

M. TECH.-III (MECHANICAL CAD/CAM) (CBCS – 2015 COURSE) :
WINTER - 2017

SUBJECT : ELECTIVE – II: DESIGN OF EXPERIMENT

Day : **Thursday**
Date : **18/01/2018**

Time : **11.00 AM TO 02.00 PM**
Max. Marks : 60

W-2017-2927

N.B.:

- 1) All questions are **COMPULSORY**.
- 2) Figures to the right indicate **FULL** marks.
- 3) Use of non-programmable **CALCULATOR** is allowed.
- 4) Answers to both the sections should be written in **SEPARATE** answer books.
- 5) Use of F – distribution, t – distribution and standard normal distribution table is **ALLOWED**.

SECTION – I

- Q.1** Suppose that you want to design an experiment to study the proportion of unpopped kernels of popcorn. Complete the steps 1 – 3 (Pre-experimental planning) of the guidelines for design of experiment. **[10]**

OR

Explain in detail guidelines for designing experiment.

- Q.2** A new filtering device is installed in a chemical unit. Before its installation, a random sample yielded the following information about the percentage of impurity: $\bar{y}_1 = 12.5$, $S_1^2 = 101.17$ and $n_1 = 8$. After installation, a random sample yielded $\bar{y}_2 = 10.2$, $S_2^2 = 94.73$ and $n_2 = 9$. **[10]**

- a) Can you conclude that the two variances are equal? Use $\alpha = 0.05$.
- b) Has the filtering device reduced the percentage of impurity significantly? Use $\alpha = 0.05$.

OR

The shelf life of a carbonated beverage is of interest. Ten bottles are randomly selected and tested and the following results are obtained:

Days	
108	138
124	163
124	159
106	134
115	139

- a) We would like to demonstrate that the mean shelf life exceeds 120 days. Set up appropriate hypotheses for investigating this claim.
 - b) Test these hypotheses using $\alpha = 0.01$. What are your conclusions?
- Q.3** An experiment was run to determine whether four specific firing temperature affect the density of a certain type of brick. The experiment to the following data:

Temperature	Density				
	21.8	21.9	21.7	21.6	21.7
100	21.8	21.9	21.7	21.6	21.7
125	21.7	21.4	21.5	21.4	--
150	21.9	21.8	21.8	21.6	21.5
175	21.9	21.7	21.8	21.4	--

Does the firing temperature affect the density of the bricks? Use $\alpha = 0.05$.

OR

Explain analysis of variance for a single factor. Derive the relations and construct ANOVA table.

P.T.O.

SECTION – II

- Q.4** An experiment to investigate warping of copper plates. The two factors studied [10] were the temperature and the copper content of the plates. The response variable was a measure of the amount of warping. The data were as follows:

Temperature (⁰ C)	Copper Content (%)			
	40	60	80	100
50	17, 20	16, 21	24, 22	28, 27
75	12, 9	18, 13	17, 12	27, 31
100	16, 12	18, 21	25, 23	30, 23
125	21, 17	23, 21	23, 22	29, 31

Prepare ANOVA table.

OR

Explain statistical analysis of fixed effect.

- Q.5** An engineer is interested in the effects of cutting speed (A), tool geometry (B) [10] and cutting angle (C) on the life (in hours) of a machine tool. Two levels of each factor are chosen, and three replicates of a 2³ factorial design are run. The results follow:

A	B	C	Treatment Combination	Replicate		
				I	II	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

- a) Estimate the factor effects. Which effects appear to be large?
 b) Use the analysis of variance to confirm your conclusions for part (a).

OR

Explain in detail two factor two level ANOVA. How the regression model is developed?

- Q.6** Explain CCD for fitting second order model with neat sketches. [10]

OR

The region of experimentation for two factors are temperature ($100 \leq T \leq 300^{\circ}\text{F}$) and catalyst feed rate ($10 \leq C \leq 30 \text{ lb/in}$). A first-order model in the usual ± 1 coded variable has been fit to a molecular weight response, yielding the following model:

$$\hat{y} = 2000 + 125x_1 + 40x_2$$

- a) Find the path of steepest ascent.
 b) It is desired to move to a region where molecular weights are above 2500. Based on the information you have from experimentation in this region, about how many steps along the path of steepest ascent might be required to move to the region of interest?

* * * *