Annexure I - Course Curriculum

SL.NO	MODULE NAME	MODULE CONTENT	MODULE LEARNING OUTCOME	DURATION (HRS)
TABLE 1: MODULE-WISE COURSE CONTENT AND OUTCOME			
1	Introduction to PCB Design and Fusion	o Overview of PCB design principles and applications. o Introduction to CAD tools for PCB design (e.g., Altium, Eagle, KiCAD). o Basics of schematic creation and library management.	o Understand PCB design concepts and CAD tool functionalities. o Gain proficiency in creating and managing schematic symbols and footprints.	10
2	Schematic Design and Component Selection	o Schematic creation and connectivity checks. o Component selection based on	o Design accurate schematics and verify electrical connectivity. o Select appropriate components for various applications.	12

		specifications and		
		application.		
		o Custom component		
		library creation and		
		management.		
3	PCB Layout and Routing	o Placement of components on the board.	o Create optimized layouts for single and multi-layer PCBs.	8
		o Routing techniques for single-layer and multi-layer PCBs.	o Perform routing that adheres to design standards.	
		o Signal integrity considerations and design rules.		
4	**Design Validati on and Simulati on**	o Design Rule Checks (DRC) and error resolution.	o Ensure design compliance with industry standards.	8
		o Thermal and signal integrity analysis.	o Validate PCB designs using simulation tools.	

		o Validation of high- speed and RF designs.			
5	**Manufact uring and Documen tation**	o Generation of Gerber files, BOM, and assembly drawings. o Preparing documentat ion for manufacturi ng and testing. o Introduction to design for manufacturabilit y (DFM) and assembly (DFA).	o Prepare complete manufactur ing documenta tion. oOptimize designs for efficient production and assembly.	7	

Annexure II: Use Cases and Test Projects

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	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	**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

documentation and user-focused design.		prototypes. ✔ Ability to simulate and analyze circuit behavior before physical implementation. ✔ Ability to identify problems in designs, iterate on solutions, and optimize prototypes. ✔ Effectiveness in testing and refining prototypes based on feedback or performance results. ✔ Quality and clarity of technical documentation, including circuit diagrams, code, and system designs. ✔ Ability to	components. **3. Rain Alarm Circuit Project Overview:** Design a PCB for a rain alarm system that detects water or moisture 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. **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. **Skills Focused On:** ✔ Analog signal conditioning and processing. ✔ Power supply design and voltage regulation. ✔ PCB layout for noise-sensitive analog circuits. **5. Fire Detector Alarm Project Overview:** Design a PCB-based fire detection system using a flame sensor or smoke sensor (e.g., MQ

		communicate design rationale, decisions, and modifications clearly in written and visual formats. ✔ 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.	series). The system will trigger an alarm when fire is detected. **Skills Focused On:** ✔ Safety-critical design and reliable circuit operation. ✔ Signal filtering and noise reduction. ✔ Compact and efficient PCB layout for sensor 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.

LIST OF FINAL PROJECTS (20 PROJECTS THAT COMPREHENSIVELY COVER ALL THE LEARNING OUTCOME)	
SL.NO	**FINAL PROJECT**
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 CO2 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: Assessment Rubrics

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. Communication and	Limited performance; shows minimal	Effective communication and reporting;	Exceptional performance; consistently	

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