

Application – Driven Electronics and Embedded Technology with IoT

(A10-days in-person course conducted at IIT Madras)

Course Schedule

Day	Module
1	Basic Electronics – Part 1
2	Basic Electronics – Part 2
3	Analog Electronics
	Digital Electronics
4	Sensors and Instrumentation
	Handling of i/o devices and measuring techniques
5	Sensing technology and applications -1 & 2
	Introduction to Embedded technology with pros and cons - Arduino
6	Applications based Logic controls
7	Applications based Automation controls
8	Introduction to Embedded technology with pros and cons – ESP32, raspberry pi, PIC
9	Project design with PCB and microcontroller
10	Building blocks with mini projects

Curriculum:

Day1	Electronics Devices and Circuits-Part 1: Basic circuits with Resistors, capacitors and Inductors. Ohms law, Kirchhoff's law, Theorems, Wheatstone Bridge, Low pass/ High pass Filters, Differentiators/Integrators, Diode based Clippers and Clamper circuits, Design of series-parallel LED circuits and brightness controller, Special types of LEDs- Auto Flash LED, RGB LED, 7 Segment LED, and Bargraph LED. Special Resistors – Light Dependent Resistor and Temperature dependent Resistor.
Day2	Electronics Devices and Circuits – Part 2 RLC Resonance, Zener diode voltage regulator, IC Regulator, Transformers, Rectifiers and Filters, Simple DC power supply Design, Transistor as a switch and Amplifier, MOSFET as a Switch, Electromagnetic relay, Buzzer and Wire continuity tester.
Day3	Analog Circuits – Opamp based Buffer, Inverting Amplifier, Non-Inverting Amplifier, Differential Amplifier, Adder, Subtractor, Wein bridge and RC Phase shift Oscillators,

	<p>Comparator, Voltage level monitor, Analog to Digital Converter and Digital to Analog Converters.</p> <p>Digital Circuits- Logic Gates, Combinational Circuits, Flip-Flops, Counters, Shift registers, BCD to Segment Decoder, 555 based LED blinker and Timer.</p>
Day4	<p>Instrumentation Systems and Sensors- Galvanometer as an Ammeter and Voltmeter Instrumentation Amplifier Conversion of various parameter into Electrical parameter using Sensors:</p> <ul style="list-style-type: none"> ➤ Temperature Sensor (Thermocouple, Thermistor) ➤ Ambient Light Sensor (LDR) ➤ Infrared Light Sensor (IR Emitter-Detector) ➤ Long Range IR Light Sensor (TSOP) ➤ Magnetic field Sensor (Reed Switch) ➤ Sound Sensor (Microphone) <p>Concept of Sensing technology and its construction of various commercial sensors.</p>
Day5	<p>Application based experiments using sensors-</p> <ul style="list-style-type: none"> ➤ Temperature measurement using Thermocouple ➤ Temperature controlled mini DC Fan ➤ Automatic Street Light Controller ➤ Remote Controlled light ➤ Object Detector ➤ Door security Alarm ➤ Solar PV operated mini DC fan <p>Embedded systems – Introduction to Arduino IDE Arduino - Download and Installation Syntax, Variables, Data types Structures- loop, setup, Arithmetic operators, Control Structures, Comparison operators, Bitwise operators. Key Functions – Pin Mode, Analog Read, Analog Write, Digital Read, Digital Write</p> <p>Programs with interfacing of basic I/O devices (LEDs and Switches):</p> <ul style="list-style-type: none"> ➤ LED Blinking with switch sensing ➤ LED brightness controller using PWM ➤ Rainbow colour (VIBGYOR) generator using RGB LED ➤ 2 lane traffic light controller ➤ Police chaser using red and blue LED <p>Programs to read Analog input voltage and LCD interface</p> <ul style="list-style-type: none"> ➤ 16*2 LCD Interface (To display 'Welcome IITM') ➤ Reading DC voltage in serial monitor ➤ Reading DC voltage in LCD display

