# EMBEDDED SYSTEM

## Programme Structure

| Course Code | Course Title | Lecture (L) Hours Per Week | Tutorial (T) Hours Per Week | Practical (P) Hours Per Week | Total Credits |
|---|---|---|---|---|---|
| ECE2352 | Introduction to Microprocessor System | 3 | - | - | 3 |
| ECE2452 | Microcontroller | 3 | - | - | 3 |
| ECE2552 | PCB Fabrication | 3 | - | - | 3 |
| ECE2652 | Robotics and Automation | 3 | - | - | 3 |
| ECE2752 | Simulation and Modelling Processing | 3 | - | - | 3 |
| ECE2852 | Project (Embedded System) | 3 | - | - | 3 |
| | **TOTAL** | | | | **18** |

# EMBEDDED SYSTEM

## Syllabus

### INTRODUCTION TO MICROPROCESSOR SYSTEMS

**Course Code: ECE2352** **Credit Units: 03**

**Course Objective:**
This course deals with the systematic study of the Architecture and programming issues of 8085-microprocessor family. The aim of this course is to give the students basic knowledge of the above microprocessor needed to develop the systems using it.

**Course Contents:**

**Module I: Introduction to Microcomputer Systems**
Introduction to Microprocessors and microcomputers, Study of 8 bit Microprocessor, 8085 pin configuration, Internal Architecture and operations,interrupts, Stacks and subroutines, various data transfer schemes.

**Module II: ALP and timing diagrams**
Introduction to 8085 instruction set, advance 8085 programming , Addressing modes, Counters and time Delays, , Instruction cycle, machine cycle, T-states, timing diagram for 8085 instruction.

**Module III: Memory System Design & I/O Interfacing**
Memory interfacing with 8085. Interfacing with input/output devices (memory mapped, peripheral I/O), Cache memory system. Study of following peripheral devices 8255, 8253, 8257, 8259, 8251.

**Module IV: Architecture of 16-Bit Microprocessor**
Difference between 8085 and 8086, Block diagram and architecture of 8086 family, pin configuration of 8086, minimum mode & maximum mode Operation, Bus Interface Unit, Register Organization, Instruction Pointer, Stack & Stack pointer, merits of memory segmentation, Execution Unit, Register Organization.

**Module V: Pentium Processors**
.Internal architecture of 8087, Operational overview of 8087, Introduction to 80186, 80286, 80386 & 80486 processors, Pentium processor (P-II, P-III, P-IV).

**Examination Scheme:**

| Components | A | CT | S/V/Q | HA | EE |
|---|---|---|---|---|---|
| Weightage (%) | 5 | 10 | 8 | 7 | 70 |

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

**Text & References:**


- Ramesh. S. Gaonkar, "Microprocessor architecture Programming and Application with 8085" Penram International Publishing, 4th Edition
- B.Ram, "Fundamentals of microprocessors and microcomputer" DhanpatRai, 5th Edition. ]
- Douglas V Hall.
- M. Rafiquzzaman, "Microprocessor Theory and Application" PHI – 10th Indian Reprint.
- Naresh Grover, "Microprocessor comprehensive studies Architecture, Programming and Interfacing" DhanpatRai, 2003.
- Gosh," 0000 to 8085" PHI.

# MICROCONTROLLER

**Course Code: ECE2452** **Credit Units: 03**

**Course Objective:**
The syllabus deals with 8051 architecture and its interfacing with other devices. A microcontroller is an integrated circuit that is programmable. The syllabus makes student perfect in assembly language programming, addressing modes etc apart from it input-output programming is discussed in detail. In the second part Embedded systems and it's application is discussed. 8051 C programming is also incorporated in the syllabus.

**Course Contents:**

**Module I: Overview of Microcontroller**
Microcontroller and Embedded Processors, Overview of 8051 Microcontroller family: Architecture, basic assembly language programming concepts, The program Counter and ROM Spaces in the 8051, Data types, 8051 Flag Bits ad PSW Register, 8051 Register Banks and Stack Instruction set, Loop and Jump Instructions, Call Instructions, Time delay generations and calculations, I/O port programming Addressing Modes, accessing memory using various addressing modes, Arithmetic instructions and programs, Logical instructions, BCD and ASCII application programs, Single-bit instruction programming, Reading input pins vs. port Latch, Programming of 8051 Timers, Counter Programming.

