

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

CLASS: IMSc.
BRANCH: QEDS

SEMESTER : IV
SESSION : SP/2023

SUBJECT: ED223 SAMPLING TECHNIQUES & DESIGN OF EXPERIMENTS

TIME: 3 HOURS

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

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| Q.1(a) Define Population, Sample and Census along with appropriate examples. | [5] | 1 |
| Q.1(b) Discuss the advantages and disadvantages of sampling over complete enumeration. | [5] | |
| Q.2 For the following population, consider all possible srsWOR-samples of size 3 and show that \bar{y} and s^2 are respectively unbiased estimators of \bar{Y} and S^2 . Calculate the sampling variance of \bar{y} and show that it agrees with the formula $(N-n) S^2 / (Nn)$. | [10] | 2 |
| Q.3 In stratified sampling, find the optimal choice of sample size based on the cost of survey and variability. Consider the cases of minimizing variability for fixed cost and minimize cost for a given variability separately in order to find the optimal choices. | [10] | 3 |
| Q.4 In respect to vascular grafts (artificial veins) production, a medical device manufacturer decides to investigate the effect of four different levels of extrusion pressure on flicks using a randomized complete block design, considering batches of resins as blocks. The design is presented in the following table. Perform the appropriate testing of hypothesis. ($F_{0.05,3,15} = 3.29$) | | |

EXTRUSION PRESSURE	BATCH OF RESIN					
	1	2	3	4	5	6
8500	90.3	89.2	98.2	93.9	87.4	97.9
8700	92.5	89.5	90.6	94.7	87.0	95.8
8900	85.5	90.8	89.6	86.2	88.0	93.4
9100	82.5	89.5	85.6	87.4	78.9	90.7

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| Q.5(a) An engineer is interested in the effects of cutting speed (A), tool geometry (B), and cutting angle (C) on the life (in hours) of a machine tool. Three replicates of a 2^3 factorial design are run, and the results are as follows: | | [10] 4 |
| | | [5] 5 |

Treatment Combinations	Replicate I	Replicate II	Replicate III
(1)	22	31	25
a	32	43	29
b	35	34	50
ab	55	47	46
c	44	45	38
ac	40	37	36
bc	60	50	54
abc	39	41	47

- Estimate the factor effects.
- Q.5(b) Use the analysis of variance to check whether the levels of each factor have the same effect or not. [5]