

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: POWER ELECTRONICS
SUBJECT NAME: ADVANCED DIGITAL SIGNAL PROCESSING
SUBJECT CODE: 3712914
M.E. 1st SEMESTER

Type of course: Engineering

Prerequisite: Understanding of Signals and Systems at UG level

Rationale: It is very important to understand the signal characteristics and system behaviour when the signals are digitized. Noises from the signals can be removed by designing filters using software. So, it is very important to understand the fundamentals of processing of complex signals. This subject will provide better understanding of discrete-time and digital signal in time and frequency domain. Students will also be able to design and implement FIR and IIR filters with different structures. Students will also be introduced to digital signal processor.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs	% Weightag
1	<ul style="list-style-type: none">Discrete time signalsLinear shift invariant systems- Stability and causalitySampling of continuous time signals-Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transformZ transform-Properties of different transforms	8	20
2	<ul style="list-style-type: none">Linear convolution using DFTComputation of DFT Design of IIR digital filters from analog filtersImpulse invariance methodBilinear transformation method	8	20
3	<ul style="list-style-type: none">FIR filter design using window functionsComparison of IIR and FIR digital filtersBasic IIR and FIR filter realization structuresSignal flow graph representations Quantization process and errorsCoefficient quantisation effects in IIR and FIR filters	8	20
4	<ul style="list-style-type: none">A/D conversion noise- Arithmetic round-off errorsDynamic range scalingOverflow oscillations and zero input limit cycles in IIR	8	20

	filters <ul style="list-style-type: none"> • Linear Signal Models 		
5	<ul style="list-style-type: none"> • All pole, All zero and Pole-zero models • Power spectrum estimation- Spectral analysis of deterministic signals. • Estimation of power spectrum of stationary random signals 	6	10
6	<ul style="list-style-type: none"> • Optimum linear filters • Optimum signal estimation • Mean square error estimation • Optimum FIR and IIR Filters 	6	10

Reference Books:

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach", TataMc Grow-Hill Edition 1998
2. Dimitris G .Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", Mc Grow Hill international editions .-2000

Course Outcome:

After learning the course, the students should be able to:

1. Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals and systems
2. Study the design techniques for IIR and FIR filters and their realization structures.
3. Acquire knowledge about the finite word length effects in implementation of digital filters.
4. Knowledge about the various linear signal models and estimation of power spectrum of stationary random signals
5. Design of optimum FIR and IIR filters

List of Experiments:

1. To represent basic signals (Unit Step, unit impulse, ramp, exponential).
2. To represent sine, and cosine signals.
3. To develop program for discrete convolution.
4. To develop program for convolution without direct matlab command.
5. To develop program for discrete correlation.
6.
 - a. Determine the Impulse response for the system described by the second order difference equations.
 - b. Also obtain the Pole-Zero plot for the equation taken inn(a) and hence comment on the ROC and stability of the system.
 - c. Express given Z transform in factored form, plot its poles & zeros, and determine its ROCs.
7. To understand sampling theorem.
8. To design digital IIR filters
9. To design digital FIR filter
- 10.

Major Equipment:

PC with necessary software like MATLAB, OCTAVE, SCILAB etc.

List of Open Source Software/learning website:

1. <https://www.nptel.ac.in>
2. <https://www.mathworks.com/>
3. <https://powersimtech.com>
4. <https://www.scilab.org/>