**Module II: Communication with 8051**
Basics of Communication, Overview of RS-232, I2C Bus, UART, USB, IEEE 488 (GPIB). Parallel input output applications. (Stepper motor Sequencer program, Strobed input/output). Interrupt driven applications (real time clock, serial input/output with interrupt). Analog-digital interfacing (Pulse width modulator, 8-bit ADC).

**Module III: Basics of 8051 C Programming**
Introduction to 8051 C, 8051 memory constitution, Constants, variables and data types.Arrays structures and unions, pointers, Loops and decisions, Functions, Modules and programs.

**Module IV: 8051 C Programming**
Data interface, Timer control, Interrupt operations, Digital operations, A/D and D/A conversions, Common control problem examples (Centronics parallel interface,Printer interace, Memory access, Key matrix scanning, Stepper motor control and digital clock. ).

**Examination Scheme:**

| **Components** | **A** | **CT** | **S/V/Q** | **HA** | **EE** |
|---|---|---|---|---|---|
| **Weightage (%)** | 5 | 10 | 8 | 7 | 70 |

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

**Text & References:**

***Text:***

- Raj Kamal, 2004, "Embedded Systems", TMH.
- James W. Stewart and Kai X. Miao, 2en Edition. "The 8051 microcontroller" Pearson Edu. Prentice Hall.
- M.A. Mazidi and J. G. Mazidi, 2004 "The 8051 Microcontroller and Embedded Systems", PHI.

***References:***

- David E. Simon,1999, "An Embedded Software Primer", Pearson Education
- K.J. Ayala, 1991, "The 8051 Microcontroller", Penram International.
- Dr. Rajiv Kapadia, "8051 Microcontroller & Embedded Systems", Jaico Press
- Dr. Prasad, 2004, "Embedded Real Time System", Wiley Dreamtech

# PCB FABRICATION

**Course Code: ECE2552** **Credit Units: 03**

Aim: To equip the students with the knowledge of PCB design and fabrication processes.
Objective:

- To make familiar with PCB design and various processes involved.
- To provide in-depth core knowledge in design, performance analysis and fabrication of Printed Circuit Boards.
- To provide the knowledge in PCB fabrication process and factors affecting PCB performance.

**Module I: Introduction to the PCB**
Definition and Evolution of the Printed Circuit Board (PCB), Purposes of a PCB, Applications, Market Drivers, Typical Development Flow for a PCB, Printed Circuit Technology, Basic Electronic Components, Resistors, Capacitors, Inductors, Diodes, Transistors, Relays, Connectors, Integrated Circuits: How a silicon wafer becomes an IC, Printed Circuit Board Characteristics, PCB Materials, Fillers, resins, laminates, base material characteristics, Dielectric, conductors, Engineering References

**Module II: Design and Analyses**
Design and Environmental Requirements: Functional, Thermal, Vibration, Shock, EMI/EMC; Electrical Engineering: Analog and digital signals, Signal integrity, Grounding concepts, Current carrying capacity, CAD, Schematics, Layout rules of thumb; Mechanical Engineering: Panels, Standard board sizes, Packaging, Thermal Design, Heat transfer basics, Convection, Conduction, PCB Thermal Design Features, Thermal modeling, Cycling and fatigue , Component Vibration Fatigue, Vibration Models and Terminology, Combined Thermal and Structural Fatigue

**Module III: Contamination Control/Environmental Control**
Contamination Control, Conformal Coatings, Polluting Agents, Safety Controls, Pollution Controls, Recycling, Standards; Manufacturing: PCB Manufacturing Information, PCB Layout and Artwork; Fabrication: Machining Operations, Blanking, Cutting, Punching, Drilling, Laminating Techniques, Plating, Etching, Surface Finishing, Conformal Coatings, Inspection and Checkout, Specifications and Standards

**Module IV: Assembly**
PCB Assembly Drawing Examples, Component Considerations, Component mounting and support , Mechanical Devices, Soldering Technology, Nonsolder Connections, Cleaning, Parts Staking, Conformal Coating Removal, Repair and Rework, Safety Considerations, ESD protection, Specifications and Standards

**Module V: Testing & Quality Assurance**
Common PCB Production Faults, Bare Board Testing, Electrical Performance Testing, Assembled PCB Testing, Quality Assurance in Design, FMEA – Failure Mode and Effects Analysis, Software Tools, Quality Assurance in Manufacturing and in Assembly, Specifications and Standards

