ANNEXURE I

MODULE-WISE COURSE CONTENT AND OUTCOME

SL.NO	MODULE NAME	MODULE CONTENT	MODULE LEARNING OUTCOME	DURATION (HRS)
1	**Unit I: Introduction to Product Design and Development**	Understanding the Product Lifecycle: Overview of ideation, prototyping, testing, and deployment.	Understand the key stages of the product lifecycle-ideation, prototyping, testing, and deployment-and their role in creating and delivering successful products.	2 Hours
		Identifying User Needs and Problem Statement: Techniques for identifying user requirements and defining problem statements.	Learn techniques to identify user needs and craft clear problem statements to drive user-focused product development.	2 Hours
		Introduction to Basic Electronics Tools and Components: Explanation of resistors, capacitors, transistors, and diodes.	Gain foundational knowledge of basic electronic component - resistors, capacitors, transistors, and diode- and their functions in electronic circuits.	2 Hours
		Introduction to Prototyping Platforms: Arduino, breadboards, and simulation tools like TinkerCAD/Fritzing.	Understand the basics of prototyping platforms, including Arduino, breadboards, and simulation tools like TinkerCAD and Fritzing, for creating and testing electronic projects.	3 Hour
2	**Unit II: Basic Circuit Design and Simulation**	Fundamentals of Circuit Design: Series and parallel circuits, Ohm's law, and circuit calculations. Solve circuit problems and build simple series/parallel circuits on breadboards.	Master the fundamentals of circuit design, apply Ohm's law, perform circuit calculations, and build simple series and parallel circuits on breadboards.	2 Hour

		Circuit Simulation: Using TinkerCAD/Fritzing for circuit simulation. Simulate a blinking LED and push-button-controlled LED circuit.	Learn to simulate electronic circuits using TinkerCAD or Fritzing by creating a blinking LED and a push-button-controlled LED circuit.	3 Hour
		Power Supply Design: Voltage and current ratings, battery selection, and safety considerations. Build a basic regulated power supply circuit on a breadboard.	Understand voltage and current ratings, battery selection, and safety considerations, and build a basic regulated power supply circuit on a breadboard.	2 Hours
		Prototyping on Breadboards: Bread boarding techniques and tips. Prototype a simple project like a switch-controlled LED on a breadboard.	Develop breadboarding skills and prototype a simple switch-controlled LED circuit, applying effective techniques and tips.	2 Hours
3	**Unit III: Sensors, Actuators, and Interfacing**	Overview of Sensors and Actuators: Explanation of common sensors (e.g., temperature, light) and actuators (motors, buzzers). Explore DHT11 and LEDs in simple circuits.	Understand the basics of common sensors and actuators, and explore their functionality by using components like the DHT11 sensor and LEDs in simple circuits.	2 Hours
		Sensor-Actuator Integration with Microcontrollers: Connecting sensors and actuators to Arduino. Build a temperature monitor with DHT11 and an LED indicator.	Learn to integrate sensors and actuators with Arduino by building a temperature monitor using a DHT11 sensor and an LED indicator.	3 Hours

		Analog and Digital Signal based interfacing: Understanding signal types and interfacing techniques. Interface a potentiometer and display its value on the serial monitor.	Understand analog and digital signal types and interfacing techniques, and interface a potentiometer with Arduino to display its value on the serial monitor.	2 Hour
		Data Acquisition and Displays: Interfacing LCD displays with Arduino. Display temperature and humidity data on an I2C display.	Learn to interface LCD displays with Arduino and display temperature and humidity data on an I2C display.	2 Hours
4	**Unit IV: Prototyping and Fabrication Techniques**	Designing Enclosures for Prototypes: Introduction to 3D printing, laser cutting, and DIY enclosures. Design a simple enclosure using cardboard or plastic sheets.	Understand the basics of designing enclosures for prototypes using methods like 3D printing, laser cutting, and DIY techniques, and create a simple enclosure using cardboard or plastic sheets.	2 Hours
		PCB Design and Soldering: Using KiCAD for PCB design and soldering techniques. Design a simple PCB layout, fabricate, and solder components.	Learn PCB design using KiCAD, and apply soldering techniques to design a simple PCB layout, fabricate it, and solder components.	3 Hours
		Prototyping with Advanced Platforms: Overview of NodeMCU/ESP32 for IoT applications. Connect NodeMCU to Wi-Fi and send a test message to a cloud platform.	Gain an overview of NodeMCU/ESP32 for IoT applications, and learn to connect NodeMCU to Wi-Fi and send a test message to a cloud platform.	2 Hours

