28. a. Calculate the S/N ratio and factor effect for the following data. Plot the factor effect diagram. Assume smaller the better S/N ratio. — 10 | 3 | 3 | 4,3,3

Expt. No	Speed	Feed rate	Depth of cut	GR
1	33(1)	2.5 (1)	0.5(1)	10
2	33(1)	5.0(2)	1.0(2)	12
3	45(2)	2.5(1)	1.0(2)	15
4	45(2)	5.0(2)	0.5(1)	20

(OR)

b. The objective of the research is an experimental investigation to find optimization of machining parameters of EDM machine for machining steel material EW-8 using Taguchi's DOE. — 10 | 2 | 3 | 4,33

Column	Factors	Units	Level – 1	Level – 2
1	Peak current	Amps	3	5
2	Pulse time	μ- sec	25	52
3	Gap voltage	Volts	45	50
4	Fluid pressure	Kg/cm	0.5	0.75

Ra values obtained according to the experiment sequence are 2.625, 1.905, 2.5275, 2.99, 4.4325, 4.10, 3.38, 3.015, 3.312. Find out the main effect and draw the factor effect diagram and identify the optimum process parameters.

29. a. Write down about central composite design for various factor. — 10 | 2 | 4 | 4,4,4

(OR)

b. Response surface for certain manufacturing process was defined by equation $Z = 17x_1 + 27x_2 - x_1^2 - 0.9x_2^2$. Determine the approximate optimum operating point using the method of steepest ascent. The starting point of research should be $X_1 = 2$ and $X_2 = 3$ and step size $e = 4.0$ — 10 | 3 | 4 | 4,4

30. a. To asses the relationship between sintering times of 100, 150 and 200 min strength of 3 different metals with 27 experiments are conducted. Complete the ANOVA table and answer the following. What design was employed? What about the total number of observations? Contribution of each factor? At 5% level of significance, can you conclude that metal type have different effect? — 10 | 3 | 54 | 4,5,5

Source of variations	Degree of freedom	Sum of square	Mean square	F	P
Sintering time	?	8.22	4.11	1.71	0.2044
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			

(OR)

b. Explain interaction effects in ANOVA. — 10 | 2 | 5 | 4,5,5

* * * * *

Reg. No.														

B.Tech. DEGREE EXAMINATION, MAY 2022

Sixth and Seventh Semester

18MEO113T – DESIGN OF EXPERIMENTS

(For the candidates admitted from the academic year 2018-2019 to 2019-2020)

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** should be answered in answer booklet.

Time: 2½ Hours — Max. Marks: 75

PART – A (25 × 1 = 25 Marks) — Marks | BL | CO | PO

Answer **ALL** Questions

1. Repeatability refers to — 1 | 1 | 1 | 2,1,1
   (A) Variability due to operator (B) Variability due to noise
   (C) Variability due to gauge (D) Variability due to interaction

2. Which of these does not appear into a typical process model? — 1 | 4 | 1 | 2,1,1
   (A) Input factors (B) Controllable input factors
   (C) Uncontrollable input factors (D) Acceptance sampling

3. A process has 2 levels and 2 factors, find out the total number of experiment trial runs — 1 | 4 | 1 | 2,1,2
   (A) 2 (B) 4
   (C) 6 (D) 8

4. A set of specified factor levels for an experiment is called — 1 | 4 | 1 | 2,1,1
   (A) Noise (B) Factor
   (C) Treatment (D) Response

5. The main goal of applying the principles of experimental design is — 1 | 4 | 1 | 2,1,1
   (A) To observe the behvaiour of process (B) To reduce the experimental bias
   (C) To determine the outcome (D) To analyze the quality characteristics

6. If the factors are spaced for widely, it increased the chances that — 1 | 1 | 2 | 2,5,1
   (A) The noise will overwhelm the signal in the data (B) The signal and noise both will affect the data
   (C) The noise will not overwhelm the signal in the data (D) The signal will not overwhelm the signal in the data

7. If we have 3 factors and two levels per factors, what kind of experiment is this? — 1 | 1 | 2 | 2,1,2
   (A) 2 (B) 3
   (C) 2^3 (D) 2^2

8. Factors in a factorial design — 1 | 1 | 2 | 2,1,1
   (A) The experimental variables (B) The independent variables
   (C) The dependent variables (D) The organismic variables

