**Course Outline for :**

***CSE3101: Mathematical Analysis for Computer Science***

Spring, 2016

**Credits:** 3 hours per week, 3 Cr.

**Year:** 3rd **Semester:** 1st

**Pre-requisite:** CSE1203, MATH2101

**Primary Textbooks:**

1. ***Concrete Mathematics: A Foundation for Computer Science*** *(2nd Edition)*

*–* by Ronald L. Graham, Donald E. Knuth, Oren Patashnik

1. ***Introduction to Probability Models*** (Eighth Edition)

– by Sheldon M. Ross

**Instructor:**

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**Course Description:**

Basic mathematical analysis techniques of algorithms: sums and products, binomial coefficients, harmonic numbers, Fibonacci numbers, recurrence relations; generating functions; Probability Distributions and Expectations: total probability and Bayes’ rule, discrete probability distributions (geometric, modified geometric, Poisson etc.), continuous probability distributions; Stochastic processes: definitions and classifications, discrete- parameter Markov chains, Continuous-parameter Markov chains; Queuing theory, Networks of queues: tandem networks, open and closed queuing models.

**Grading Policy:**

Attendance : 10%

Quizzes : 20%

Final Exam : 70%

***Course Plan***

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| **Week** | **Topics** |
| 1 | ***Recurrent Problems*:** Towers of Hanoi, Lines in the plane, Josephus problem, Binary properties of Josephus problem, Generalized version of Josephus problem, Radix based solution of general recurrence. |
| 2–3 | ***Sums*:** Notation, Manipulation of Sums, Converting a sum into a recurrence, Converting a recurrence into a sum, General methods, Summation factor, Quick sort recurrence, Harmonic number, Finding closed form by index replacement, Perturbation technique. |
| 4 | ***Integer Functions*:**Floors and Ceilings, Floor/Ceiling Applications, Floor/Ceiling recurrences, MOD: the binary operation.  **Quiz #1** |
| 5–6 | ***Number Theory*:** Divisibility, Stein’s algorithm to find GCD, Euclid’s algorithm to find GCD, Prime numbers, Composite numbers, Fibonacci numbers, Special numbers, Factorial Factors, Stern-Brocot tree. |
| 7 | ***Bionomial Coefficients*:** Basic identities, Symmetry identity, Absorption identity, Addition formula, Upper and Parallel summation. **Quiz#2** |
| 8 | ***Introduction to Probability Theory*:** Introduction, sample space and events, probabilities defined on events, conditional probabilities, independent events, Bayes’ formula. |
| 9–10 | ***Random Variables*:** Random variables, Discrete random variables, Continuous random variables, Expectation and variance of random variables, Stochastic process.  **Quiz#3** |
| 11 | ***Markov Chains*:** Discrete-parameter Markov chains, continuous-parameter Markov chains, Applications, The Gambler’s ruin problem. |
| 12 | ***Queuing Theory*:** Queuing model, Steady state probabilities, M/M/1 Queue, M/M/1 Queue with Finite Capacity, M/G/1 Queue, Network of queues, Open and closed queuing models.  **Quiz#4** |
| 13 | Review classes. |