		Testing and Debugging Techniques: Debugging tools and common troubleshooting steps. Identify and fix issues in a sample circuit or prototype.	Learn debugging tools and common troubleshooting steps to identify and fix issues in a sample circuit or prototype.	2 Hours
5	**Unit V: Project Development and Documentation**	Structuring Project Development: Defining goals, milestones, and deliverables. Create a project plan for a simple electronics product.	Understand how to structure project development by defining goals, milestones, and deliverables, and create a project plan for a simple electronics product.	2 Hours
		Writing Technical Documentation: Documenting circuit diagrams, code, and system design. Document a sample project, including all components and schematics.	Learn how to write technical documentation by documenting circuit diagrams, code, and system design for a sample project, including all components and schematics.	2 Hours
		Testing and Iterating the Prototype: Techniques for testing prototypes and improving designs. Test a prototype and identify areas for improvement.	Learn techniques for testing prototypes and iterating on designs by evaluating a prototype and identifying areas for improvement.	2 Hours
		Presenting the Prototype: Techniques for live demonstrations and presentations. Prepare a presentation and demonstrate a completed prototype to the class.	Develop skills for live demonstrations and presentations by preparing and presenting a completed prototype to an audience.	3 Hours

Total Hours	45 Hours

ANNEXURE II

OVERALL COURSE LEARNING OUTCOME ASSESSMENT CRITERIA AND USECASES			
LEARNING OUTCOME	**ASSESSMENT CRITERIA**	**PERFORMANCE CRITERIA**	**USECASES**
✓ Understand the product design lifecycle, including problem identification and solution generation. ✓ Develop and prototype simple electronics projects using microcontrollers and basic components. ✓ Work with simulation tools and prototyping platforms like Arduino and breadboards. ✓ Utilize sensors, actuators, and interfacing techniques in electronic designs. ✓ Fabricate, test, and iterate on functional prototypes. ✓ Present projects with clear documentation and user-focused design.	Practical Skills Assessment Simulation and Design Proficiency Problem-Solving and Iteration: Documentation and Reporting: Presentation and Communication:	✓ Ability to design and prototype simple electronics projects using microcontrollers, sensors, actuators, and basic components. ✓ Performance in building functional prototypes on breadboards or similar platforms (e.g., Arduino) and troubleshooting issues. ✓ Competence in using simulation tools like TinkerCAD, Fritzing, or KiCAD for designing circuits and testing prototypes. ✓ Ability to simulate and	**Sequential Timer for DC Motor Control** **Project Overview:** Design a PCB to control a DC motor using a sequential timer. The motor will operate in a pre-defined sequence based on timer settings, such as turning on, off, or running at different speeds. **Skills Focused On:** ✓ Power and signal routing for motor control. ✓ Designing for high-current circuits. ✓ Component placement for efficient timing and power distribution. **2. Motor Speed Control** **Project Overview:** Design a PCB to control the speed of a DC motor using Pulse Width Modulation (PWM). The speed can be adjusted via a potentiometer or a microcontroller. **Skills Focused On:** ✓ Designing PWM-based motor control circuits. ✓ PCB routing for power and control signals. ✓ Efficient placement of high-power and low-power components. **3. Rain Alarm Circuit** **Project Overview:** Design a PCB for a rain alarm system that detects water or moisture

		analyze circuit behavior before physical implementation.	levels via a sensor and triggers an alarm when water is detected. **Skills Focused On:** ✓ Low-power PCB design. ✓ Analog signal conditioning. ✓ Designing for compact and efficient PCB layouts.
		✓ Ability to identify problems in designs, iterate on solutions, and optimize prototypes.	**4. Temperature Alarm Circuit** **Project Overview:** Design a PCB for a temperature alarm system that triggers when the temperature exceeds a threshold, using a temperature sensor like the LM35 or DHT11.
		✓ Effectiveness in testing and refining prototypes based on feedback or performance results.	**Skills Focused On:** ✓ Analog signal conditioning and processing. ✓ Power supply design and voltage regulation. ✓ PCB layout for noise-sensitive analog circuits.
		✓ Quality and clarity of technical documentation, including circuit diagrams, code, and system designs.	**5. Fire Detector Alarm** **Project Overview:** Design a PCB-based fire detection system using a flame sensor or smoke sensor (e.g., MQ series). The system will trigger an alarm when fire is detected.
		✓ Ability to communicate design rationale, decisions, and modifications clearly in written and visual formats.	**Skills Focused On:** ✓ Safety-critical design and reliable circuit operation. ✓ Signal filtering and noise reduction. ✓ Compact and efficient PCB layout for sensor

