Annexure I: Course Curriculum

TABLE 1: MODULE WISE COURSE CONTENT AND OUTCOME				
Sl. No	**Module Name**	**Module Content**	**Module Learning Outcome**	**Duration (Hrs)**
1	Introduction to IC Design	Overview of digital design and VLSI, basic digital logic (AND, OR, NOT, NAND, NOR, XOR, XNOR), combinational logic design (adders, multiplexers, decoders), sequential logic design (flip-flops, registers, counters), RTL design methodologies, applications of IC design.	Understand basic principles of IC design, learn digital design flow and methodologies, familiarize with combinational and sequential logic, discuss applications of IC design.	9 Hrs
2	RTL Coding Techniques	Introduction to Verilog/VHDL, coding combinational logic in Verilog/VHDL, coding sequential logic in Verilog/VHDL, testbenches and simulation, RTL coding best practices, debugging and verifying RTL designs.	Learn various RTL coding techniques, understand principles of HDLs like Verilog and VHDL, practice writing RTL code, simulate and verify RTL designs.	9 Hrs

3	Synthesis and Optimization	Overview of synthesis tools (e.g., Synopsys Design Compiler, Cadence Genus), constraints and timing analysis, logic synthesis process, optimization techniques (area, speed, power), analyzing and interpreting synthesis reports, common issues and troubleshooting in synthesis.	Understand principles of physical design and its importance in IC design, learn various stages of physical design, practice using physical design tools and verifying designs.	9 Hrs
4	Physical Design and Verification	Overview of physical design flow, placement and routing techniques, clock tree synthesis, design rule checks (DRC), layout verification, physical verification tools.	Implement robust security measures to protect data and ensure system integrity in industrial settings.	9 Hrs
5	Verification and Testing	Overview of verification methodologies, simulation-based verification, formal verification, hardware emulation, design for test (DFT) techniques, testing and validation tools.	Learn various verification techniques (simulation, formal verification, hardware emulation), understand the importance of testing in IC design, practice using verification tools and techniques.	9 Hrs

Annexure II: Use Cases and Test Projects

TABLE 2: Use Cases
Processor Design: This use case involves the design and development of custom processors and microcontrollers tailored to specific applications. These processors are integral components of various digital systems, providing the computational power necessary for tasks ranging from simple control functions to complex data processing.
Communication Systems: This use case involves the design and development of high-speed data transfer protocols and interfaces. These communication systems are essential for ensuring efficient and reliable data transmission in various digital systems, including networking, telecommunications, and data storage applications.
Automotive Electronics: This use case involves the design and development of control systems and infotainment systems in automotive electronics. These systems are crucial for ensuring vehicle safety, comfort, and entertainment, thereby enhancing the overall driving experience.
Use Case: Consumer Electronics Description: This use case involves the design and development of digital components for consumer electronics such as smartphones and gadgets. These components are essential for ensuring efficient performance, user-friendly interfaces, and advanced functionalities in modern consumer devices.
Use Case: Industrial Automation Description: This use case involves the design and development of control logic for machinery and robots in industrial automation. These systems are essential for ensuring precision, efficiency, and safety in automated manufacturing and industrial processes
Use Case: Medical Devices Description: This use case involves the design and development of digital circuits for diagnostic and monitoring equipment used in medical applications. These systems are essential for ensuring accurate diagnostics, continuous monitoring of patient health, and reliable performance in medical environments.

Use Case: Aerospace Description: This use case involves the design and development of avionics and navigation systems for aerospace applications. These systems are essential for ensuring the safety, reliability, and efficiency of aircraft and spacecraft operations.
Use Case: Networking Description: This use case involves the design and development of routers, switches, and network processors that are essential for efficient and reliable data communication within networking infrastructures.
Use Case: Storage Systems Description: This use case involves the design and development of controllers for SSDs (Solid State Drives) and memory devices. These controllers are essential for managing data storage, access, and retrieval, ensuring high performance and reliability in storage systems.
Use Case: IoT Devices Description: This use case involves the design and development of digital logic for IoT (Internet of Things) devices and sensors. These systems are essential for enabling smart functionalities in various applications, including home automation, health monitoring, industrial IoT, and environmental sensing.

