GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (SIGNAL PROCESSING AND VLSI TECHNOLOGY) (26)
ADVANCED DIGITAL SIGNAL PROCESSING AND APPLICATIONS
SUBJECT CODE: 2722601
SEMESTER: II

Type of course: Advanced Statistical and Adaptive Signal Processing

Prerequisite: Higher Engineering Mathematics, Digital Filter Structure and Design, Estimation and Linear Prediction, Estimation of spectra from finite duration signals, Periodogram, Nonparametric and Parametric methods and model based spectral estimation**.**

Rationale: PG Students of EC Engineering need to possess good understanding of the fundamentals and applications of Adaptive systems including estimation theory and random variables for implementing changing real world into DSP system. They are expected to be able to design Adaptive Digital filters and process real world signals as per desired applications. They will be guided in designing Adaptive Filters using various Algorithms using MATLAB/Scilab/CCS software.

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)		
						ESE	OEP	PA	RP	
4	2#	0	5	70	30	20	10	10	10	150

Sr.No.	Course Content	Teaching hours	Module weightage
1	**Random Variables, Vectors and Sequences:** Random Variables, Random Vectors, Discrete-Time Stochastic Processes, Linear Systems with Stationary Random Inputs, Whitening and Innovations Representation, Principles of Estimation Theory.	**12**	**20%**
2	**Least-Squares Filtering and Prediction:** The Principle of Least Squares, Linear Least-Squares Error Estimation, Least-Squares FIR Filters, Linear Least-Squares Signal Estimation, LS Computations Using the Normal Equations, LS Computations using Orthogonalization Techniques, LS Computations using the Singular Value Decomposition	**16**	**30%**
3	**Adaptive Filters:** Introduction to Adaptive System, Adaptive Linear Combiner, Properties of Quadratic Performance Surface, Searching the Performance Surface, Gradient Estimation and its Effect on Adaptation, Method of Steepest Descent, LMS Algorithm, RLS Algorithms, Fast RLS Algorithms.	**20**	**40%**
4	**Applications of Adaptive Filters:** Echo Cancelation in Communications, Equalization of Data	**04**	**10%**

	Communications Channels, Linear Predictive Coding, Noise Cancelation.		

Reference Books:

1. Statistical and Adaptive Signal Processing by Dimitris Manolakis, Vinay Ingle and Kogon, McGraw-Hill
2. Adaptive Signal Processing by Bernard Widrow and Samuel Stearns, Pearson
3. Fundamentals of Adaptive Signal Processing by Aurelio Uncini, Springer
4. Fundamentals of Adaptive Filtering by Ali Sayed, Wiley
5. Adaptive Filter Theory by Simon Haykin, Prentice Hall International

Course Outcome:

1   To study Random Variables and Random Vectors.
2   To study Discrete-Time Stochastic Processes.
3   To analyze Linear Systems with Stationary Random Inputs.
4   To Estimate Linear Least-Squares Error.
5   To study Linear Least-Squares Signal Estimation.
6   To study LS Computations Using Orthogonalization Techniques
7   To study LS Computations Using the Singular Value Decomposition.
8   To study and Design Adaptive System for various applications.
9   To Use MATLAB and 'C language' for Adaptive DSP system analysis and design.

Tutorial/Teacher Guided Student Activity:
As a part of this activity students can perform following activities.
   A) Refer scholarly articles from well known journal/conferences such as IEEE, ELSEVIER, and SPRINGER etc
   B) Student can be assigned topics for seminars on some research topics.

1   Write C code to generate various signals in CCS and display them on CRO through DSP Processor Kit TMS X 6713.

2   Write MATLAB/Scilab and C code to generate Random signals and to measure their mean, standard deviation and variance.

3   Write MATLAB/Scilab and C code to design Gaussian Filter and vary the σ and view the effect.

4   Write MATLAB/Scilab and C code to design Gaussian Filter and adapt the σ based on some application.

5   Write MATLAB/Scilab and C code for Noise Cancellation.

6   Write MATLAB/Scilab and C code for Echo Cancellation in Communication.

Major Equipments: PC with MATLAB and CCS, Digital Storage Oscilloscope, DSP Processor Kit TMS X 6713.

List of Open Source Software/ Learning website:

1. Scilab (software)
2. www.nptel.ac.in

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