Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
EXC701	Embedded System Design	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
EXC701	Embedded System Design	20	20	20	80	-	-	-	100

Course Pre-requisite:

- EXC403: Microprocessor and Peripherals
- EXC501: Microcontroller & Applications

Course Objectives:

1. To teach scope, usage, requirements, challenges and general design methodology of embedded system
2. To apply hardware and software knowledge to develop embedded system applications according to requirement and constraints

Course Outcomes:

After successful completion of the course student will be able to

1. interpret component's functional and electrical specifications and its implication and advantage in design.
2. develop their skill to select/choose proper components, approach, and method to develop optimal system.

Module No.	Unit No.	Topics	Hrs.
1		**Fundamentals of Embedded System**	8
	1.1	Core of the embedded system, Memory, Sensors (resistive, optical, 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 system. Real time system's requirements, real time issues, interrupt latency.	
	1.3	Embedded Product development life cycle, Program modeling concepts: DFG, FSM, Petri-net, UML	
2		**Embedded Serial Communication**	4
	2.1	Study of basic communication protocols like SPI, SCI (RS232, RS485), I^2C, 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 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 (CortexA8), ARM-v7-R (CortexR4), ARM-v7-M (Cortex-M3)	
	3.3	Direct digital solution using CPLD, FPGA, its advantages, and introduction to related development methodology	
4		**Embedded Software, Firmware Concepts and Design**	16
	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).	
	4.2	Basic embedded C programs/applications for ARM-v7, using ARM-GCC-tool-chain, Emulation of ARM-v7 (e.g. using QEMU), and Linux porting on ARM-v7 (emulation) board	
	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.	
	4.4	Introduction to µCOS-II RTOS, study of kernel structure of µCOS-II, Synchronization in µCOS-II, Inter-task communication in µCOS-II, Memory management in µCOS-II, porting of RTOS on ARM-v7 (emulation) board, Application developments using µCOS-II.	
	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.	
6		**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.	
		Total	**52**

Recommended Books:

1. Embedded Systems, Rajkamal , TMH, 2008.
2. Frank Vahid - Embedded Systems , Wiley India, 2002
3. ARM System-on-Chip Architecture, Steve Furber - Pearson 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
7. Embedded systems software primer, David Simon - Pearson
8. ARM System Developers Guide- Sloss, Symes, Wright, ElsevierMorgan Kaufman, 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.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered for final internal assessment.

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the modules.