Subject Description Form

Subject Code	COMP6705
Subject Title	Advanced Topics in System Modeling and Evaluation
Credit Value	3
Level	6
Pre-requisite / ~~**Co-requisite/**~~ ~~**Exclusion**~~	First course in probability and statistics
Objectives	1. Equip research students with a foundational understanding of the applied probability theory and stochastic processes (renewal theory, queueing theory, Markov process, etc). 2. Expose research students with the applications of the applied probability theory and stochastic processes in the areas of, for example, computer systems and networks, manufacturing, transportations, logistics, operational management, etc.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Acquired a foundational understanding of the frequency-based approach and axiomatic approach to probability. (b) Understand the fundamental concepts and results for a class of renewal processes, including single-server queuing models. (c) Analyze a discrete-event system using an appropriate probabilistic model. (d) Acquire some understanding of advanced techniques for queuing networks and other stochastic problems.
Subject Synopsis/ Indicative Syllabus	1. Applied Probability Theory • The fundamentals: probability space, conditional probability, Bayes' rule, counting. • Random variable and distributions: functions of random variables, covariance and correlation, probability and moment generating functions, etc. • Limit theorems: Markov and Chebyshev Inequalities, Laws of Large Numbers, etc. 2. Stochastic Processes • The Poisson Process and Renewal Theory • The M/G/1 queue: Little's Law, Poisson Arrivals See Time Averages, etc. • Markov processes: Markov chains, ergodicity, generator matrix, etc. • Network of queues 3. Advanced topics • Matrix geometric solutions • Stability analysis • Stochastic comparison • Large Deviation Theory • Self-similarity and long-range dependency

<table>
<tr><td>Teaching/Learning Methodology</td><td>The teaching and learning methodology will be primarily based on lecturing and problem solving. Additional reading of research papers that use the modeling techniques will be assigned, whenever appropriate.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td></td><td></td></tr>
<tr><td>1. Assignments</td><td>50%</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>2. Examination</td><td>50%</td><td>√</td><td>√</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="6"></td></tr>
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Assignment(s): assessment of the theoretic studies with respect to the understanding of the relevant subject matters including new concepts, algorithms and techniques by proving answers to the assignment questions
Exam assessment of the overall performance by written report and oral presentation.</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>Lectures/Tutorials/Labs</td><td>39 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>Reading and doing assignments</td><td>83 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>122 Hrs.</td></tr>
</table></td></tr>
<tr><td>Reading List and References</td><td>
1. R. Nelson, Probability, Stochastic Processes, and Queueing Theory, Springer-Verlag, 1995.
2. D. P. Bertsekas and J. Tsitsiklis, Introduction to Probability, Athena Scientific, 2002.
3. K. Trivedi, Probability and Statistics with Reliability, Queueing, and Computer Science Applications, Second Edition, Wiley-Interscience, 2001.
4. K. Park and W. Willinger, Self-Similar Network Traffic and Performance Evaluation, Wiley, 2000.
5. S. Ross, Stochastic Processes, Second Edition, Wiley, 1996.
6. H. Takagi, Queueing Analysis: A Foundation of Performance Evaluation, vol. 1-3, North-Holland, 1991.
7. M. Molly, Fundamentals of Performance Modeling, Macmillan, 1989.
8. R. Wolff, Stochastic Modeling and the Theory of Queues, Prentice-Hall, 1989.
9. R. Larson and A. Odoni, Urban Operations Research, Prentice-Hall, 1981.
10. L. Kleinrock, Queueing Systems, vol. 1-2, Wiley, 1976.</td></tr>
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