Part I PhD (Statistics) Comprehensive Exam Syllabus

Summary of the Syllabus:

Exam 1 – Probability (at the level of Stat 2410 – Introduction to Probability Theory) and Mathematical Statistics (at the level of Stat 2410 & the corresponding topics from Stat 3411 – Statistical Inference I: sampling distributions, order statistics)

Exam 2 – Statistical Inference (at the level of Stat 3411 – Statistical Inference I: other Stat 3411 topics than the first exam) and Regression (at the level of Stat 3521 – Regression)

Exam 3 – Experimental Design (at the level of Stat 3520 – Experimental Design I) and Sampling Techniques (at the level of Stat 4530 – Survey Sampling)

Detailed Syllabus:

Exam 1 (at the level of Statistics 2410 and the corresponding topics of Statistics 3411)

Introduction to Probability Theory and Mathematical Statistics which cover combinatorial analysis, axioms of probability, conditional probability, independence, random variables, distribution function, mathematical expectation, Markov Inequality, Chebyshev's inequality, joint distribution of two random variables, binomial and related distributions, Poisson, gamma, beta, normal, student t and F distributions, functions of random variables, convergence in probability, convergence in distribution, central limit theorem, sampling distributions, order statistics.

Reference: a) *Introduction to Mathematical Statistics* by R.V. Hogg, J.W. McKean and A.T. Craig, Boston: Pearson 2019, 8th edition.
Chapters covered: Chapters 1-3 (excluding 3.7), Section 4.4, Chapter 5 (excluding 5.4).

b) Introduction to Probability (CH1-CH10) by Grinstead and Snell (https://math.dartmouth.edu/~prob/prob/prob.pdf)
c) Statistical Modeling and Computation (CH1-CH3) by Kroese and Chan (https://people.smp.uq.edu.au/DirkKroese/statbook_part1.pdf)

Exam 2 (at the level of Statistics 3411 and Statistics 3521)

Statistical Inference which covers confidence interval, hypotheses testing, chi-square tests, maximum likelihood estimation, maximum likelihood estimation, Rao-Cramér inequality and efficiency, maximum likelihood tests, sufficiency, completeness and uniqueness, exponential class of distributions, likelihood ratio test, Neyman-Pearson lemma.

Reference: *Introduction to Mathematical Statistics* by R.V. Hogg, J.W. McKean and A.T. Craig, Pearson, 8th edition.
Chapters covered: Sections 4.1- 4.2, 4.5, Chapter 6 (excluding 6.6), Chapter 7, Sections 8.1-8.3.

Regression which covers inferences in linear regression analysis including estimation, confidence and prediction intervals, hypotheses testing and simultaneous inference; matrix approach to regression analysis, multiple linear regression, multicollinearity, model building and selection, polynomial regression, qualitative predictor variables.

References: a) *Applied Linear Statistical Models* by Kutner, Nachtsheim, Neter and Li
Chapters covered: Chapters 1-2, Sections 3.1-3.9, Chapters 5, 6, Sections 7.1-7.4, 7.6, 8.3, 9.3, 9.4.

b) Introduction to Linear Regression Analysis by Montgomery, Peck and Vining, 5th edition, Wiley. Chapters covered: 1-6, 8-10.

Exam 3 (at the level of Statistics 3520 and Statistics 4530)

Experimental Design which covers basic concepts in experimental design, including principles of experimentation; single factor designs such as completely randomized designs; randomized block designs; Latin square designs; Graeco Latin square designs; multiple comparison tests; analysis of covariance; balanced incomplete block designs; factorial designs; fixed, random and mixed effects models.

Reference: *Design and Analysis of Experiments*, by D.C. Montgomery, Wiley 2019, 10th edition.
Chapters covered: Chapters 1, 2, Sections 3.1, 3.2, 3.3, 3.4 (excluding Bartlett's test), Section 3.5, Section 3.8 (excluding Section 3.8.3), Sections 3.10 and 3.11, Chapter 4 (excluding Section 4.4.3), Section 5.1, Section 5.2, Section 5.3 (excluding Section 5.3.5), Section 5.4, Sections 13.1, 13.2 and 13.3, on-line materials for analysis covariance (or Section 15.3 in 8th edition).

Survey Sampling which covers simple random sampling, unequal probability sampling and the Horvitz-Thompson principle, sufficiency, design and modelling in sampling, ratio and regression estimators, stratified and cluster sampling.

Reference: *Sampling*, by S.K. Thompson, Wiley 2012, 3rd edition.
Chapters covered: Chapters 1-8, Chapters 11 and 12 (excluding 12.4).