**Department of Information Technology**

**Course File Index**

**2018-19**

**Course Name: Microcontroller & Embedded ProgrammingCourse ID:**ITC501

**Semester: V**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Course  Code | Course Name | Theory | Practical | Tutorial | Theory | Oral &  Practical | Tutorial | Total |
| ITC501 | Microcontroller  and Embedded Programming | 04 | -- |  | 04 | -- | -- | 04 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Course Code | Course Name | Examination Scheme | | | | | | | |
| Theory Marks | | | | Term Work | Oral & Practical | Oral | Total |
| Internal assessment | | | End Sem. Exam |
| Test1 | Test2 | Avg. of two Tests |
| ITC501 | Microcontroller and Embedded Programming | 20 | 20 | 20 | 80 | -- | -- | -- | 100 |

**Course Objectives:** Students will try to learn:

1. The concepts and architecture of embeddedsystems
2. Basic of microcontroller8051.
3. The concepts of microcontrollerinterface.
4. The concepts of ARMarchitecture
5. The concepts of real-time operatingsystem
6. Different design platforms used for an embedded systemsapplication

**Course Outcomes:** Students will be able to:

1. Explain the embedded system concepts and architecture of embeddedsystems
2. Describe the architecture of 8051 microcontroller and write embedded program for 8051 microcontroller.
3. Design the interfacing for 8051microcontroller.
4. Understand the concepts of ARMarchitecture.
5. Demonstrate the open source RTOS and solve the design issues for thesame.
6. Select elements for an embedded systemstool.

**Prerequisite:** COA, Microprocessors and Assembly Programming languages

# Detailed syllabus:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr.**  **No.** | **Module** | **Detailed Content** | **Hours** | **CO**  **Mapping** |
| 0 | Prerequisite | Revision of microcomputer system terminologies, High level, Machine level and Assembly level programming language , difference between microprocessor and microcontroller | 02 |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| I | Introduction to  Embedded systems | Overview of Embedded System Architecture, Application areas,  Categories of embedded systems, specialties of embedded systems. Recent trends in embedded systems. Brief introduction to embedded microcontroller cores CISC, RISC,  ARM, DSP and SoC. | 05 | CO1 |
| II | The  Microcontroller Architecture and Programming of 8051: | Introduction to 8051 Microcontroller, Architecture, Pin configuration, Memory  organization, Input /Output Ports, Counter and Timers, Serial communication, Interrupts.  Instruction set, Addressing modes, Development tools, Assembler Directives, Programming based on Arithmetic & Logical  Operations, I/O parallel and serial ports, Timers & Counters, and ISR. | 14 | CO2 |
| III | Interfacing with  8051Microcontr oller | Interfacing ADC, DAC, Stepper motor,  LCD, KBD matrix, 8255 PPI | 06 | CO3 |
| IV | ARM 7  Architecture | Architectural inheritance, Detailed study of Programmer’s model, ARM  Development tools, Instruction set: Data processing, Data  Transfer, Control flow. Addressing modes. Writing simple assembly language programs. Pipelining, Brief introduction to exceptions and interrupts  handling. | 10 | CO4 |
| V | Open source  RTOS | Basics of RTOS: Real-time concepts,  Hard Real time and Soft Real-time, differences between general purpose OS & RTOS, basic architecture of an RTOS, scheduling systems, inter-process communication, performance Matrix in scheduling models, interrupt management in RTOS environment, memory management, file systems, I/O systems, advantage and disadvantage of RTOS. POSIX standards, RTOS issues – selecting a Real Time Operating System, RTOS comparativestudy. | 07 | CO5 |
| VI | Introduction to  Embedded target boards | Introduction to Arduino, Raspberry Pi,  ARM Cortex, Intel Galileo etc. Open- source prototyping platforms. Basic Arduino programming; Extended Arduino libraries; Arduino-based Internet communication; Raspberry pi; ARM | 08 | CO6 |

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| --- | --- | --- | --- | --- |
|  |  | Cortex Processors; Intel Galileo boards;  Sensors and Interfacing: Temperature, Pressure, Humidity |  |  |

**Text Books:**

1. M. A. Mazidi, J. G. Mazidi, R. D., McKinlay ,”The 8051 microcontroller & Embedded systems Using Assembly and C”, Pearson, 3rdedition
2. Embedded / real – time systems: concepts, design & programming, Black Book, Dr.K.

