T. Y. B. Tech (E&TC Engineering)

Academic Year – 2021-2022 Semester -VI

[EC3108]: Embedded and Real Time Operating Systems

Teaching Scheme:	Credits	Examination Scheme:
TH: - 4Hours/Week	TH:4	In Sem. Evaluation :15 Marks
LAB: - 2Hours/Week	LAB:1	Mid Sem. Exam : 25 Marks
		End Sem. Exam : 60 Marks
		LAB Evaluation :50 Marks

Course Pre-requisites:
Microprocessor & Microcontroller concepts and applications, Assembly language concepts, C programming, Computer architecture and operating system.

Course Objective:
This Course will give the insights of architecture, instruction set and programming aspects of ARM Processor. It also provides basics of operating systems, terms related to real time operating systems, features and its applications.

Course Outcome:
After successful completion of the course, students will able to:
CO1: Recognize the basic concepts of embedded systems
CO2: Adapt with Microcontroller Operating system (RTOS)
CO3: Analyze various features of RTOS functions in embedded systems applications
CO4: Implement device drivers and file systems in Linux operating system.
CO5: Construct an application of embedded RTOS

Course Contents

UNIT-I	Introduction to Embedded Systems	07 Hours

Definition of Embedded System, Embedded Systems Vs General Computing Systems. Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems. ARM Design Philosophy, Embedded System models and Development Cycle

UNIT-II	ARM7 processor	07 Hours

ARM Architecture (LPC 2148) and Organization, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, ARM/ Thumb Instruction set.LPC2148 Microcontroller: Features, Block diagram, GPIO, Interrupts, Timers, PLL, ADC/DAC, PWM, RTC interfacing and programming, Protocols such as UART, CAN, I2C & SPI Implementation.

UNIT-III	Introduction to Real Time Operating System	08Hours

Introduction to RTOS, role of RTOS, foreground Back ground system, pros and cons. Functionalities of RTOS – Task Management, I/O management, Inter Task Communication, Tasks and task states, Process and Threads, Multiprocessing and Multitasking, Context switching, Intertask Communication, Mutual Exclusion, preemptive and non-preemptive kernel, Priority Inversion, Deadlock, semaphores,

Dr. B. D. Jadhav
B.O.S. Chairman

Dr. R. B. Joshi
Dean Academics

Dr. R. K. Jain
Director RSCOE, Pune

and shared data, message queues, mailboxes and pipes, timer functions, events, memory management, interrupt routines in an RTOS environment.

UNIT-IV	µCOS II OS	07 Hours

Features of µCOS II. Kernel structure. µCOS II RTOS services: Task management, Memory management, Time management, Task Scheduling, Intertask Communication and Synchronization.

UNIT-V	Embedded Linux	07 Hours

Need of Linux, Embedded Linux Today, Open Source and the GPL, BIOS Versus Boot loader, Cross-Development Environment, Host System Requirements, Hosting Target Boards. Development Tools, GNU Debugger, Tracing and Profiling Tools, Binary Utilities. Role of a Boot loader, Boot loader Challenges, Device Driver Concepts, Module Utilities, Driver Methods. Linux File System & Concepts.

UNIT-VI	Embedded software development tools and Applications	08 Hours

Host and target machines, linker/locators for embedded software, getting embedded software into the target system, debugging techniques: Testing on host machine, using laboratory tools, an example system. Case study of Embedded system like Automatic Chocolate Vending Machine, Mobile Phone, ATM, digital camera, point of sales terminal, ECG machines, engine control units.

Lab Contents

Guidelines for Assessment

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file.
- Final practical examination for specific practical and oral examination will be conducted.

List of Laboratory Assignments/Experiments

1	Write a program for LPC2148 interfacing with LED and 7 segment Display
2	Write a program to interface LPC2148 with temperature sensor and relay.
3	Write a program to interface ARM board (LPC2148) with SPI/CAN protocol
4	Write a program to interface ARM board (LPC2148) with ADC
5	Write a program for Task Scheduling of Input and Output Devices using µCOS- II Semaphore
6	Implementation of Message Queue for 3 Tasks on µCOS- IIusing Embedded C.
7	Implementation of Message Mailbox for 3 Tasks on µCOS- II using Embedded C.
8	Writing a program for "Hello World" message using device Driver. Loading the device driver into & removing from Kernel on ARM9 board.
9	Write a program for I2C based RTC using embedded Linux on ARM9
10	Case study: To design a real time clock using I2C protocol for implementation of student/faculty attendance.

Text Books:

T1. Jean J.Labrosse, ―MicroC OS II, The Real-Time Kernel‖, 2nd edition, CMP Books.
T2. Christopher Hallinan, "Embedded Linux Primer -A Practical, Real-World Approach "2nd edition, Prentice Hall.

Reference Books:

R1. Steve Furber, ― ARM System-On-Chip Architecture‖, Second Edition, Pearson Publisher.
R2. Embedded Systems: Architecture, Programming and design, Raj Kamal, Second Edition.

Dr. B. D. Jadhav	Dr. R. B. Joshi	Dr. R. K. Jain
B.O.S. Chairman	Dean Academics	Director RSCOE, Pune