

**AT77.02      Signals, Systems & Stochastic Processes 3(2-3)**

**Semester: August**

Rationale: To lay the theoretical foundation for understanding the behavior of deterministic and random signals in communication systems, and to complement the theory with extensive laboratory work.

Catalog Description: Fourier Analysis, Linear Systems, Random Variables and Vectors, Stochastic Processes, Spectral Characteristics of Random Signals, Basics in Digital Communication, Introduction to Markov Processes

Pre-requisite: None

Course Outline:

I      Fourier Analysis and Linear Systems

1. Classification and Representation of signals
2. Fourier Series and Transform
3. Impulse Response and Frequency Response of LTI Systems
4. Relation of Spectral Densities of LTI Systems
5. Other Transforms: Hilbert transform
6. Time Variant Systems

II      Random Variables: Discrete and Continuous

1. Random Variables, Probability Distributions and Probability Densities
2. Functions of Random Variables
3. Statistical Averages
4. Real and Complex Random Vectors, Transformations
5. Probability Models
6. Characteristic functions
7. Upper bounds on the Tail Probability

III      Stochastic (Random) Processes

1. Definition
2. Statistics of Random Processes
3. Stationary and Ergodic Processes, Cyclostationary Processes
4. Gaussian Processes, Multivariate probability density functions, Transformations
5. Spectral Characteristics of Random Signals
6. Random Process Characterization: Karhunen-Loeve expansion
7. Random Signals and LTI Systems
8. Noise Processes, White and Colored Noise
9. Noise-Equivalent Bandwidth

IV      Digital Communication Basics

1. Matched Filters
2. Signal Characterization
3. Additive White Gaussian Noise Channel
4. Coherent Detection of Binary Signals in AWGN Channel
5. Error Probabilities for Binary Signalling

6. Optimum Digital Receivers
7. Spectrum control: line codes

V Markov Processes

1. Introduction
2. Chapman-Kolmogorov Equations
3. Classification of States, Limiting Probabilities
4. Discrete time, Discrete State Markov Processes

Text Book:

Lecture Notes, and

A.V. Oppenheim, A.S. Willsky and S.H. Nawab:  
**Signals and Systems**, Prentice Hall, 1997, 2nd Edition

A.B. Carlson, P.B. Crilly and J.C. Rutledge:  
**Communication Systems, An Introduction to Signals and Noise in Electrical Communication**, McGraw Hill, 2002, 4th Edition.

Athanasios Papoulis:  
**Probability, Random Variables, and Stochastic Processes**, Mc-Graw Hill, 1991, 3rd Edition

References

J.G. Proakis:  
Digital Communications, Mc-Graw Hill, 1995, 3<sup>rd</sup> edition

Leon W. Couch II:  
Digital and Analog Communication Systems, Macmillan, 1993

Simon Haykin  
Communication Systems, John Wiley & Sons Inc., 1994

Sheldon M. Ross:  
Introduction to Probability Models, Academic Press Inc., 1993, 5<sup>th</sup> Edition

Alan V. Oppenheim & Alan S. Willsky  
Signals & Systems, Prentice Hall, 1997

M. A. Berger:  
An Introduction to Probability and Stochastic Processes, Springer-Verlag, 1993

S. P. Meyn, R. L. Tweedie:  
Markov Chains and Stochastic Stability, Springer-Verlag, 1993

R. G. Gallager:  
Discrete Stochastic Processes, KAP 1996.

R. Nelson:  
Probability, Stochastic Processes, and Queueing Theory, Springer-Verlag, 1995

J.S. Milton, J.C. Arnold:  
Introduction to Probability and Statistics, McGraw-Hill, 1990

F.G. Stremmer:  
Introduction to Communication Systems, Addison Wesley, 1990

W.B. Davenport, W.L. Root:

An Introduction to the Theory of Random Signals and Noise, IEEE Press, 1987

J. Dunlop, D.G. Smith:

Telecommunications Engineering, Van Nostrand Reinhold Int., 1989

T.H. Glisson:

Introduction to System Analysis, McGraw-Hill, 1987

S. Haykin:

Analog & Digital Communications, John Wiley & Sons, 1989

B.P. Lathi:

Modern Digital and Analog Communication Systems, Holt, Rinehart and Winston, Inc., 1989

P.Z. Peebles, Jr.:

Probability, Random Variables, and Random Signal Principles, McGraw-Hill, 1987

H. Taub, D.L. Shilling:

Principles of Communication Systems, McGraw-Hill, 1987

Wozencraft and Jacobs

Principles of Communication Engineering, John Wiley & Sons, 1965

*Robert Wrede & Murray R. Spiegel*

Schaum's Outline of Advanced Calculus, 2<sup>nd</sup> Edition, 2002

*Glyn James*

Advanced Modern Engineering Mathematics, Prentice Hall, 2004, 3<sup>rd</sup> Edition

IEEE Transactions on Communications

IEEE Communications Magazine

IEE Proceedings- Communications

IEEE Communications Letters

IEEE Transactions on Information Theory

IEE Electronic Letters

IEEE Journal of Selected Areas in Communications

Instructor: Dr. R.M.A.P. Rajatheva

Grading:

Midsem 30%

Assignments 10%

Labs 10%

Final 50%

**Open Book Examination**