

Sardar Patel Institute of Technology Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India

(Autonomous Institute Affiliated to University of Mumbai)

| Course Code | Course Name | Teaching Scheme (Hrs/week) | | | Credits Assigned | | | |
|----------------|------------------------|----------------------------------|---|-----|---------------------|---|---|-------|
| | | L | Т | P | L | Т | Р | Total |
| | | 4 | | | 4 | | | 4 |
| EXC701 | Embedded System Design | Examination Scheme | | | | | | |
| | | ISE | | MSE | ESE | | | |
| | | 10 | | 30 | 100 (60% Weightage) | | | tage) |

| Pre-requisite Course Codes | | Codes EXC403: Microprocessor and Peripherals | | |
|--|---|--|--|--|
| | | EXC501: Microcontroller & Applications | | |
| After successful completion of the course, student will be able to | | | | |
| | CO1 | Discuss the fundamentals of embedded systems and communication protocols | | |
| | CO2 | Decide the use of MSP430, ARM and Reconfigurable hardware for given | | |
| Course | Course applications | | | |
| Outcomes | s CO3 Examine the working of Real time operating systems | | | |
| | CO4 | Compare Simulation, testing and debugging methods | | |
| | CO5 | Design Embedded System for given application | | |

| Module | Unit | Topics | | Hrs. | |
|--------|------|--|-------|-------|--|
| No. | No. | | | 11150 | |
| 1 | | Fundamentals of Embedded System | | 08 | |
| | 1.1 | Core of the embedded system, Memory, Sensors (resistive, optical, | 1,5 | | |
| | | position, thermal) and Actuators (solenoid valves, relay/switch, | | | |
| | | opto-couplers), Communication Interface, Embedded firmware | | | |
| | | (RTOs, Drivers, Application programs), Power-supply (Battery | | | |
| | | technology, Solar), PCB and Passive components, Safety and | | | |
| | | reliability, environmental issues. Ethical practice. | | | |
| | 1.2 | Characteristics and quality attributes (Design Metric) of embedded | 1,5 | | |
| | | system. Real time system's requirements, real time issues, interrupt | | | |
| | | latency. | | | |
| | 1.3 | Embedded Product development life cycle, Program modeling | 1,5,3 | | |
| | | concepts: DFG, FSM, Petri-net, UML | | | |
| 2 | | Embedded Serial Communication | | 04 | |
| | 2.1 | Study of basic communication protocols like SPI, SCI (RS232, | 1,5 | | |
| | | RS485), I2C, CAN, Field-bus (Profibus), USB (v2.0), Bluetooth, Zig- | | | |
| | | Bee, Wireless sensor network | | | |
| 3 | | Embedded Hardware and Design | | 12 | |
| | 3.1 | Low power hardware design (MSP430 / Cortex-M3 based Real time | 11 | | |
| | | clock and PWM dc motor control as a case study using on chip timers | | | |
| | | and watch-dog-timers). | | | |
| | 3.2 | Introduction to ARM-v7-M (Cortex-M3), Comparison of ARM-v7-A | 3,8,9 | | |
| | | (CortexA8), ARM-v7-R (CortexR4), ARM-v7-M (Cortex-M3) | | | |
| | 3.3 | Direct digital solution using CPLD, FPGA, its advantages, and | 3,8 | | |



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| | | introduction to related development methodology | | |
|------------------|-----|--|-------|----|
| 4 | | Embedded Software, Firmware Concepts and Design | | |
| | 4.1 | Embedded C-programming concepts (from embedded system point of view): Optimizing for Speed/Memory needs, Interrupt service routines, macros, functions, modifiers, data types, device drivers, Multithreading programming. (Laboratory work on J2ME Java mobile application). | 1,5 | |
| | 4.3 | Real time operating system: POSIX Compliance, Need of RTOS in Embedded system software, Foreground/Background systems, multitasking, context switching, IPC, Scheduler policies, Architecture of kernel, task scheduler, ISR, Semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS. | 1,5 | |
| | 4.4 | Introduction to μ COS-II RTOS, study of kernel structure of μ COS-II, Synchronization in μ COS-II, Inter-task communication in μ COS-II, Memory management in μ COS-II, porting of RTOS on ARM-v7 (emulation) board, Application developments using μ COS-II. | 4 | |
| | 4.5 | Introduction Linux OS, Linux IPC usage, basic device (drivers) usage. | | |
| 5 | | Simulation, Testing and Debugging Methodology and Tools | | 04 |
| | 5.1 | GNU Debugger (gdb), Boundary-Scan/JTAG interface concepts, Black-box, White-box testing, Hardware emulation, logic analyzer. | 1,5 | |
| 6 Embedded Syste | | Embedded System Designing | | 08 |
| | 6.1 | Requirement analysis, Hardware blocks diagram, System model (like FSM, UML), Software architectures (modules, drivers). And Component/hardware selection, covering following cases: Hard real time/ Mission critical: Missile, Car cruise control, medical monitoring systems, process control system (temp, pressure) Soft real time: Automated vending machines, digital camera, media- player. Communication: Embedded web servers, routers, Wireless (sensor) networks. | 1,5,2 | |
| | | | Total | 52 |

References:

- [1] Embedded Systems, Rajkamal, TMH, Edition 2008.
- [2] Frank Vahid Embedded Systems, Wiley India, Edition 2002
- [3] ARM System-on-Chip Architecture, Steve Furber Pearson Edition 2005
- [4] Jean J Labrose MicroC / OS-II, Indian Low Price Edition 2002
- [5] DR.K.V.K.K. Prasad Embedded / real time system, Dreamtech
- [6] Iyer, Gupta Embedded real systems Programming, TMH



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- [7] Embedded systems software primer, David Simon Pearson
- [8] ARM System Developers Guide- Sloss, Symes, Wright, ElsevierMorgan Kaufman, Edition 2005
- [9] LPC2148 Data Sheets www.arm.com
- [10] ARM Programers/architectural manual.
- [11] MSP430 architectural manual.

[12] Embedded Microcomputer Systems – Real Time Interfacing – Jonathan W. Valvano; Cengage Learning; Third or later edition.