Proposal for Course Update
Department of Electrical Engineering, IIT Kanpur

1. **Course No.:** EE621
2. **Course Title:** Foundations of Probability
3. **Proposing Department:** Electrical Engineering
4. **Other Departments:** CSE, IS
5. **Proposer:** Washim Uddin Mondal (EE)
6. **Other Interested Faculty:** Subrahmanya Swamy Peruru, Abhishek Gupta, Adrish Banerjee.
7. **Units:** [9] (3-0-0-0)
8. **Duration of the Course:** Full semester.
9. **Pre-requisites:** None.
10. **Course Description:** The course introduces foundational concepts in probability and stochastic processes, primarily targeted for first-year PG students in M. Tech., MS, and Ph. D. programs.

No.	Broad Title	Topics	Hours
1	Preliminaries	Set Theory, Functions, Pre-images, Countability	3
2	Probability Spaces	Sample Space, σ-algebra, Generated σ-algebra, Borel σ-algebra, Probability Measure and its Continuity, Independent Events, Conditional Probability, Combinatorics	6
3	Random Variables	Measurability, Induced Measure, CDF, Discrete RVs, PMF, Bernoulli, Geometric, Poisson, Binomial, Negative Binomial, Hypergeometric RVs, Continuous RVs, PDF, Uniform, Exponential, Normal, Gamma, Beta RVs	7
4	Transformations	Borel-measurable maps, Affine Transformations, Bijective maps, Examples: Pareto, Chi-Squared, Rayleigh, Log-Normal RVs	3
5	Expectation	Raw and Central Moments, Applications to Special RVs, Moment Generating Functions, Linearity	3
6	Multiple RVs	Measurability, Joint CDF, PDF, PMF, Independent and Identically Distributed RVs, Applications to Special RVs, Distribution of Sum, Product, Ratio of RVs, Expectation, Variance, Correlation, Order Statistics, Transformations, Conditional PMF and PDF, Conditional Expectation	8
7	Sequence of RVs	Types of Convergence, Concentration Bounds: Markov, Chebyshev, Chernoff, Law of Large Numbers, CLT	3
8	Stochastic Processes	Symmetric and Asymmetric Random Walk, Stationarity, Ergodicity, Autocorrelation, White Gaussian Process, Discrete and Continuous time Markov Chains, Chapman-Kolmogorov Equations	6

11. **Short Summary for Course Booklet:** The course covers topics in Sample Spaces, σ-algebra, Borel σ-algebra, Probability Measure, Independent Events, Random Variables, Transformations of Random Variables, Expectation, Moment Generating Functions, Joint Distributions, Independent and Correlated Random Variables, Conditional Expectation, Sequence of Random Variables, Concentration Bounds, Law of Large Numbers, Central Limit Theorem, Stochastic Process, Stationarity, Ergodicity, White Gaussian Process and Markov Chains.

12. **References:**

[1] Sheldon Ross, "A First Course in Probability", Prentice Hall, 8th Edition.

[2] A. Papoulis and S. Pillai, "Probability, Random Variables, and Stochastic Processes", McGrawHill, 4th Edition.

[3] P. Billingsley, "Probability and Measure", John Wiley & Sons.

Proposer: Washim Uddin Mondal

Convener, DPGC

Chairperson, SPGC