Semester	**Seven**
Course	**Major**
Paper Code	
Paper Title	**Advanced Sampling Techniques and Experimental Design**
No. of Credits	**6**
Theory/Composite/ Practical	**Theory**
Minimum No. of preparatory hours per week a student has to devote	**4** **Module 1: 3 periods/week** **Module 2: 1 period/week**
Number of Modules	**2**
Syllabus	**Module 1: Advanced Sampling Techniques** **UNIT 1:** ***Systematic Sampling:*** Technique, estimates of population mean and total, variances of these estimates ($N = n \times k$case). Comparison of systematic sampling with SRS and stratified sampling in the presence of linear trend and corrections. Basic idea of modification of the scheme for $N \neq n \times k$ case. [4L] **UNIT 2:** ***Cluster and Two-stage sampling:*** Technique (equal cluster sizes), estimation of population mean and its variance. Motivation of two-stage sampling, description of the scheme, estimation of population mean and variance of the estimate. Estimation of sample sizes (f.s.u. and s.s.u.). Comparison among two-stage, cluster and direct sampling. [10L] **UNIT 3:** ***Use of Auxiliary variable:*** Ratio and Regression methods of estimation in simple random sampling. Description of the scheme and suggested estimator of the population mean/total. Comparison of these estimators with usual mean per unit estimator. Hartley-Ross estimator. Modification of the scheme and estimator when population total/mean of auxiliary variable is unknown. Double sampling. [10L] **UNIT 4:** ***Probability Proportional to Size Sampling*:** Concepts of probability proportional to size (PPS) sampling, selection of samples with and without replacement, estimation of population total and variance using Horvitz-Thompson, Hansen-Hurwitz and Desraj estimator. [10L] **UNIT 5:** ***Some Special sampling techniques:*** Warner's model and estimation of population proportions using randomized response technique(RRT). Snowball sampling. [5L] **Module II: Experimental Design** **UNIT 1:** ***Incomplete Block Designs (IBD):*** Definition and application. Balanced and imbalanced IBD. Properties and construction of balanced IBD. [6L] **UNIT 2 :**

	Response surface design: Introduction, First order model and method of steepest ascent/descent. Second order model and canonical analysis. Rotatability and orthogonality. Applications. [7L]	
Learning Outcomes	1. Understand the concepts of systematic, cluster, two-stage, ratio–regression, PPS, and special sampling techniques (RRT, snowball). 2. Apply estimators of population mean, total, and variance in systematic, cluster, two-stage, and PPS sampling. 3. Analyze and compare the efficiency of Systematic Sampling with SRS and Stratified Sampling, and Two-stage Sampling with Cluster and Direct Sampling. 4. Evaluate ratio, regression estimators, assessing their suitability and efficiency in different survey designs. 5. Design a survey framework using suitable sampling methods. 6. Create an incomplete block design. 7. Remember the properties of an incomplete block design. 8. Understand response surface designs.	
Reading/Reference List	1. Cochran, W.G. (1984): Sampling Techniques (3rd Ed.), Wiley Eastern. 2. Sukhatme, P.V., Sukhatme, B.V. Sukhatme, S. Asok, C. (1984). Sampling Theories of Survey with Application, IOWA State University Press and Indian Society of Agricultural Statistics. 3. Murthy, M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta. 4. Des Raj and Chandhok P. (1998): Sample Survey Theory, Narosa Publishing House. 5. Goon A.M., Gupta M.K. and Dasgupta B. (2008): Fundamentals of Statistics, Vol-II, World Press. 6. Dean, A. and Voss, D. (2006): Design and Analysis of Experiments. Springer. 7. Cochran, W.G. and Cox, G.M. (1959): Experimental Design. Asia Publishing House. 8. Dey, A. (1986) : Theory of Block Designs. Wiley Eastern Limited. 9. Montgomery, D. C. (2008): Design and Analysis of Experiments. John Wiley. 11. Kempthorne, O. (1965): The Design and Analysis of Experiments. John Wiley.	
Evaluation	CIA: 30 End-Sem: 70 Total: 100	
Paper Structure for Semester Exam	**Module 1 (55 marks)**	**Module 2 (15 marks)**
	Short questions (5 marks each): 2 out of 3 Long questions (15 marks each): 3 out of 5	Long questions (15 marks each): 1 out of 2