TABLE 3: LIST OF TEST PROJECTS (20 PROJECTS THAT COMPREHENSIVELY COVER ALL THE LEARNING OUTCOMES)	
S.NO	**Final Projects**
1	Custom Processor Design: Develop a custom processor with ALU, control unit, and register file.
2	High-Speed Data Transfer Protocol: Design and implement a high-speed data transfer protocol for communication systems.
3	Robotic Arm Control System: Create control logic for a robotic arm used in industrial automation.
4	Patient Monitoring System: Develop digital circuits for real-time patient health monitoring and diagnostics.

5	Flight Control System: Design avionics systems for aircraft flight control.
6	Network Router and Switch: Implement a network router and switch for efficient data routing and switching.
7	SSD Memory Controller: Design a memory controller for SSDs to manage data read/write operations.
8	Smart Home IoT Device: Develop digital logic for a smart home IoT device with sensor interfaces.
9	Signal Processing Unit for Smartphones: Create a signal processing unit for audio and video processing in smartphones.
10	Automotive Infotainment System: Design an infotainment system for vehicles including multimedia playback and navigation.
11	Industrial Sensor Interface: Develop an interface for industrial sensors used in automation systems.
12	Wearable Health Monitor: Design a wearable device for continuous health monitoring and data processing.
13	Navigation System for Drones: Implement a navigation system for drones, ensuring accurate positioning and control.
14	Data Encryption and Decryption Module: Create a module for secure data encryption and decryption in communication systems.
15	Real-Time Traffic Management System: Design a system to manage and monitor traffic in real-time for smart city applications.
16	Low-Power Design for IoT Sensors: Develop a low-power design for IoT sensors to extend battery life.
17	Automotive Safety Control System: Create control logic for automotive safety systems like ABS and traction control.
18	FPGA-Based Signal Generator: Design an FPGA-based signal generator for testing and diagnostics.

19	Environmental Monitoring System: Develop digital circuits for monitoring environmental parameters like temperature and humidity.
20	Advanced Digital Filter Design: Implement digital filters for signal processing applications in various fields.

Annexure III: Assessment Rubrics

TABLE 5: COURSE ASSESSMENT RUBRICS (TOTAL MARKS: 70)				
ASSESSMENT CRITERIA	**FAIR (50%-64%)**	**GOOD (65%-79%)**	**EXCELLENT (80%-100%)**	**WEIGHTAG E (MARKS)**
Understanding of RTL Principles and Methodologies	Demonstrates basic understanding with minor errors in terminology and concepts.	Shows good understanding, uses appropriate terminology and concepts accurately with few errors.	Demonstrates thorough understanding, uses terminology and concepts accurately and confidently in all assessments.	10
implementation of Digital Logic Circuits	Designs and implements circuits with several errors, requires significant corrections.	Designs and implements circuits with few errors, shows good creativity and logic in design solutions.	Designs and implements circuits with high accuracy and creativity, demonstrating exceptional logic design skills.	10
Proficiency in Verilog/VHDL Coding	Writes RTL code with multiple errors, requires significant debugging and optimization.	Writes RTL code with few errors, demonstrates strong coding skills and ability to debug and optimize code effectively.	Writes efficient and error-free RTL code, demonstrating exceptional coding skills and optimization techniques.	15
Simulation and Verification	Uses simulation	Effectively uses	Demonstrates mastery in	10

Skills	tools with limited success, results contain errors and require major corrections.	simulation tools, results contain few errors and require minor corrections.	using simulation tools, produces accurate results, and interprets them correctly with no errors.	
Synthesis and Report Analysis	Uses synthesis tools with limited success, struggles with interpreting reports accurately.	Proficiently uses synthesis tools, interprets reports accurately with minor issues.	Demonstrates exceptional proficiency with synthesis tools, accurately interprets reports, and applies optimizations effectively.	10
Application of Optimization Techniques	Applies optimization techniques with limited success, results in moderate improvements.	Applies optimization techniques effectively, results in significant improvements.	Demonstrates exceptional application of optimization techniques, achieving optimal performance and significant improvements.	10
Hands-on Hardware Experience	Shows basic understanding of hardware implementation, limited success in prototypin	Demonstrates good understanding and practical skills in hardware implementation, successful in	Exhibits exceptional practical skills and thorough understanding in hardware implementation, successful in all aspects of prototyping	5

	g and validation.	prototyping and validation.	and validation.	