**Examination Scheme:**

| **Components** | **A** | **CT** | **S/V/Q** | **HA** | **EE** |
|---|---|---|---|---|---|
| **Weightage (%)** | 5 | 10 | 8 | 7 | 70 |

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

**Text & References:**

***Text &References:***


- Jon Uarteresian, 2002, “Fabricating Printed Circuit Boards”, Newnes (Elsevier Science)
- RS Khandpur, 2008, “Printed Circuit Boards”, Tata McGraw-Hill Education
- Christopher T Robertson, 2004, “Printed Circuit Board: Designer's Reference, Basics”, Prentice Hall Professional, 2004

Charles Harper, 2000, “High Performance Printed Circuit Boards”, McGraw-Hill Education

# ROBOTICS AND AUTOMATION

**Course Code: ECE2652** **Credit Units: 03**

Aim: To equip the students with the knowledge of Robotics, Automation and their applications.
Objective:

- To make students familiar with the field of robotics.
- To provide in-depth core knowledge in design and performance analysis of bots.
- To provide the knowledge in sensors, actuators, motion planning and kinematics & dynamics of robots.

**Module-I: Introduction to Robotics**
History, Robots, Robot Usage, Robot Subsystems, Robot Classification by Application, Robot Classification by Coordinate System, Robot Classification by Actuation System, Robot Classification by Control Method, Robot Classification by Programming Method

**Module-II: Actuators and Sensors**
Pneumatic Actuators, Hydraulic Actuators, Electric Actuators, Selection of Motors, Sensor Classification, Internal Sensors, External Sensors, Vision System, Sensor Selection,

**Module-III: Transformations and Kinematics**
Robot Architecture, Pose of a Rigid Body, Coordinate Transformation, Denavit and Hartenberg (DH) Parameters,, Forward Position Analysis, Inverse Position Analysis, Velocity Analysis: The Jacobian Matrix, Link Velocities *133,* Jacobian Computation, Jacobian Using the DeNOC, Singularity, Acceleration Analysis,

**Module-IV: Statics and Dynamics**
Forces and Moment Balance, Recursive Calculation, Equivalent Joint Torques, Role of Jacobian in Statics, Force Ellipsoid, Inertia Properties, Euler–Lagrange Formulation, Newton—Euler Formulation, Recursive Newton–Euler Algorithm, Dynamics Algorithms

**Module-V: Recursive Robot Dynamics and Control**
Dynamic Modelling, Analytical Expressions, Recursive Inverse Dynamics using RIDIM, Recursive Forward Dynamics and Simulation, Control Techniques, Second-Order Linear Systems, Feedback Control, Performance of Feedback Control Systems, A Robotic Joint, Joint Controller, Non-linear Trajectory Control, State-space Representation and Control, Stability, Cartesian and Force Controls

**Module-VI: Motion Planning**
Joint Space Planning, Cartesian Space Planning, Position and Orientation Trajectories, Point-to-Point Planning, Continuous Path Generation

**Examination Scheme:**

| **Components** | **A** | **CT** | **S/V/Q** | **HA** | **EE** |
|---|---|---|---|---|---|
| **Weightage (%)** | 5 | 10 | 8 | 7 | 70 |

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

**Text & References:**


- John J. Craig, 2004, "Introduction to Robotics: Mechanics and Control" Prentice Hall,3rd Edition
- S K Saha, 2008, "Introduction to Robotics", McGraw-Hill Education (India)
- Thomas R. Kurfess, 2004, "Robotics and Automation Handbook", CRC Press

# SIMULATION & MODELLING LAB

**Course Code: ECE2752** **Credit Units: 03**

**Course Contents:**

**List of Experiments:**

1. Layout & Simulation of CMOS Inverter using CAD Tools.
2. Layout & Simulation of NAND & NOR Gates with Optimal Aspect Ratio.
3. Design & Simulation of SR Latch using NAND & NOR Representations.
4. Design & Simulation of JK Flip Flop using SR Latch.
5. Design & Simulation of Master Slave JK Flip Flop.
6. Design & Simulation of R2R Ladder DAC.
7. Design & Simulation of ADC using DAC.

**Examination Scheme:**

| **IA** | | | | **EE** | |
|---|---|---|---|---|---|
| **A** | **PR** | **LR** | **V** | **PR** | **V** |
| 5 | 10 | 10 | 5 | 35 | 35 |

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.