 2. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things: Key applications and Protocols”, Wiley, 2012, ISBN:978-1-119-99435-0

@The CO-PO mapping table												
PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	--	--	--	--	--	--	--	--	--
CO2	--	2	3	--	--	--	--	--	--	--	--	--
CO3	--	--	3	2	--	--	--	--	--	--	--	3