

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (COMMUNICATION SYSTEMS ENGG) (05)

INTRODUCTION TO STOCHASTIC CONTROL

SUBJECT CODE: 2730501

M.E. SEM-III

Type of course: Major Elective-IV

Prerequisite: Students taking this course should have complete familiarity with the topics of state variable in automatic control as well as random processing courses. Specifically students should be familiar modeling of state variable systems in different forms, solution of continuous as well as discrete state variable equations. Familiarity with controllability and observability of systems with multiple input and multiple output.

Rationale:

PG Students of EC Engineering need to understand Control of linear, Stochastic Modeling, Markov Chains Poisson Processes, Poisson Processes and Queuing Systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
4	0	2#	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction 1. Stochastic Modeling 2. Probability Review 3. The Major Discrete Distributions 4. Important Continuous Distributions 5. Some Elementary Exercises 6. Useful Functions, Integrals, and Sums	6	15
2	Conditional Probability and Conditional Expectation 1. The Discrete Case 2. The Dice Game Craps 3. Random Sums 4. Conditioning on a Continuous Random Variable	6	15
3	Markov Chains: Introduction 1. Definitions 2. Transition Probability Matrices of a Markov Chain 3. Some Markov Chain Models 4. First Step Analysis 5. Some Special Markov Chains 6. Functions of Random Walks and Success Runs Another Look at First Step Analysis	6	15

	8. Branching Processes 9. Branching Processes and Generating Functions		
4	The Long Run Behavior of Markov Chains 1. Regular Transition Probability Matrices 2. Examples 3. The Classification of States 4. The Basic Limit Theorem of Markov Chains 5. Reducible Markov Chains	4	10
5	Poisson Processes 1. The Poisson Distribution and the Poisson Process 2. The Law of Rare Events 3. Distributions Associated with the Poisson Process 4. The Uniform Distribution and Poisson Processes 5. Spatial Poisson Processes 6. Compound and Marked Poisson Processes	4	10
6	Continuous Time Markov Chains 1. Pure Birth Processes 2. Pure Death Processes 3. Birth and Death Processes 4. The Limiting Behavior of Birth and Death 5. Birth and Death Processes with Absorbing States 6. Finite State Continuous Time Markov Chains 7. A Poisson Process with a Markov Intensity	6	15
7	Renewal Phenomena 1. Definition of a Renewal Process and Related Concepts 2. Some Examples of Renewal Processes 3. The Poisson Process Viewed as a Renewal 4. The Asymptotic Behavior of Renewal Processes 5. Generalizations and Variations on Renewal Processes 6. Discrete Renewal Theory	4	10
8	Queueing Systems 1. Queueing Processes 2. Poisson Arrivals, Exponential Service Times 3. General Service Time Distributions 4. Variations and Extensions 5. Open Acyclic Queueing Networks 6. General Open Networks	6	10

Reference Books:

1. An Introduction To Stochastic Modeling by Howard M.Taylor & Samuel Karlin, Third Edition Academic Press.
2. Stochastic Optimal Linear Estimation and Control, J.S.Meditch, McGraW Hill Book Company, 1969.
3. Breiman, L. Probability and Stochastic Processes with a View Toward Applications. Boston: Houghton Mifflin, 1969.
4. Cinlar, E. Introduction to Stochastic Processes. Englewood Cliffs, N.J.: Prentice-Hall, 1975.

Course Outcome:

By the end of this course, the student should be able to do the followings & this course supports the achievement of the following outcomes:

1. To design the stochastic modeling of electrical and electronics systems.
2. To compare and analyse the performance of Poisson Process, Markov Chains and Queuing system.
3. Ability to apply knowledge of advanced principles to the analysis of electrical & electronics Engineering problems.

List of Experiments:

Experiments are to be designed looking to the given course of content.

Design based Problems (DP)/Open Ended Problem:

1. Example: (Ross, p.257 #30). Three out of every four trucks on the road are followed by a car, while only one out of every five cars is followed by a truck. What fraction of vehicles on the road are trucks?
2. Example: (Ross, p.229 #26, extended). Three out of every four trucks on the road are followed by a car, while only one out of every five cars is followed by a truck. If I see a truck pass me by on the road, on average how many vehicles pass before I see another truck?
3. If $S = \{1, 2\}$ then the transition matrix is $P = \begin{pmatrix} 1 - \alpha & \alpha \\ \beta & 1 - \beta \end{pmatrix}$ where $0 \leq \alpha, \beta \leq 1$

Major Equipments:**C. List of Software:**

MATLAB: Control and Simulink Tool Boxes, Math Works Inc.

List of Open Source Software:

<http://hpme12.me.edu/matlab/html/>

Learning website:

www.nptel.ac.in; IEEE explore

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.