		✓ Effectiveness of live demonstrations and presentations of completed prototypes. ✓ Ability to explain the functionality, design ✓ rocess, and user-focused aspects of the project to an audience.	systems. **6. Water Level Indicator** **Project Overview:** Design a PCB to indicate the water level in a tank using sensors like conductive probes or ultrasonic sensors, with visual indicators (e.g., LEDs). **Skills Focused On:** ✓ Designing sensor-based measurement systems. ✓ Signal processing and conditioning. ✓ Power distribution and component isolation. **7. Soil Moisture Sensor** **Project Overview:** Design a PCB for a soil moisture sensor that detects moisture levels in the soil and triggers an output (e.g., water pump or LED indicator) when moisture is low. **Skills Focused On:** ✓ Low-power design for battery-operated sensors. ✓ Signal conditioning and analog-to-digital conversion. ✓ Outdoor and environmental sensor design. **8. Automatic Street Light** **Project Overview:** Design a PCB that automatically turns street lights on/off based on ambient light levels using a light-dependent resistor (LDR).

Skills Focused On:
- ✓ Light-sensing circuit design.
- ✓ Power-efficient PCB design.
- ✓ Outdoor and rugged PCB design.

9. Clap Switch
Project Overview: Design a PCB that uses a sound sensor to detect a clap and switch an electrical device (e.g., a light) on or off.

Skills Focused On:
- ✓ Sound signal processing and filtering.
- ✓ Power-efficient designs for sensor-based applications.
- ✓ Designing for low-noise environments.

10. Door Bell Using IC 555
Project Overview: Design a PCB-based doorbell circuit using the IC 555 timer in a stable multivibrator mode to generate a tone when a button is pressed.
Skills Focused On:
- ✓ Working with timer ICs and simple logic circuits.
- ✓ Low-power design for simple output systems.
- ✓ Compact and efficient PCB layout design.

SL. NO	FINAL PROJECT
LIST OF FINAL PROJECTS (20 PROJECTS THAT COMPREHENSIVELY COVER ALL THE LEARNING OUTCOME)
1.	**Automated Plant Watering System** **Project Overview:** Design a PCB to control a water pump based on soil moisture levels using a moisture sensor and ESP32 microcontroller. The system automatically waters plants as needed.

	Skills Focused On: ✓ Power routing ✓ Signal conditioning for analog sensors ✓ Motor driver integration.
2.	**Motion-Activated Lighting System** **Project Overview:** Create a PCB for an automatic lighting system using a PIR motion sensor to detect movement and control an LED light strip. **Skills Focused On:** ✓ Sensor interfacing ✓ LED driver circuit design ✓ Thermal management
3.	**Temperature-Controlled Fan** **Project Overview:** Develop a PCB for a fan system that adjusts speed based on temperature readings from a DHT22 sensor. **Skills Focused On:** ✓ Temperature sensing ✓ PWM signal routing ✓ High-current circuit design
4.	**Proximity-Based Door Lock System** **Project Overview:** Build a PCB for an automatic door lock that operates when an authorized RFID tag is detected. **Skills Focused On:** ✓ RFID interfacing ✓ Motor control ✓ Noise suppression
5.	**Digital Thermometer with Display** **Project Overview:** Design a PCB for a digital thermometer that displays temperature on an OLED screen. **Skills Focused On:** ✓ Analog signal processing ✓ Display integration ✓ Power optimization
6.	**Smart Energy Meter** **Project Overview:** Create a PCB to measure and display household power usage using current and voltage sensors. **Skills Focused On:** ✓ Current and voltage sensing ✓ Safety design ✓ High-voltage PCB design ✓
7.	**Home Security Alarm** **Project Overview:** Design a PCB for a security alarm system using IR sensors for intrusion detection and a buzzer as the alarm. **Skills Focused On:** ✓ Sensor-triggered event handling

