

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (SIGNAL PROCESSING & COMMUNICATION) (41)

STATISTICAL SIGNAL PROCESSING

SUBJECT CODE: 2724111

SEMESTER: II

Type of course: Conceptual and theoretical foundation for signal processing and communication

Prerequisite: Fundamentals of signal processing and communication

Rationale: The course aims at providing insight into various signal estimation methods. It also aims to explore adaptive filter process for signals with emphasis on spectral estimation as these are key issues in signal processing for various communication systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Content	Total Hrs	% weightage
1	Introduction: Review of random variables and random processes: independent, uncorrelated and orthogonal random variables; wide-sense stationary (WSS) random processes, autocorrelation function and spectral representation of a WSS process, white noise; spectral factorization and signal modelling by AR, MA and ARMA processes.	10	20
2	Parameter Estimation: Principle of estimation and properties of estimators, Cramer Rao bound, the methods of maximum likelihood and Bayesians estimation; Linear Minimum Mean-square error.	14	30
3	Filtering: FIR and IIR Wiener filter; Linear prediction; Adaptive Filters- LMS and RLS filtering.	14	30
4	Spectral Estimation: Smoothed and windowed periodograms, minimum variance, maximum entropy and parametric methods for spectral estimation.	10	10

Reference Books:

1. Statistical Digital Signal Processing and Modelling, M.H.Hayes, Wiley India Edition.
2. Fundamentals of Statistical Signal Processing Steven M.Kay Prentice Hall

3. Probability and Random Processes with Application to Signal Processing Henry Strak, Pearson Education

Course outcomes:

On successful completion of the course, the students should be able to:

- Understand about random signal and their processing requirements
- Understand about various estimation techniques
- Understand about linear predictors and adaptive filtering algorithms.
- Learn about complexity involved in processing communication signals with noise

Presentations:

1. Correlations functions and applications
2. Signal modeling using AR model, MA model with simulations
3. Signal modeling using ARMA model with simulations
4. Method of maximum likelihood estimates with simulations
5. Method of Bayesian estimates with simulations.
6. Application of LMS and RLS algorithms to various class of signals.
7. Recent trends in statistical signal processing.
8. Spectral estimation techniques
9. Adaptive signal processing

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