GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (07)
ADVANCED MICROCONTROLLER
SUBJECT CODE: 2730711
M.E. SEM-III

Type of course: Engineering

Prerequisite: Microcontroller

Rationale: The students learn the Hardware architecture of a 32 bit microcontroller (based on ARM CORTEX M0 & M4 cores) and Programming of the same in Embedded 'C'. They learn the design of Microcontroller based systems. They will be able to use the Program algorithms of latest microcontroller based systems design used in electrical engineering related fields like Power system protection, instrumentation, power electronics, Electrical Drives and control of Electrical Equipments where many activities has to be done in very short time. They will also be able to verify and co-relate the results of software modelling and simulation with actual hardware.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Practical Marks				
L	T	P	C	ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**INTRODUCTION TO ARM CORTEX M MCU cores** Overview of ARM CORTEX Architecture, A Series, R Series and M Series. CORTEX M0 &M4 Cores, Advantages and applications, Harvard and Von Neumann Architecture.	02	4%
2	**INTRODUCTION TO EMBEDDED 'C' PROGRAMMING & SOFTWARE DEVELOPMENT TOOLCHAIN** Integrated Development Environment, Components of IDE (Assembler, Compiler, Linker, Debugger, etc), Hardware debugging techniques, JTAG/SWD debug adapter, Software development flow, Data types in C, pointers, structures & unions, pointer to structures, pointers to functions, addressing mechanism for memory mapped registers, Cortex microcontroller software interface standard (CMSIS).	05	12%
3	**INTRODUCTION TO STM32F4xx DSC ARCHITECTURE (CORTEX-M4 based MCU)** Hardware architecture, System control block (SCB) Bus matrix, AHB & APB buses, Memory systems and registers, interrupt processing, NVIC, System Tick Timer.	08	18%
4	**ARCHITECTURE AND PROGRAMING OF PERIPHERALS OF STM32F4xx** Hardware Architecture & Embedded 'C' programming of GPIO, Basic timers, Advanced control timers,UART, ADC, DAC,DMA controller.	22	50%

	Interfacing of DSC with Matrix Keyboard, LCD.		
5	**APPLICATION OF 32 BIT CONTROLLER IN POWER ELECTRONICS, POWER SYSTEMS AND CONTROL** Programming for Single/Three phase Sine PWM, Thyristor Firing,PWM for Buck and Boost converters, Space Vector PWM.	06	16%

Reference Books:

1. Datasheet, programming and user reference manual of STM32F4xx (www.st.com)
2. The insider's guide to the STM32 ARM based Microcontroller, www.hitex.com
3. Joseph Yiu, "Definitive Guide to ARM CORTEX M0/M4", Elsevier, 2007
4. The Designer's Guide to the Cortex-M Processor Family: A Tutorial Approach, By Trevor Martin,Newnes, Elsevier

Course Outcome:

After learning the course the students should be able to:

- Program algorithms for Power Electronics, Power Systems and Control Systems
- Debug and test microcontroller based hardware and software for different applications
- Understand correlation between simulation and hardware based system

List of Experiments and Design based Problems (DP)/Open Ended Problem:

Based on Syllabus students shall perform following Practical.

1. Introduction to STM 32 cortex M4
2. Introduction to Integrated Development Environment (IDE)
3. Programming of GPIO port with LED toggling and key interface
4. Interrupt Programming
5. Programming of Base timer for accurate delays
6. Programming of Advanced control timer in capture mode (Frequency measurement)
7. Programming of UART
8. Programming of advanced control timer for edge aligned and center aligned PWM wave forms with and without dead time
9. Programming for Matrix keyboard
10. Programming of LCD for embedded system output message display
11. Programming of on-chip ADC
12. Programming of on-chip DAC for wave form generation

Major Equipment: The lab experimentation require (1) Computers (2) Trainer kits for Microcontroller and other related cards (3) Digital storage oscilloscopes (4) Digital Multimeters

(5) Function generators (6) Multi-range DC power supply (6) Evaluation version of IDE (Program Development Tool chain)

List of Open Source Software/learning website:Evaluation version of KEIL MICRO VISION IV OR

Higher IDE/ OR IAR IDE (www.keil.com, www.iar.com)

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.