INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

RANDOMIZED ALGORITHMS								
VII Semester: CSE (AI&ML)								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACAD25	Elective	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisites: Probability and Statistics / Deep Learning								

I. COURSE OVERVIEW:

A randomized algorithm is a technique that uses a source of randomness as part of its logic. It is typically used to reduce either the running time, or time complexity; or the memory used, or space complexity, in a standard algorithm. It covers randomized algorithms, distributions, Chernoff's Bounds and its Applications, Markov Chains and Random Walks Markov chains – representations. Randomized algorithms have various applications in computer science and mathematics, such as cryptography, data structures, machine learning, optimization, and computational geometry.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The concept of randomized algorithms and the concepts of probabilistic analysis of algorithms.
II. deriving good upper bounds for the expected running time of simple randomized algorithm.
III. The performance of randomized algorithms and to design simple randomized algorithms that run faster or return correct output with high probability.

III. COURSE OUTCOMES:

At the end of the course, student should be able to:

CO1 Explain the mathematical foundations for emphasizing the design and analysis of randomized algorithms.
CO2 Apply basics of probability theory for the analysis of algorithms.
CO3 Outline the randomized algorithms and their advantages to traditional algorithms.
CO4 Demonstrate Packet routing in sparse networks - permutation routing on the hypercube and butterfly for efficient routing algorithms.
CO5 Implement randomized techniques in solving real world problems.
CO6 Design randomized algorithms and analyzed their performance for Markov Chains and Random Walks Markov chains.

IV. COURSE CONTENT:

MODULE – I: PROBABILITY AND COMPUTING (09)
Probability and Computing Elements of probability theory - Verification of strings - poly identities - matrix multiplication - Las Vegas and Monte Carlo algorithms - Expectations - Jensen's Inequality - Coupon collector's problem - geometric distribution. .

MODULE – II: EXPECTATIONS (09)
Expectations, Moments and Inequalities Randomized Quick Sort and its expected run-time - Variance and moments - Chebyshev's inequality - Coupon collector's problem - randomized median finding - analysis - moment generating functions.

MODULE – III: CHERNOFF'S BOUNDS AND ITS APPLICATIONS (10)
Chernoff's Bounds and its Applications Derivation and application of Chernoff's bounds - Sum of Poisson Trials - Coin flips.

Set balancing - Packet routing in sparse networks - permutation routing on the hypercube - butterfly.

MODULE – IV: BALLS, BINS, AND RANDOM GRAPHS (10)
Balls, Bins and Random Graphs Birthday paradox - balls and bins model - application to bucket sort - Poisson distribution - Application to hashing - random graph models - Hamiltonian cycles in random graphs.

MODULE – V: MARKOV MODEL (10)
Markov Chains and Random Walks Markov chains - representations - randomized algorithm for 2-satisfiability and 3-satisfiability - classification of states - gambler's ruin - random walks on undirected graphs - s-t connectivity algorithm.

V. TEXTBOOKS:

1. M. Mitzenmacher, E. Upfal, "Probability and Computing: Randomized Algorithms and Probabilistic Analysis", Cambridge, 2005.
2. Rajeev Motwani, Prabhakar Raghavan, " Randomied Algorithms", Cambridge University Press,2013.

VI. REFERENCE BOOKS:

1. Juraj HromkoviČ, "Design and Analysis of Randomized Algorithms", Springer, 2005.

VII. WEB REFERENCES

1. https://ocw.mit.edu/courses/6-856j-randomized-algorithms-fall-2002/
2. https://courses.csail.mit.edu/6.856/current/
3. https://ocw.mit.edu/courses/6-856j-randomized-algorithms-fall-2002/pages/lecture-notes/

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper – II

9. Lecture notes
10. PowerPoint presentation
11. E-Learning Readiness Videos (ELRV)