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- **SUBJECT** – DESIGN AND ANALYSIS OF EXPERIMENTS

Question 1: Hardness Testing Machine

a. Appropriate Design:

The appropriate design for comparing the effectiveness of the four tip types in producing significantly different hardness readings would be a completely randomized design (CRD). In a CRD, each coupon is randomly assigned to one of the four tip types, ensuring that any observed differences in hardness readings are due to the tip type and not to any other confounding factors.

b. Response Variable and Factors:

Response Variable: Hardness of the coupon (measured by the depth of the depression).

Factors:

Tip Type: The four different types of tips being tested.

Coupon Type: The four different types of coupons on which the hardness is being tested.

c. Model to be Used:

A one-way analysis of variance (ANOVA) model would be appropriate for analyzing the data. The ANOVA model tests whether there are any statistically significant differences in the mean hardness readings among the four tip types. The model can be represented as:

$Yij=\mu+\tau i+\epsilon ij$ $Y_{ij}=\mu+\tau_i+\epsilon_{ij}$

Where:

Yij Y_{ij} = Hardness reading for the jth coupon with the ith tip type.

$\mu\mu$ = Overall mean hardness.

τi τ_i = Effect of the ith tip type (i=1,2,3,4 i=1,2,3,4).

ϵij ϵ_{ij} = Random error term.

Question 2: ANOVA for Car Safety Examination

a. Design Used:

The design used in this problem is a completely randomized design (CRD). Each treatment (car type) is randomly assigned to a sample of four cars.

b. ANOVA Table:

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-ratio
Treatment (Between)	SST = ?	dfT = ?	MST = ?	F = ?
Error (Within)	SSE = ?	dfE = ?	MSE = ?	
Total	SSTotal = ?	dfTotal = ?		

(Note: "?" denotes values to be calculated)

In this ANOVA table, we need to calculate the sum of squares (SS), degrees of freedom (df), and mean squares (MS) for both the treatment (between) and error (within) sources of variation. Then, the F-ratio is calculated as the ratio of MST to MSE.