ECE6022: MODELLING AND SIMULATION

Programme: B.Tech. (ECE) Year: 2015 Semester: EVEN
Course: Core Credits: 4 Hours: 40

Course Context and Overview (100 words): This course will provide Modelling of random variable, stochastic processes, ergodic, wide sense stationary processes, spectrum estimation and system simulation (behavior of system convergence). Review of signal modelling: Mean square, least square based pade's, prony, shanks modelling. Review of processing of random processes: wiener, steepest descent, adaptive systems, Review of channels modelling: discrete channels, Gaussian channel, Rayleigh/Ricean channel modelling in stationary and non-stationary environments. Review of spectrum estimation, periodogram and maximum entropy method based spectrum estimation.

Prerequisites Courses: Probability theory,
Linear Algebra
Digital Signal processing

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1 **Explain** the key concepts of random processes and its properties.
C02 **Explain and analyse** modelling random process with Mean square/ Least square criteria, Processing of random processes, stability, and convergence behaviour.
C03 **Differentiate the characteristic, design understanding and requirements of** deterministic as well as random processes **in different applications like day to day communication,** signal prediction, equalization and detection **etc**.
C04 **List** the various methods for spectrum estimation, channel modelling and modelling and simulation of space/time/frequency diverse systems.
C05 **Simulate and practice** converging solutions of various systems using matlab and Monte-carlo methods.

Course Topics:

Topics	**Lecture Hours**	
UNIT – I **1. Background**		
1.1 Linear Algebra, Signals and systems, Random variable and Random process.	3	9
1.2 Statistical characterization of random processes (Stationary, Wide Sense Stationary, Ergodic)	3	
1.3 Random number generation methods: LCG, Box Muller, Central Limit, Rejection method.	3	

UNIT – II **2. Signal Modelling**		9
2.1 Deterministic Signal Modelling :	1	
2.2 Pade's method, Pony's Method, Shank's method, All Pole Modelling	7	
2.3 Least square error & Minimum Mean square error based Modelling Modeling Random Process: AR, MA, ARMA Processes	1	
UNIT – II **3. System Simulation**		8
3.1 Noise Cancellation, Linear predictor, Optimum Filtering.	2	
3.2 Adaptive systems: Channel estimation, System identification, Equalizer.	6	
UNIT – IV **4. Modeling of functional blocks in communication systems**		8
4.1 Space/Time/Frequency Diversity , OFDM Transceiver	2	
4.2 Wireless fading channel models: Rayleigh, Rician.	3	
4.3 Case study : MIMO-OFDM System	3	
UNIT-V **5. Spectrum Estimation**		6
5.1 Basics of Periodogram	2	
5.2 Minimum variance based estimation	2	
5.3 Maximum Entropy and Frequency based estimation	2	

Textbook references (IEEE format):
Text Book:

1. A. Papoulis, "Probability, Random variables and Stochastic Processes", Tata McGraw Hill.4th Ed.
2. Monson Hayes, "Statistical Signal Processing and Modeling". Wiley Publications, New York.
3. D.G.Manolokis "Statistical and adaptive signal processing, signal modelling". Artech Hosuse, London.

Reference books:

1. David Tse and Vishwanathan "Fundamentals of wireless communication".
2. Bernard Sklar "Digital Communication Fundamentals and Applications".
3. Fuqin ziang "Digital Modulation Techniques".

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):

Evaluation Methods:

Item	Weightage

Seminar Presentation	30
Project	
Midterm	35
Final Examination	35

Prepared By:
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