Syllabus for Q Exam on Probability and Random Processes


**Basic concepts:** sample spaces, probability measures, outcomes, events, combinatorial approaches to computing probabilities, conditioning, total probability, independence, Bayes’ rule;

**Random variables:** definition of, probability mass functions (PMFs), probability density functions (PDFs), cumulative distribution functions (CDFs), commonly-used distributions, expectations, characteristic functions, moment inequalities;

**Random vectors:** definition of, joint PMFs, PDFs, and CDFs, joint characteristic functions, conditional distributions and conditional expectation, joint moments, covariance matrices and their properties, jointly Gaussian random variables;

**Limit theorems:** law of large numbers, central limit theorem

**Estimation:** LLSE and MMSE estimators

**Detection:** MAP and ML detectors

**Second-order random processes:** stationarity and wide-sense stationarity, autocorrelation, power spectral density, white noise, filtered random processes;

**Discrete-time Markov chains:** definition, conditions for stationarity, \(n\)-step transition probabilities, stationary distributions, occupancy rates;

**Continuous-time Markov chains:** definition, conditions for stationarity, the forward and backward equations, Poisson processes, the M/M/1 queue, occupancy rates.