V. K. K. Prasad, Dreamtech press, Reprint edition 2013

1. ShibuK. V., “Introduction to embedded systems”, McGrawHil

# References:

1. Laya B. Das, “Embedded systems an integrated approach”, Pearson, Third impression,2013
2. Steve Furber, “ARM System on chip Architecture”, Pearson, editionsecond
3. Michael Margolis, “Arduino Cookbook”,O’reilly
4. Simon Monk,” Raspberry Pi Cookbok”,O’reilly
5. Raspberry Pi UserGuide.
6. Massimo Banzi, “Getting Started with Arduino: The Open Source Electronics Prototyping Platform (Make)”, O'ReillyMedia.

# Assessment:

**Internal Assessment for 20 marks:**

Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

**End Semester Examination:** Some guidelines for setting the question papers are as:

* + Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in thesyllabus.
  + Question paper will comprise of total **six questions**, **each carrying 20marks.**
  + **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
  + **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all themodules.)
  + Total **four questions** need to be solved.

**Course Outcome Statement**

|  |  |
| --- | --- |
| Sr.No. | Course Outcome Statement |
| ITC501.1 | Explain the embedded system concepts and architecture of embedded system. |
| ITC501.2 | Describe the architecture of 8051 microcontroller and write embedded program for 8051 microcontroller. |
| ITC501.3 | Design the interfacing for 8051 microcontroller. |
| ITC501.4 | Understand the concepts of ARM architecture. |
| ITC501.5 | Demonstrate the open source RTOS and solve the design issues for the same. |
| ITC501.6 | Select elements for an embedded systems tools. |

**CO Assessment Tools**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **CO number** | **Direct Measurement** | | | | | | **Indirect Measurement** |
|  | **UT1** | **UT2** | **Quiz** | **Univ. Theory** | **Mini project** | **Course Exit Survey** | |
| ITC502.1 | 40% |  | 30% | 30% |  | 100% | |
| ITC502.2 | 70% |  |  | 30% |  | 100% | |
| ITC502.3 |  | 70% |  | 30% |  | 100% | |
| ITC502.4 |  | 70% |  | 30% |  | 100% | |
| ITC502.5 |  | 70% |  | 30% |  | 100% | |
| ITC502.6 |  | 30% | 10% | 10% | 50% | 100% | |

**5. CO-PO and CO-PSO Mapping**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Name** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| ITC502.1 | 1 |  |  |  |  |  |  |  |  |  |  |  | 2 | 2 |
| ITC502.2 |  |  |  |  | 2 |  |  |  |  |  |  |  | 2 | 2 |
| ITC502.3 |  |  | 2 |  | 2 |  |  |  |  |  |  |  | 1 | 1 |
| ITC502.4 |  |  | 2 |  |  |  |  |  |  |  |  |  | 1 | 1 |
| ITC502.5 |  |  | 2 |  | 2 |  |  |  |  |  |  |  | 2 | 2 |
| ITC502.6 |  |  | 2 |  | 3 |  |  | 2 | 2 | 3 | 2 |  | 2 | 3 |

