GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3172416

Semester – VII

Subject Name: Digital Signal Controller

Type of course: Professional Elective Course- IV

Prerequisite:
1. Microcontrollers Architecture Interfacing and Applications (3152409)
2. Digital signal Processing for Power Electronics (3162414)

Rationale: Many Power Electronics Applications require complex control schemes and signal processing. Hence, for such applications, embedded processor having very good control capacity and signal processing capacity both are required. So, special processors combining both these capacities are used in such applications. They are Digital Signal Controllers (DSC). They combine the best features of microcontrollers (MCU) and powerful digital signal processing (DSP) capabilities in one single chip Considering this, it becomes necessary for any power electronics engineer involved in product development to understand the concepts of Digital Signal Controllers which has control and signal processing both capacities.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction: Digital signal processing, DSP architecture, Requirements of digital signal processing for power electronics	6
2	Introduction to C2000 family of microcontrollers: DFT - Frequency Domain Sampling and Reconstruction of Signal – Comparison of C2000 real time microcontrollers like PICOLO, DELFINO, 28M3x etc., with reference to on chip peripherals, processing capacity, applications etc.	8
3	Code Composer Studio: Introduction to CCS as IDE for TI processors, Basics of CCS, Multiprocessing with CCS, Testing Program, debugging Breakpoints, points, using file I/O, Memory map, Watch window, Integrated editor, project environment	8
4	TI 320F28X Digital Signal Controllers: TMS320F28335 Introduction, Functional Overview, Memory map, brief description of available peripherals, register maps, device emulation registers, interrupts, system control	8

5	On chip Peripherals of TMS320F28335(or any other C2000 Family processor): Timers, PWM generation, ADC, Serial Communication, GPIO, Flash Memory	6
6	Software Development and Programming: Overview, description, object module, program loading and running, Assembler, Assembler directives, Macros, Linker, using C language Writing program for some simple objectives like initializing peripheral, timer interrupt and ISR for timer interrupt, PWM generation etc. for C2000 microcontrollers.	9

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	15	15	10	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

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.

Reference Books:

1. DSP-Based Electromechanical Motion Control (Power Electronics and Applications Series), Hamid A. Toliyat (Author), Steven G. Campbell, CRC press
2. TI technical documents: Code Composer Studio User's Guide, Document no. SPRU328B (Data Manual 28335), SPRS439M (TI 28335 Data sheet), SPRUI07 (Technical Reference Manual), SPRU513V (Discrete TMS320C28x Assembly Language Tools User's Guide), SPRU514V (TMS320C28x Optimizing C/C++ Compiler v20.12.0.STS) , SPRAC71A (C28x Embedded Application Binary Interface), SPRU566N (C2000 Real-Time Control Peripherals)
3. Embedded System Design A Unified Hardware Software Introduction, Frank Vahid, Tony Givargis, Wiley India
4. The DSP Handbook Algorithms, Applications and design techniques, Andrew Bateman, Iain Paterson-Stephens, Pearson Education
5. C the complete reference, Herbert Schildt
6. Digital Signal Processing: Principles, Algorithms, and Applications, Dimitris Manolakis and John G Proakis, Pearson

Course Outcomes:

Sr. No.	CO statement **After studying this subject, student will be able to**	Marks % weightage
CO-1	understand implementation requirements of Power Electronics systems	25

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CO-2	select appropriate Digital Signal Controller for a given application	25
CO-3	apply Digital Signal Controller for practical application	25
CO-4	apply the software development tools in a real time embedded application.	25

List of Experiments:

Directions for Laboratory work:

✓ The list of experiments is given as a sample.
✓ Similar laboratory work fulfilling the objectives can also be considered.
✓ As far as possible, **printed manual should be preferred** so that students can concentrate in laboratory experiments and related study. The sample list of experiments is given below.

Suggested List of Experiments and Design Based (DP)/Open Ended Problems:

1. Study of generation of different elementary signals and sequences used in DSP
2. To study Code Composer studio as Integrated Development Environment
3. Using DSC for reading Analog Signal
4. Using DSC for Generating Timer interrupt and writing program for Interrupt service routine
5. Generation of PWM
6. Implementation of simple operations on signals
7. Reading digital signals from GPIO port
8. Writing signals to GPIO port

Software / Major Equipment:

Microcontroller kit, Logic analyser, DSO etc.

List of Open-Source Software/learning website:

Learning website:

1. http://nptel.iitm.ac.in/courses.php
2. http://ocw.mit.edu/
3. www.ti.com
4. http://www.electrical-engineering-portal.com
5. www.nxp.com
6. www.microship.com
7. www.st.com
8. https://www.ti.com/microcontrollers-mcus-processors/microcontrollers/c2000-real-time-control-mcus/overview.html#portfolio
9. http://software-dl.ti.com/C2000/docs/software_guide/intro.html
10. https://software-dl.ti.com/C2000/docs/optimization_guide/index.html
11. https://www.ti.com/tool/CCSTUDIO#tech-docs
12. https://www.ti.com/tool/CCSTUDIO
13. https://software-dl.ti.com/ccs/esd/documents/users_guide/index.html

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