	✓ Buzzer driving ✓ Power routing
8.	**Portable Weather Station** **Project Overview:** Develop a PCB for a weather station that measures temperature, humidity, and atmospheric pressure and logs data. **Skills Focused On:** ✓ Sensor data logging ✓ Low-power design ✓ PCB layout for modular components
9.	**Smart Light Dimmer** **Project Overview:** Create a PCB to dim an AC bulb using a TRIAC-based dimming circuit controlled by a microcontroller. **Skills Focused On:** ✓ AC power control ✓ Signal isolation ✓ High-voltage PCB safety
10.	**Solar-Powered IoT Device** **Project Overview:** Design a PCB for a solar-powered IoT device to monitor environmental conditions and send data to the cloud. **Skills Focused On:** ✓ Renewable energy integration ✓ Battery management ✓ IoT communication
11.	**Air Quality Monitoring System** **Project Overview:** Design a PCB to measure air quality parameters like CO_2 levels, temperature, and humidity using sensors, and display the data on an OLED screen. **Skills Focused On:** ✓ Sensor integration ✓ Power management ✓ Real-time data display
12.	**Industrial Equipment Vibration Monitor** **Project Overview:** Build a PCB to monitor vibrations in industrial machines using an accelerometer and display the data on a monitoring system. **Skills Focused On:** ✓ Accelerometer interfacing ✓ Signal filtering ✓ Wireless communication
13.	**Smart Doorbell System** **Project Overview:** Design a PCB for a smart doorbell that detects visitors using a motion sensor and sends notifications to a mobile app. **Skills Focused On:** ✓ Motion detection ✓ Wi-Fi communication ✓ Compact PCB design
14.	**Smart Thermostat** **Project Overview:** Develop a PCB for a thermostat that controls heating/cooling

	systems based on temperature readings. **Skills Focused On:** ✓ Temperature sensing ✓ Relay control ✓ High-power PCB design
15.	**Automated Street Light System** **Project Overview:** Build a PCB for an automated street lighting system that turns on lights based on ambient light levels. **Skills Focused On:** ✓ Light sensing ✓ Power relay control ✓ Safe PCB design.
16.	**Wireless Data Logger** **Project Overview:** Design a PCB for a wireless data logger that records environmental data and sends it to the cloud. **Skills Focused On:** ✓ Data logging ✓ Wireless transmission ✓ Low-power design
17.	**Smart Trash Bin** **Project Overview:** Create a PCB for a smart trash bin that uses an ultrasonic sensor to detect bin fullness and alerts the user. **Skills Focused On:** ✓ Ultrasonic sensing ✓ IoT communication ✓ Efficient PCB design
18.	**Bluetooth-Controlled Robot** **Project Overview:** Develop a PCB for a robot that can be controlled via a Bluetooth-enabled mobile app. **Skills Focused On:** ✓ Motor control ✓ Bluetooth communication ✓ Modular PCB design
19.	**Energy Harvesting System** **Project Overview:** Build a PCB to harvest energy from a solar panel or piezoelectric device and store it in a battery. **Skills Focused On:** ✓ Renewable energy integration ✓ Efficient power management ✓ Compact design
20.	**IoT-Based Fire Detection System** **Project Overview**: Design a PCB for a fire detection system using a flame sensor and gas sensor, with alerts sent via Wi-Fi. **Skills Focused On:** ✓ Fire detection

		✓ IoT communication ✓ Signal isolation in PCB design

ANNEXURE III

COURSE ASSESSMENT RUBRICS (TOTAL MARKS: 70)				
ASSESSMENT CRITERIA	**DESCRIBE THE CRITERIA OF THE BELOW CATEGORY PERFORMANCE**			**TOTAL MARKS**
	FAIR (50-64%)	**GOOD (65-79%)**	**EXCELLENT (80- 100%)**	
1. Performance Skill Level	Fundamental performance; exhibits limited application of skills and understanding; requires substantial development to align with industry expectations.	Demonstrates solid performance; fulfills expectations with minor areas for improvement; able to carry out job responsibilities independently with occasional support when needed.	Exceptional performance; demonstrates advanced proficiency and outstanding problem-solving abilities; fully prepared for professional roles in the industry.	20
2. Technical Knowledge	Exhibits limited technical knowledge with minimal application and understanding; requires substantial improvement to meet industry standards	Displays solid technical knowledge, meeting expectations with some minor gaps; capable of performing tasks independently while requiring occasional guidance.	Demonstrates exceptional technical expertise, consistently surpassing expectations with advanced problem-solving abilities and in-depth knowledge; fully prepared for professional industry roles	15
3. Project Execution	Limited performance; shows basic understanding and application of skills; requires considerable improvement to align with industry standards in project execution	Solid performance; meets expectations with only minor areas for improvement; able to execute project tasks independently, requiring occasional support or guidance.	Exceptional performance; consistently surpasses expectations by demonstrating advanced skills and innovative problem-solving; well-prepared for professional roles in the industry.	25
4. Commu	Limited	Effective	Exceptional	

nicatio n and Reporti ng	performance; shows minimal ability in communication and reporting with insufficient clarity and detail; requires substantial improvement to meet professional standards.	communication and reporting; consistently meets expectations with some minor areas for improvement; able to handle tasks independently, seeking guidance when needed	performance; consistently surpasses expectations with advanced skills and innovative problem-solving; fully prepared for professional roles in the industry.	10