ii. List 10 desirable design features of a response surface design. 10 3 4 3

(OR)

b. Write in detail about CCD and Box-Behnken methods. 12 3 4 4

32. a. Different types of oranges (1-3) form 4 different orchards (A-C) were compared. Find out its significance using two-way ANOVA. 12 4 5 2

Types →		1	2	3
Location	A	18	13	12
	B	20	23	21
	C	11	17	10

(OR)

b. To assess the relationship between sintering time of 100, 150 and 200 minutes and strength of 3 different metals, 27 experiments were conducted. Complete the ANOVa table and answer the following: 12 4 5 3

(1) What design was employed?
(2) What is the total number of observations?
(3) What is the contribution of each factor?
(4) At 5% significance level, can we conclude whether a metal type has a different effect or not?

Source of variations	DOF	Sum of square	Mean squares	F	P
Sintering time	?	8.22	4.11	1.71	0.244
Metal type	?	20.22	?	4.2	0.0318
Sintering time X metal type?	?	46.22	11.55	?	0.0082
Error	18	?	2.407		
Total	?	118.0			

* * * * *

Reg. No.														

B.Tech. DEGREE EXAMINATION, MAY 2023

Fifth to Seventh Semester

18MEO113T – DESIGN OF EXPERIMENTS

(For the candidates admitted from the academic year 2018-2019 to 2021-2022)

Note:

(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

(ii) **Part - B & Part - C** should be answered in answer booklet.

Time: 3 hours Max. Marks: 100

	Marks	BL	CO	PO

PART – A (20 × 1 = 20 Marks)

Answer **ALL** Questions

1. A _____ is a series of runs or tests. 1 1 1 3
   (A) Objective (B) Factor
   (C) Experiment (D) Response

2. A process affected minimally by external sources of variability is called _____. 1 2 1 3
   (A) Reliability (B) Robust design
   (C) Preventive maintenance (D) Variability

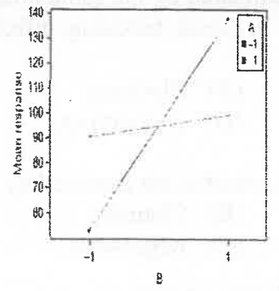
3. Which of these methods produces a poor interaction response? 1 2 1 3
   (A) Several factors at a time (B) 2^k factorial design
   (C) Full-factorial design (D) One factor at a time

4. If the standard deviation is minimal from an experiment, it implies that the experiment is _____. 1 2 1 3
   (A) Precise (B) Simple
   (C) Uncertain (D) Random

5. Identifying which factors affect the outcome of a response is called _____. 1 1 1 3
   (A) Response surface (B) Characterisation
   (C) Process variables (D) Central composite design

6. What information does the sign of the main effect provide? 1 2 1 3
   (A) Direction of the effect (B) Strength of the effect
   (C) Magnitude of the effect (D) Interaction strength

7. What kind of interaction is presented in this diagram? 1 2 1 3



   (A) Mutually exclusive (B) Cross over
   (C) Antagonistic (D) Synergistic

8. A formal way to seek the direction of maximum improvement in optimization process problems is called the _____. 1 2 1 3
   (A) Tunneling (B) Localization
   (C) Method of steepest descent (D) Method of steepest ascent

9. What is the Hadamard matrix associated with? 1 2 1 3
   (A) Taguchi's design (B) Screening design
   (C) Confidence level (D) Full-factorial design

10. Taguchi's design makes _____ the focal point of his analysis. 1 2 1 3
   (A) Control factors (B) Interactions
   (C) Blocking (D) Noise

11. Maximum permissible variation is called 1 2 1 3
   (A) Loss (B) Quality
   (C) Tolerance (D) Function

12. In orthogonal array design of experiments, the inner array is for the design of _____. 1 2 1 3
   (A) Control factors (B) Noise factors
   (C) Random factors (D) Interactions

13. A maximization problem in RSM is one of _____. 1 2 1 3
   (A) Star point (B) Steepest ascent
   (C) Steepest descent (D) Mid point

14. How many levels of a factor does a Box-Behnken design have? 1 2 1 3
   (A) 2 (B) 3
   (C) 5 (D) >5

15. A design that uses both centre and axial points is called a _____. 1 2 1 3
   (A) Mixed design (B) OFAT
   (C) Full – factorial (D) CCD

16. Split-plot designs are encountered in _____ factors designs. 1 2 1 3
   (A) Random (B) Fixed
   (C) Full (D) Higher order

17. When some treatment effects are estimated by the same linear combination of the experimental observations as some blocking effects, it is called _____. 1 2 1 3
   (A) Aliasing (B) Blocking
   (C) Confounding (D) Derivatives

18. Relationships between independent variable are explored by _____. 1 2 1 3
   (A) MANOVA (B) Chaining
   (C) ANOVA (D) Regression

19. ANOVA tests use which of the following distributions? 1 1 5 2
   (A) Z (B) Chi-square
   (C) T (D) F

20. An analysis of variance comparing three treatment conditions produce of dF. Total = 24 for this ANOVA. What is the value of dF. Within? 1 2 5 2
   (A) 2 (B) 21
   (C) 22 (D) 3

PART – B (5 × 4 = 20 Marks) Marks BL CO PO
Answer **ANY FIVE** Questions

21. What is "Bias" or "Distortion"? What should be done to minimize it? 4 3 2 2

22. "Statistical thinking adds value to management and decision-making". Discuss this statement w.r.t DOE. 4 3 2 3

23. Sketch a surface plot example and briefly discuss why you need it. 4 4 2 5

24. Draw up the general 2^3 full factorial table showing all major effects, 2 and 3-factor interactions. 4 4 2 5

25. Write briefly about the three methods used by Taguchi to achieve a robust design. 4 3 3 4

26. What is response surface methodology? Give a schematic example. 4 3 4 5

27. Write about the assumptions in ANOVA. 4 3 5 4

PART – C (5 × 12 = 60 Marks) Marks BL CO PO
Answer **ALL** Questions

28. a.i. With a schematic, differentiate accuracy and precision. 6 3 1 4

ii. Define efficiency, treatment, response, levels and factors. 6 2 1 3

(OR)

b. Explain all the steps in experimentation in detail. 12 3 1 3

29. a. Explain pareto, NPP and cube plots with schematic examples. 12 4 2 5

(OR)

b. Barriers in implementing DOE. 12 3 2 4

30. a. Discuss Taguchi's loss functions in detail. 12 4 3 2

(OR)

b.i. Explain the categories of variability in input and output parameters in detail. 8 4 3 3

ii. What is 'Interchangeability'? Explain with an example. 4 3 3 4

31. a.i. What is the difference between RSM and a factorial design? 2 3 4 3