Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NECC537	Embedded System Design	3	1	0	4

Course Objective

With this course students will learn the basics, building blocks of Embedded System, Input/output Interfacing & Bus Communication with processors, automation using scheduling algorithms and Real time operating system along with different Phases & Modeling of a new embedded product.

Learning Outcomes

Upon successful completion of this course, students will:
- Demonstrate the functionalities of processor internal blocks, with their requirement.
- Analyze that Bus standards are chosen based on interface overheads without sacrificing processor performance
- Explain the role and features of RT operating system, that makes multitask execution possible by processors.
- Illustrate that using multiple CPU based on either hardcore or softcore helps data overhead management with processing- speed reduction for uC execution.

Module No.	Topics to be Covered	Lecture +Tutorial Hours	Learning Outcome
1	Introduction to Embedded Systems –built in features for embedded Target Architecture - selection of Embedded processor – DMA- memory devices – Memory management methods-memory mapping, cache replacement policies- Timer and Counting devices, Watchdog Timer, Real Time Clock Software Development tools-IDE, assembler, compiler, linker, simulator, debugger, In circuit emulator, Target Hardware Debugging- Overview of functional safety standards for embedded systems.	9L+2T	Acquire an understanding of the basics and in-built architectures of embedded systems.
2	Embedded Networking: Introduction, I/O Device Ports & Buses- multiple interrupts and interrupt service mechanism – Serial Bus communication protocols - RS232 standard–RS485–USB–Inter Integrated Circuits (I2C)- CAN Bus –Wireless protocol based on Wifi , Bluetooth, Zigbee – Introduction to Device Drivers.	8L+3T	Acquire the knowledge about the interfaces, bus standards and communication protocols in embedded systems
3	Introduction to basic concepts of RTOS- Need, Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication context switching, interrupt latency and deadline shared memory, message passing-, Interprocess Communication – synchronization between processes- semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, uC/OS-II, RT Linux.	8L+3T	Understand the concept of real time operating systems
4	Modelling embedded systems- embedded software development approach --Overview of UML modeling with UML, UML Diagrams-- Hardware/Software Partitioning, Co-Design Approaches for System Specification and modeling- CoSynthesis- features comparing Single-processor Architectures & Multi-Processor Architectures--design approach on parallelism in uniprocessors & Multiprocessors.	9L+3T	Knowledge about the Modeling of a new embedded product (both hardware and software).
5	Objective, Need, different Phases & Modelling of the EDLC.choice of Target Architectures for Embedded Application Development-for Control Dominated-Data Dominated Systems-Case studies on Digital Camera, Adaptive Cruise control in a Car, Mobile Phone software for key inputs	8L+3T	Knowledge about embedded consumer product design based on phases of product development
	Total	42L+14T	

Textbook:

1. Rajkamal, 'Embedded System-Architecture, Programming, Design', TMH,2011.
2. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson 2013

Reference Books:

1. Peckol, "Embedded system Design", John Wiley & Sons, 2010
2. Tammy Noergaard," Embedded System Architecture, A comprehensive Guide for Engineers and Programmers", Elsevier, 2006
3. Elicia White," Making Embedded Systems", O'Reilly Series, SPD, 2011
4. Bruce Powel Douglass, "Real-Time UML Workshop for Embedded Systems, Elsevier,2011
5. Shibu.K.V, "Introduction to Embedded Systems", Tata McGraw Hill,2009
6. Jorgen Staunstrup, Wayne Wolf, Hardware / Software Co- Design Principles and Practice, Springer, 2009.
7. Giovanni De Micheli, Mariagiovanna Sami, Hardware / Software Co- Design, Kluwer Academic Publishers, 2002.