9. How many independent variables are there in an experimental two factor design? — 1 | 1 | 2 | 2,1,2
   (A) 1 (B) 2
   (C) 3 (D) 4

10.	What is the appropriate statistical test for a factorial design? (A) The modes test (B) Anova (C) t-test (D) Chi-square	1	1	2	2,5,1
11.	A machine has five factors that can be varied at two levels each. Determine the array to be used (A) L8 (B) L9 (C) L12 (D) L18	1	2	3	2,1,2
12.	Taguchi's loss function can be expressed in terms of (A) Step function (B) Quadratic relation (C) Linear relation (D) Cubic relation	1	1	3	2,1,2
13.	A scientific or technical study always consists of (A) Decides the objective (B) Considering the method (C) Evaluate the method in relation to the objective (D) Decide the objective, considering the method and evaluate the method in relation to the objective	1	1	3	2,3,2
14.	Select the external noise factor (A) Temperature (B) Old material (C) Product wear (D) Change in components	1	1	3	2,1,1
15.	Cause and effect diagrams are also known as (A) Process chart (B) Target specification graphs (C) Fish-bone chart (D) Pareto charts	1	1	3	2,1,1
16.	The objective of response surface methodology is to (A) Maximize the response (B) Minimize the response (C) Optimize the response (D) Neglect the response	1	1	4	2,1,1
17.	A procedure for moving sequentially in the direction of maximum decrease in the response is called _____and used for _____ (A) Method of steepest ascent, maximization (B) Method of steepest ascent, minimization (C) Method of steepest descent, minimization (D) Method of steepest descent, maximization	1	1	4	2,1,1
18.	The method of steepest ascent is a procedure for moving sequentially in the (A) Direction of the average increase in the response (B) Direction of the minimum increase in the response (C) Direction of the maximum increase in the response (D) Direction perpendicular to the maximum increase in the response	1	1	4	2,1,1
19.	In central composite design the possible of estimate quadratic terms defined by (A) $\alpha = \sqrt[4]{NFD}$ (B) $\alpha = \sqrt[3]{NFD}$ (C) $\alpha = \sqrt[7]{NFD}$ (D) $\alpha = \sqrt[1]{NFD}$	1	1	4	2,1,2
20.	Screening in RSM used for (A) Outcome approach (B) Steepest ascent approach (C) CCD approach (D) Optimum response	1	1	4	2,1,1
21.	A variable that measure the effect that manipulating another variable has (A) A dependent variable (B) A confounding variable (C) A predictor variable (D) An independent variable	1	4	5	2,1,1
22.	A predictor variable is another name for (A) A dependent variable (B) An independent variable (C) A confounding variable (D) A discrete variable	1	4	5	2,1,2

23.	Analysis of variance is a statistical method of comparing the several populations (A) Means (B) Variances (C) Standard deviations (D) Error	1	4	5	2,1,2
24.	When conducting an ANOVA FDATA will always fall within what range (A) Between 0 and infinity (B) Between 0 and 1 (C) Between negative, infinity and infinity (D) Between 1 and infinity	1	4	5	2,1,1
25.	What is the function of a post test ANOVA? (A) Describe those groups that have reliable differences between group means (B) Set the critical value (C) Determine if any statistical significant group differences have occurred (D) Only critical value	1	4	5	2,1,1

PART – B (5 × 10 = 50 Marks) — Marks | BL | CO | PO

Answer **ALL** Questions

26. a. What are the three basic principles of DOE? What is replication and write down its significance. — 10 | 2 | 1 | 4,1,1

(OR)

b. Write down about DOE temminology. — 10 | 2 | 1 | 4,1,1

27. a. Using the 2 factor factorial design predict the popcorn model. The factors used are time on the stove, low level (–)160sec and high level (+) 200 sec. type of popcorn used are white (–) low level and yellow corn (+) high level.

Std. order	Run order	A = time	B=corn type	Outcome
1	2	-	-	52
2	4	+	-	74
3	1	-	+	62
4	3	+	+	80

(OR)

b. Find the coefficient of chemical (C), temperature (T) and speed (S) factor using 3 factor factorial design. — 10 | 2 | 2 | 4,2,2