DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Course Title	Advanced Digital Signal Processing		
Course Code	EC603	No. of Credits	3
Course Code of Pre-requisite subject(s)	Nil		
Session	July 2018	Semester	I Semester M.Tech. (Communication Systems)
Name of Faculty	Dr.P.Palanisamy	Department	ECE
Email	palan@nitt.edu	Telephone No.	0431- 2503312
Name of Course Coordinator(s) (if, applicable)	-		
E-mail	palan@nitt.edu	Telephone No.	04312503312
Course Type	Core course		

Syllabus (approved in BoS)

Review of sampling theory. Sampling rate conversion by integer and rational factors. Efficient realization and applications of sampling rate conversion.

Wiener filtering. Optimum linear prediction. Levinson- Durbin algorithm. Prediction error filters.

Adaptive filters. FIR adaptive LMS algorithm. Convergence of adaptive algorithms. Fast algorithms. Applications: Noise canceller, echo canceller and equalizer.

Recursive least squares algorithms. Matrix inversion lemma. Convergence analysis of the RLS algorithm. Adaptive beam forming. Kalman filtering.

Spectrum estimation. Estimation of autocorrelation. Periodogram method. Nonparametric methods. Parametric methods.

Text Books

1. *J.G.Proakis, M. Salehi, "Advanced Digital Signal Processing", McGraw –Hill, 1992.*
2. *S.Haykin, "Adaptive Filter Theory (3/e)", Prentice- Hall, 1996.*

Reference Books

1. *D.G.Manolakis, V. K. Ingle, and S. M. Kogon ,"Statistical and Adaptive Signal Processing", McGraw-Hill,2005*
2. *S.L.Marple,"Digital Spectral Analysis", 1987.*
3. *M.H.Hays," Statistical Digital Signal Processing and Modeling", John-Wiley, 2001.*
4. *Recent literature in Advanced Digital Signal Processing.*

COURSE OBJECTIVES	
To provide rigorous foundations in multirate signal processing, power spectrum estimation and adaptive filters.	
COURSE OUTCOMES (CO)	
Course Outcomes	**Aligned Programme Outcomes (PO)**
1. Apply multirate DSP for applications and design efficient digital filters & construct multi-channel filter banks.	
2. select linear filtering techniques to engineering problems	
3. describe the most important adaptive filter generic problems.	
4. describe the various adaptive filter algorithms.	
5. describe the statistical properties of the conventional spectral estimators.	

COURSE PLAN – PART II			
COURSE OVERVIEW			
The prinicpal goal of this course is to provide a unified introduction to the theory, implemenatation, and applications of Multirate Digital Signal processing and Statistical and adaptive filtering. In this course, the topics focussed are on (i) Sampling rate conversion and its applications, (ii) Optimum filtering, linear predcition and adaptive filerting, (iii) Spectral estimation and array processing .			
COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	**Week/Contact Hours**	**Topic**	**Mode of Delivery**
1	**3 Contact Hours**	Multirate digital signal processing. Sampling conversion. Sampling rate decrease by an integer factor. Sampling rate increase by an integer factor. Sampling rate change by a rational factor.	Lecture C&T
2	**3 Contact Hours**	Efficient realization of sampling rate converters. Polyphase realization of FIR filter. Realization of sampling rate conversion using polyphase filters. Application of sampling rate conversion. Subband coding of speech signals.	Lecture C&T
3	**3 Contact Hours**	Filter bank realization. Quadrature filter bank. Condition for alias free and perfect reconstruction. Multichannel filter banks.	Lecture C&T

4	**3 Contact Hours**	Linear Filtering: Optimum FIR filter, Optimum IIR filter, Wiener-Hopf Equations. Linear Predictor (Forward & backward). Augmented Wiener Hopf Equations.	Lecture C&T
5	**3 Contact Hours**	Properties of prediction error filters. Levinsion-Durbin algorithm. Lattice structures.	Lecture C&T
6	**3 Contact Hours**	Adaptive filters: Need of adaptive filter. Adaptive algorithm: Steepest Descent algorithm (SDA), Convergence of SDA, LMS algorithm and its convergence analysis. Robustness of LMS algorithm.	Lecture C&T
7	**3 Contact Hours**	Applications of adaptive filters: Noise cancellation, echo-cancellation and equalization. Fast adaptive algorithms. Frequency domain analysis of adaptive filters.	Lecture C&T
8	**3 Contact Hours**	Least square concepts. Recursive least square (RLS) algorithm. Convergence analysis of RLS algorithm (both in mean and in mean-square sense). Roubustness of RLS algorithm.	Lecture C&T
10	**3 Contact Hours**	Spectrum Estimation: Power spectrum analysis (Whiner-Khintchine Theorem). Ergodicity concept. Power spectrum estimation (PSD): Estimation of autocorrelation values. Properties of estimators: Consistency (bias and variance). Periodogram estimator and its properties	Lecture C&T
11	**3 Contact Hours**	Non-parametric methods: Bartlett's method, Welch method and Blackman & Tukey method. Performance analysis.	Lecture C&T
12	**3 Contact Hours**	Parametric methods: ARMA, AR and MA models. Yule-Walkers equation. PSD estimation using ARMA, AR and MA. Frequency estimation: MUSIC and ESPRIT	Lecture C&T
C & T : Chalk and Talk			

COURSE ASSESSMENT METHODS (shall range from 4 to 6)				
S.No.	**Mode of Assessment**	**Week/Date**	**Duration**	**% Weightage**
1	**ASSESSMENT I** Descriptive Type Examination **(2 Units)**	03.10.2018 to 05.10.2018	60 Minutes	20
2	**ASSESSMENT II** Descriptive Type Examination **(2 Units)**	12.11.2018 to 16.11.2018	60 minutes	20
3	**RE-ASSESSMENT**	03.12.2018 to 04.12.2018	60 Minutes	20
4	**SEMINAR / ASSIGNMENT**	-	-	10
6	**END SEMESTER** Descriptive Type Examination **(Unit 1,2,3,4 & 5)**	Starts from 14.12.2018	180 Minutes	50

***mandatory; refer to guidelines on page 4**

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

Feedback from the students during class committee meetings

Anonymous feedback through questionnaire

COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, , academic honesty and plagiarism etc.)

MODE OF CORRESPONDENCE (email/ phone etc)

1. **All the students are advised to come to class regularly. All the correspondence (schedule of classes/ schedule of assessment/ course material/ any other information regarding this course) will be intimated in the class only.**
2. **Queries (if required) to the course teacher shall only be emailed to the email id specified by the teacher.**

ATTENDANCE

Attendance will be taken in all the lecture hours. Every student should maintain **minimum 75%** physical attendance (on other duty will not be considered) in the lecture hours to attend the end semester examination. Student having attendance less than 75% at the end of the semester will have to RE DO the course.

COMPENSATION ASSESSMENT

There will be two tests and one final examination. All exams will be closed book. The exam topics will be a subset of the course learning outcomes and for each test and examination the portions will be intimated in the class. A Re-test/Re-exam will be given only in the case of illness and medical emergency (doctor's certificate is required), and only if I am notified in advance of the exam by email or telephone.

ACADEMIC HONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION

I teach directly to specific course contents, so simply skipping class and reading a text book is unlikely to lead to success in this course. So, all the students are advised to come to class regularly.

FOR APPROVAL

Course Faculty _____ **CC-Chairperson** _____ **HOD** _____