<p>Day6</p>	<p>Programs to measure other Electrical parameters-</p> <ul style="list-style-type: none"> ➤ Capacitance measurement ➤ Frequency measurement <p>Programs with Motor control and Membrane Key switch detection-</p> <ul style="list-style-type: none"> ➤ Forward/Reverse control of DC Motor by pushbutton switches ➤ Speed control of DC motor ➤ 4X3 Membrane Key Matrix Switch Detection <hr/> <p>Application based Programs with interfacing of Sensors to measure various Parameters-</p> <ul style="list-style-type: none"> ➤ Temperature measurement using LM35 (°C and F) ➤ Humidity measurement ➤ Sound level measurement using mini microphone (dB) ➤ Distance measurement using ultrasonic sensor (cm, feet) and Accident Prevention Alarm ➤ Heart rate measurement using HRM sensor <p>Mini projects with Logical Control-</p> <ul style="list-style-type: none"> ➤ Bank Token counter ➤ Implementation of Logic Gates, combinational and sequential logic ➤ IC Tester ➤ 3 floor Lift operating system ➤ Instrumentation Amplifier Design and Weight measurement system
<p>Day 7 (Part 1)</p>	<p>Concept of Sensing technology and its construction of various commercial sensors.</p> <ul style="list-style-type: none"> ➤ Human motion Detection (Passive Infrared Sensor) ➤ Magnetic field Sensor (Hall sensor and Reed Switch) ➤ Force/Pressure (Strain Gauge) ➤ Gas/Fire Sensor (Gas sensor) ➤ Soil moisture sensor (Resistance strip) ➤ Water Quality sensor (TDS) ➤ Water tank over flow control (Float)
<p>Day 7 (Part 2)</p>	<p>Application programs with Sensors</p> <ul style="list-style-type: none"> ➤ Fan Speed (RPM) Measurement ➤ Vehicle Speed Measurement ➤ Solar light intensity Measurement <hr/> <p>Programs with Motor control and Key switch detection-</p> <ul style="list-style-type: none"> ➤ Stepper Motor control ➤ Capacitive touch Key Detection

	<ul style="list-style-type: none"> ➤ Load ON/OFF control with single push button
Day 8	<p>Automation and control based Applications</p> <ul style="list-style-type: none"> ➤ Smart Farm water irrigation ➤ RFID Detection – Office room entry with auto power shutdown at no entry ➤ Fire Alarm/Gas leakage Alarm with Auto power shutdown ➤ Industrial Process control for Juice Maker and bottle filling system ➤ Automatic Water Tap <p>Raspberry Pi , PIC and ESP32 Embedded Platform</p> <p>Download and Installation</p> <p>Functions of Analog, Digital and PWM Ports, Configuring Input-Output Ports</p> <p>Coding - Syntax, Variables, Data types</p> <p>Programs with interfacing of basic I/O devices (LEDs and Switches):</p> <ul style="list-style-type: none"> ➤ LED Blinker ➤ LED control with switch sensing <p>Programs to read Analog input voltage and LCD interface</p> <ul style="list-style-type: none"> ➤ 16*2 LCD Interface (To display 'Welcome IITM') ➤ Reading DC voltage in LCD display <p>Program to store data in Cloud</p> <ul style="list-style-type: none"> ➤ DC voltage measurement and Cloud Storage
Day 9	<p>PCB Design for Smart Automation system using Microcontroller</p> <ul style="list-style-type: none"> ➤ Prototype design ➤ Schematic Drawing ➤ PCB design ➤ Gerber file generation ➤ Testing in Assembled PCB
Day 10	<p>Advanced Application based mini projects</p> <ul style="list-style-type: none"> ➤ Real time clock in OLED Display ➤ Time stamped 4 Channel Data Acquisition System with upload in excel ➤ Temperature setting and control in Industrial Heater ➤ Human Motion Detection Corridor lighting power saver ➤ Automatic car parking with Anti-collision Alarm and headlight control ➤ Mobile App control Home Automation/ Robot control ➤ Weather Data log in Cloud storage with Message/email Alert