**6. Lesson Plan**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No of classes available:** | **43** | **No of Classes taken:** | | **41** | |
|  |  |  | |  | |
| **Sr. No.** | **Topic Planned** | | **Planned Date** | **Actual Date** | **Delivery Mechanisms** |
| 1 | Course outcomes for the subjects, syllabus, marking scheme, termwork, practicals. | | 2/7/18 | 2/7/18 | Chalk board |
| 2 | Overview of Embedded System Architecture. Application areas, Categories of embedded systems, Specialties of embedded systems | | 4/7/18 | 4/7/18 | Chalk board |
| 3 | Revision of previous lecture, Recent trends in embedded systems.  Brief introduction to embedded microcontroller cores CISC, RISC, ARM, DSP and SOC | | 9/7/18 | 9/7/18 | Chalk board |
| 4 |  | | 10/7/18 | 10/7/18 | Chalk board |
|  | Introduction to 8051 Microcontroller, difference bet microcontroller and microprocessor  Architecture, Pin configuration, Memory organization | | 11/7/18 | 11/7/18 |  |
| 5. | Revision of previous lecture,pin configuration, Memory organization, block diagram  Input /Output Ports | | 12/7/18 | 12/7/18 | Chalk board and ppts,ppts |
| 6. | Revision of previous lecture, PSW register, register banks, stack | | 17/7/18 | 17/7/18 | Chalk board and ppts,ppts |
| 7. | Revision of previous lecture ,Architectural inheritance, Instruction set, Addressing modes. | | 18/7/18 | 18/7/18 | Chalk board and ppts,ppts |
| 8. | Revision of previous lecture,Development tools, Assembler Directives | | 19/7/18 | 19/7/18 | Chalk board and ppts,ppts |
| 9. | Revision of previous lecture, Programming based on Arithmetic & Logical operations. | | 20/7/18 | 20/7/18 | Chalk board and ppts,ppts |
| 10. | Revision of previous lecture, I/O parallel and serial ports | | 25/7/18 | 25/7/18 | Chalk board and ppts,ppts |
| 11. | Revision of previous lecture Timers, Counters and ISR | | 26/7/18 | 26/7/18 | Chalk board and ppts,ppts |
| 12. | Revision of previous lecture,timer 0,timer 1, Timers2 | | 27/7/18 | 27/7/18 | Chalk board and ppts,ppts |
| 13. | Revision of previous lecture ,generation of delay using timer | | 30/7/18 | 30/7/18 | Chalk board and ppts,ppts |
| 14. | Revision of previous lecture ,Problems on timer delay generation. | | 03/8/18 | 03/8/18 | Chalk board |
| 15. | Revision of previous lecture, Detailed study of Programmer‘s model, | | 04/8/18 | 04/8/18 | Candppts,ppts |
| 16. | Revision of previous lecture, ARM Development tools, | | 05/8/18 | 05/8/18 | Chalk board and ppts,ppts |
| 17. | Revision of previous lecture, Instruction set: Data processing, Data transfer, Control flow. Addressing modes | | 08/8/18 | 08/8/18 | Chalk board and ppts,ppts |
| 18. | Revision of previous lecture, Writing simple assembly language programs. | | 09/8/18 | 09/8/18 | Chalk board and ppts,ppts |
| 19. | Revision of previous lecture, Pipelining | | 10/8/18 | 10/8/18 | Chalk board and ppts,ppts |
| 20 | Revision of previous lecture,5 stage pipelining in ARM.Brief introduction to exceptions and interrupts handling | | 10/8/18 | 10/8/18 | Chalk board and ppts.ppts |
| 21 | Revision of previous lecture,Brief introduction to exceptions and interrupts handling | | 20/8/18 | 20/8/18 | Chalk board and ppts |
| 22 | Revision of previous lecture Mixed language programming, datatypes, program structure, programs | | 23/8/18 | 23/8/18 | Chalk board and ppts |
| 23 | Revision of previous lecture Programs in C language | | 23/8/17 | 23/8/17 | Chalk board and ppts |
| 24 | Architecture of kernel, Task and Task scheduler | | 24/8/17 | 24/8/17 | Chalk board and ppts |
| 25 | Revision of previous lecture,Interrupts,service routines, | | 24/8/18 | 24/8/18 | Chalk board and ppts |
| 26 | Revision of previous lecture Semaphores, Mutex, Mailboxes, Message queues | | 27/8/18 | 27/8/18 | Chalk board and ppts |
| 27 | Revision of previous lecture Eventregisters, Pipes, Signals, Timers. | | 30/8/18 | 30/8/18 | Chalk board and ppts |
| 28 | Memory management.Revision of previous lecture | | 31/8/18 | 31/8/18 | Chalk board and ppts |
| 29 | Revision of previous lecturePriority inversion problem | | 5/9/18 | 5/9/18 | Chalk board and ppts |
| 30 | Revision of previous lecture Off-the-Shelf Operating Systems.  Embedded Operating Systems | | 6/9/18 | 6/9/18 | Chalk board and ppts |
| 31 | Revision of previous lecture Real Time Operating System (RTOS) and Handheld Operating  Systems. | | 10/9/18 | 10/9/18 | Chalk board and ppts |
| 32 | Revision of previous lecture Digital clock, | | 12/9/18 | 12/9/18 | Chalk board and ppts |
| 33 | Revision of previous lecture Battery operated smart card reader, | | 19/9/18 | 19/9/18 | Chalk board and ppts |
| 34 | Revision of previous lecture Automated meter reading system, Digital camera | | 21/9/18 | 21/9/18 | Chalk board and ppts |
| 35 | Introduction to Arduino ,Raspberry Pi | | 24/9/18 | 24/9/18 | ppts |
| 36 | Revision of previous lecture Off-the-Shelf Operating Systems.  Embedded Operating Systems | | 26/9/18 | 26/9/18 | ppts |
| 37 | Revision of previous lecture Real Time Operating System (RTOS) and Handheld Operating  Systems. | | 27/9/18 | 27/9/18 | ppts |
| 38 | Introduction to Arduino ,Raspberry Pi | | 28/9/18 | 28/9/18 | ppts |
| 39 | Open source prototypingPlatforms,basicarduino programming | | 1/10/18 | 1/10/18 | ppts |
| 40 | Extended Arduino libraries Arduino based internet communication. | | 1/10/18 | 1/10/18 | ppts |
| 41 | Discussion of question bank. | |  |  | Chalk board |