GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3162414
Semester VI
Subject Name: Digital Signal Processor for Power Electronics

Type of course: Professional Core Course

Prerequisite: Microcontrollers Architecture, Interfacing and Applications

Rationale: Digital Signal Processing is an important field of engineering study in this era of automation. Now a days, almost every home appliance, industry application, electronic gazettes, wearable have one or another programmable device. They all need to interface with the real-world signals, process them digitally and produce the result for further action. Hence, digital signal processors have become back bone of today's industrial applications. This is true for power electronics applications also. Hence, it is required to understand digital signal processing with reference to power electronics applications. We all know that in power electronics applications, real time control of power electronics switches is important to obtain desired output to be fed to load. Control of Power Electronic System is carried out through high end processors. The effect of digital signal processing on controlled output also needs to be understood in this context. When designed properly, may improve system reliability, and make fail safe system by employing digital signal processing concepts to Power Electronic Systems. This is very much important in certain critical applications where reliability is of prime importance. For example, a power supply system for critical load like a data server. This course aims to build general understanding about the digital signal processing and how it can be used in digitally controlled power electronic systems.

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	1	0	4	70	30	0	0	100

Contents:

Sr no.	Topics	Teaching Hrs.	Module weightage
1	**Introduction:** Signals – Classification – Continuous& Discrete Time Signals – Basic Operations on Signals & Sequences – Elementary Signals - Discrete Time Systems &Properties of System, Impulse response of DT-LTI system, Linear Convolution. Sampling of Continuous Time Signals – Sampling Theorem – Aliasing & it's Effects, Signal reconstruction.	6	15
2	**The z-Transform:** Relation between Laplace Transform &The Z-Transform, Properties of z-Transform, ROC and its properties , One Sided Z-transform , Z-Transform of basic sequences ,Inverse z-Transform, Analysis of LTI Systems using z-Domain, Applications of z Transforms.	6	12
3	**Implementation Discrete Time Systems:** Block diagram / signal flow graph representation of DT System, Structures for realization of FIR & IIR Systems – Direct, Cascade, Parallel & Linear phase.	8	20
4	**Fourier series& Fourier Transform of DT signals**: Discrete Time Fourier series, Discrete Time Fourier Transforms –Properties, Analysis of DT-LTI systems using DTFT.	6	15
5	**Discrete Fourier Transform and Fast Fourier Transform:** **DFT**- Relationship of DFT & other transforms, Properties, Frequency	8	20

	spectrum using DFT, Analysis of LTI system using DFT, DFT as Linear Transformation. **FFT**– DIT Radix-2 FFT, DIFRadix-2 FFT, Computation of Inverse DFT using FFT.		
6	**Representation of Numbers** in digital system (Floating point, Fixed-point representation), Types of arithmetic in digital system, Quantization effect & Errors therein, Concept of Limit Cycle Oscillations & Scaling	5	8
7	**Architecture of DSP:** Features of Processors– Types of architecture, DMA, MAC, Pipelining etc., introduction to DSP architecture. Peripherals available in DSP IC chips, requirements of on chip hardware for power electronics applications.	5	10

Reference Books:

1. A. Nagoor Kani , "Digital Signal Processing" 2nd Edision, TMH
2. Proakis, Manolakis, Proakis, Manolakis, "Digital Signal Processing: Principles, Algorithm & Application", 4th edition, Pearson
3. Oppeheim, Schafer, "Discrete Time Signal Processing", Pearson education publication, 2nd Edition, 2003.
4. D. Williamson, "Discrete Time Signal Processing", Springer, 2002

Course Outcome:

Sr. No.	CO statement At the end of this course, students will demonstrate the ability to	Marks % weightage	Topics Mapped
CO1	understand the concept of signals		
CO2	analyze discrete time system using z-transform		
CO3	design digital filters for various applications		
CO4	explain architecture and various blocks of DSP processor		

List of Open Source Software/learning website:

1. https://nptel.ac.in/courses/108/105/108105055/
2. https://nptel.ac.in/courses/117/104/117104070/
3. https://nptel.ac.in/courses/117/102/117102060/