CVM UNIVERSITY
Aegis: Charutar Vidya Mandal (Estd.1945)

FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **BACHELOR OF TECHNOLOGY (Electronics and Communication)**

Semester: **VII**

Course Code: **202060705**

Course Title: **Embedded Systems**

Course Group: Professional Elective Course

Course Objectives: This course emphasizes on comprehensive treatment of embedded hardware and real time operating systems along with case studies, in tune with the requirements of Industry. The objective of this course is to enable the students to understand embedded-system programming and apply that knowledge to design and develop embedded solutions.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50/18	50/17	25/9	25/9	150/53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr. No	Contents	Hours
1	**Introduction to Embedded systems:** What is an embedded system Vs. The general computing system, history, classification, major application areas, and purpose of embedded systems. The core of the embedded system, memory, sensors and actuators, a communication interface, embedded firmware, other system components, PCB, and passive components.	5
2	Selecting the Right MCU, Technical requirements, The importance of MCU selection, MCU considerations, Development board considerations, Selecting an IDE, Technical requirements, The IDE selection criteria, Free MCU vendor IDEs and hardware-centric IDEs, Platform-abstracted IDEs, Open source/free IDEs, Proprietary IDEs	5
3	Operating System basics, Types of Operating systems, RTOS, tasks, process and threads, multiprocessing and multitasking, types of multitasking, Task Scheduling, non-preemptive scheduling, SCFS, LCFS, SJF and Priority based scheduling, Preemptive scheduling, SRT, RR, Priority based preemptive scheduling	10

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4	Task communication of RTOS, shared memory, pipes, memory-mapped objects, message passing, message queue, mailbox, signaling, RPC and sockets, task communication/synchronization issues, racing, deadlock, deadlock handling live lock, starvation, the dining philosopher's problem, solution, The producer-consumer problem, Reader writers problem, Priority Inversion, Priority ceiling	**10**
5	Task Synchronization techniques, busy waiting, spinlock, sleep and wake, semaphore, mutex, critical section objects, events, device drivers, how to choose an RTOS, Integration, and testing of embedded hardware and fire ware.	**10**
6	Open Source Real-Time Operating Systems, FreeRTOS Alternative to Proprietary RTOS, FreeRTOS Platform and Tools, FreeRTOS Real-Time Service Programming Fundamentals	**5**
		45

List of Practicals / Tutorials:

1	Introduction to IDE development Toolchain and Installing IDE environment and Importing the source tree into IDE
2	Blinky example using the IDE and ARM Hardware platform
3	To interface a Push button with the ARM board board and control onboard LEDs of with an onboard push button.
4	To use UART communication ports of ARM board discovery board to transmit and receive data to/from external UART based devices.
5	Use built-in ADC of the ARM board to measure analog voltage connected with one of the ADC input pins using HAL Libraries
6	Configure DAC module of ARM board with HAL DAC drivers to generate waveforms.
7	To display on LCD screen on ARM board discovery board
8	Use ARM Cortex-M SysTick timer to blink LEDs on ARM board
9	To transmit and receive CAN bus message using can bus analyzer. Using the ARM board and an external CAN transceiver to communicate with the MAIN Station to send and receive messages.
10	To demonstrate multitasking with FreeRTOS and ARM Evalboard
11	FreeRTOS project

Reference Books:

1	Introduction to embedded systems Shibu. K.V, TMH, 2009
2	Hands-On RTOS with Microcontrollers: Building real-time embedded systems using Free RTOS, STM32 MCUs, and SEGGER debug tools by Brian Amos, Packt Publishing, 2020
3	Real Time Embedded systems, Jiacun Wang, Wiley-2017
4	Real-time embedded components and systems with Linux and RTOS by Sam Siewert and John pratt by Mercury learning and information

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Supplementary learning Material:	
1	NPTEL and Coursera Video Lectures

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
10	**35**	**10**	**10**	**15**	**20**	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the basics of an embedded system and Program an embedded system	**20**
CO-2	Identify the unique characteristics of real-time systems	**20**
CO-3	Explain the general structure of a real-time system	**35**
CO-4	Design, implement and test an embedded system.	**25**

Curriculum Revision:	
Version:	**2**
Drafted on (Month-Year):	June -2022
Last Reviewed on (Month-Year):	-
Next Review on (Month-Year):	June-2025

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