Course Title: Embedded System for Smart Applications
Course Code: CT508
Credit Structure (L-T-P-Cr): (2-0-2-3)
Semester: Winter, 2020
Prerequisites (if any)/Desired Skill Set: Basic Electronics
Instructor: Prof. Tapas Kumar Maiti

Course Objective: The goal of this course is to give the students an understanding and practical implementation of an embedded systems for smart applications, including the recent developments on sensors, actuators, communication systems, VLSI/SoC, robotics, AR/VR, etc. The students will acquire key concepts and skills to become a good embedded-system designer.

Course Content: This course considers the cutting-edge embedded-system technologies with focus on embedded architecture and product development. It will start with the programming of embedded processor where sensors and actuators will be accessed by Android/iOS Apps. The course consists of three parts: (i) interactive classroom lectures, (ii) practical exercises using software and hardware tools, and (iii) a project. The course will cover following topics:

Classroom Lectures:
1. Introduction to Embedded Systems
   - What is an Embedded System • Computer System vs. Embedded System vs. Cyber-Physical System
   - Embedded System Applications • Components of a Typical Embedded System
2. Sensors, Actuators, and Interfaces
   - Pressure Sensor • Image Sensor • Proximity Sensor • IMU Sensor • GPS
   - Servo-Motor • Wi-Fi on Arduino/Raspberry Pi
3. Integrated Design Environment (IDE)
   - Installation of Numerous OS for IDE • Arduino Uno IDE • Linux on Raspberry Pi
   - Ubuntu on SoC • AR/VR IDE
4. Embedded System Programming
   - Embedded C • Python • Verilog/VHDL • CUDA • Middleware/Firmware • Hardware/Software Co-Design
   - Connecting Android/iOS (example on iPhone/iPad) with Arduino/ Raspberry Pi
5. Embedded Processor, Memory, and Microcontroller
   - ATMEGA328/AVR • FPGA • CPU/GPU •SoC • Embedded Memory
6. Embedded Operating Systems
   - Introduction to RTOS • Robot Operating System •Internet Technology Platform
7. Architectural Design of Embedded Systems
   - Analog and Digital Components • VLSI/SoC •Power Driver Circuits • PID Control • DC Motor Control System
   - Mechanical Design of Embedded Product • Prototyping AR/VR
8. Robot System Architecture
   - Architectural Design of Robots • Robot Technology Platform • Self-Driving Car • Flying Robot
   - Underwater Robot • Humanoid Robot • Robotics IoT
Practical Exercises:
Lab 1: Connecting Sensors and Actuators with Arduino.
Lab 2: Interfacing Arduino Uno Based Smart System (use Lab1 outcome) with Raspberry Pi, FPGA, and GPU.
Lab 3: Development of iOS/Android Apps and Accessing the Built-in-Sensors on Embedded System (use Lab2 outcome) via Wi-Fi and Bluetooth.
Lab 4: Interacting the Physical World via Embedded System (use Lab3 outcome) by Prototyping AR/VR.

Course Project: You pick a project of your own accord, then design and build it.

Suggested Textbook:

Course Evaluation Policy:
II In-Semester Examination: 20%
End-Semester Examination: 30%
Labs: 30%
Project: 10%
Others (Home Work, Quiz, etc.): 10%
Total: 100%