University of Mumbai

Examinations Summer 2022

1T01435 / / T.E.(Mechanical) Engineering)(SEM-V)(CBCGS) ((R- 19) (C Scheme)

32626 / / Design of Exaperiments

SET-1

Time: 2 hour 30 minutes Max. Marks: 80

Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**	**20 marks**
	Questions 1,2&3 are based on the following case A manufacturer of television sets is interested in the effect of tube conductivity of four different types of coating for color picture tubes. The following conductivity data are obtained (Use α=0.05)	

Coting type	conductivity			
1	143	141	150	146
2	152	149	137	143
3	134	136	132	127
4	129	127	132	129

1.	The mean square of the model is	
Option A:	281.56	
Option B:	844.69	
Option C:	19.69	
Option D:	236.25	
2.	Degree of freedom of the model is	
Option A:	12	
Option B:	3	
Option C:	13	
Option D:	4	
3	Degree of freedom of the error is	
Option A:	12	
Option B:	3	
Option C:	13	
Option D:	4	
4.	The basic principles of experimental design are	
Option A:	randomization, repetition, blocking	
Option B:	repetition, randomization, factorization	
Option C:	replication, blocking, randomization	
Option D:	Optimization, blocking, factorization	
5.	The analysis procedure used for experimental data with uncontrollable and measurable nuisance factor is	
Option A:	blocking	
Option B:	analysis of covariance	
Option C:	analysis of variance	

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Option D:	none of these	
6.	An independent repeat run of each factor combinations is called	
Option A:	Replication	
Option B:	Randomization	
Option C:	Blocking	
Option D:	Repeated measurement	
7.	ANOVA stands for…..	
Option A:	Analysis of Variance	
Option B:	Analysis of Value	
Option C:	Analysis of Virtue	
Option D:	Analysis of Variety	
8.	A technique of statistical interference used to assist the experimenter in compering two formulations is known as	
Option A:	Hypothesis testing	
Option B:	Factor testing	
Option C:	Variable testing	
Option D:	Level testing	

Questions 9&10 are based on the following case:
A chemist wishes to test the effect of four chemical agents on the strength of a particular type of cloth. Because there might be variability from one bolt to another, the chemist decides to use a randomized block design, with the bolts of cloth considered as blocks. She selects five bolts and applies all four chemicals in random order to each bolt. The resulting tensile strengths as follows (use α=0.05)

chemical	bolt				
	1	2	3	4	5
1	73	68	74	71	67
2	73	67	75	72	70
3	75	68	78	73	68
4	73	71	75	75	69

9.	Mean square value of block in this experiment is	
Option A:	4.32	
Option B:	1.82	
Option C:	39.25	
Option D:	12.95	
10.	Mean square value of treatment in this experiment is	
Option A:	4.32	
Option B:	1.82	
Option C:	39.25	
Option D:	12.95	
Q.2	**Solve any Four out of Five (5 marks each)**	**20 marks**
A	Write a note on Latin Square Design with example.	
B	Define the Hypothesis in DOE.	

C	Define the Population in DOE.	
D	Define the Sample in DOE	
E	Why is randomization important in an experiment?	
Q.3	**Solve any Two Questions out of Three (10 marks each)**	**20 marks**
A	List Guidelines for Designing Experiments and explain any one	
B	Table presents the effective life (in hours) observed in the battery design example. Do the Analysis of Variance for Battery Life Data and find Sum of Square, Degrees of Freedom, and fill it in tabular format given.	

Material type	Temperature (^{0}F)					
	15		70		125	
1	130	155	34	40	20	70
	74	180	80	75	82	58
2	150	188	136	122	25	70
	159	126	106	115	58	45
3	138	110	174	120	96	104
	168	160	150	139	82	60

The Analysis of Variance Table for the Two-Factor Factorial, Fixed Effects Model

Source of Variation	**Sum of Squares**	**Degrees of Freedom**	**Mean Square**	***F*0**
A treatments				
B treatments				
Interaction				
Error				
Total				

C	Explain in detail Basic Principles of Randomization	
Q.4	**Solve any Two out of Three (10 marks each)**	**20 marks**
A	A soft drink bottler is interested in obtaining more uniform fill heights in the bottles produced by his manufacturing process. The filling machine theoretically fills each bottle to the correct target height, but in practice, there is variation around this target, and the bottler would like to understand the sources of this variability better and eventually reduce it. The process engineer can control three variables during the filling process: the percent carbonation (*A*), the operating pressure in the filler (*B*), and the bottles produced per minute or the line speed (*C*). The pressure and speed are easy to control, but the percent carbonation is more difficult to control during actual manufacturing because it varies with product temperature. However, for purposes of an experiment, the engineer can control carbonation at three levels: 10, 12, and 14 percent. She chooses two levels for pressure (25 and 30 psi) and two levels for line speed (200 and 250 bpm). She decides to run	

	two replicates of a factorial design in these three factors, with all 24 runs taken in random order. The response variable observed is the average deviation from the target fill height observed in a production run of bottles at each set of conditions. The data that resulted from this experiment are shown in Table Positive deviations are fill heights above the target, whereas negative deviations are fill heights below the target.	

Percent Carbonation(A)	Operating pressure(B)			
	25 psi		30psi	
	Line speed (c)		Line speed (c)	
	200	250	200	250
10	-3	-1	-1	1
	-1	0	0	1
12	0	2	2	6
	1	1	3	5
14	5	7	7	10
	4	6	9	11

	Do the Analysis of Variance for Battery Life Data and find Sum of Square, Degrees of Freedom	
B	Write and explain the stapes to be consider while Using Statistical Techniques in Experimentation.	
C	What are the potential risks of a single large, comprehensive experiment in contrast to a sequential approach?	