16CE722 STOCHASTIC MODELLING AND QUEUEING THEORY 3-0-0-3

Objectives:

- To Provide a thorough understanding of the mathematical foundations of telecommunication and computer communication networks
- To teach the applications of Markov processes and queueing theory, to analyze the performance and address the design questions in circuit- and packet-switching networks

Keywords:

Markov Chains, Renewal Processes, Queueing Theory, Performance Analysis, Capacity Design

Contents:

Review of Probability and Random Variables - memoryless property of exponential and geometric random variables, moment generating function, Laplace-Stieljes transform (LST) of random variables; Stochastic Processes - stationarity, ergodicity, independence, correlation; Stationary Increment and Independent Increment Processes - Bernoulli trials, Poisson processes, Gaussian processes; Markov Processes - discrete time Markov chains (DTMCs), continuous time Markov chains (CTMCs), recurrence, transience, stability; Renewal Processes and Markov Renewal Processes; Queueing Theory - common queueing models (M/M/1, M/M/1/K, M/M/K/K, M/G/1, M/G/1/K, G/M/1, Geo/Geo/1, M/G/∞), vacation models, loss networks and delay networks, multiclass queueing models with priority, open and closed networks of queues; Fluid and Gaussian approximations; Applications to Telecommunications and Computer Communication Networks – capacity design, dynamic channel allocation and scheduling in 4G/LTE, TCP/IPnetworks and telecommunication switching,throughput and delay analysis in wireless local area networks (WLANs), coverage analysis in wireless sensor networks (WSNs), spreading of computer virus and messages in intermittently connected networks (ICNs/DTNs).

Outcome:

After successfully finishing this course, students will

- Acquire the skill of mapping frequently occurring scenarios in telecommunication and computer networking into standard stochastic models, i.e., they will develop the ability of constructing mathematical models from the physical description of the problems
- Be able to identify appropriate solution methods in each case and physically interpret the mathematical results

TEXT BOOKS / REFERENCES:

1. Kulkarni, Vidyadhar G., *Modeling and Analysis of Stochastic Systems*, CRC Press, 2016.
2. Kumar, Anurag, *Discrete Event Stochastic Processes*,available onlinehttp://ece.iisc.ernet.in/~anurag/books/anurag/spqt.pdf
3. Bertsekas, Dimitri P., and Robert G. Gallager, *Data Networks*, Prentice-Hall International, 1987.
4. Leon-Garcia, Alberto, *Probability, Statistics, and Random Processes for Electrical Engineering*, 3rd ed. Pearson/Prentice Hall, 2008.