



UNIVERSITI KUALA LUMPUR
KAMPUS CAWANGAN MALAYSIAN SPANISH INSTITUTE

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE : SFB47113 (V1)
COURSE TITLE : DESIGN OF EXPERIMENTS
PROGRAMME NAME : BACHELOR OF ENGINEERING TECHNOLOGY (HONS) IN
MANUFACTURING (AUTOMOTIVE)
DATE : 24 JANUARY 2026
TIME : 2:00PM - 4:30PM
DURATION : 2 HOURS 30 MINUTES

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. Tick if applicable
9. Refer to the attached Formula/ Appendies. Tick if applicable

THERE ARE 3 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

1. Why are the basic principles of DOE important?
 - A. To make experiments longer
 - B. To confuse the researcher
 - C. To avoid drawing conclusions
 - D. To ensure valid, reliable, and unbiased results

2. What is the first step in the Design of Experiments (DOE) process?
 - A. Drawing conclusions
 - B. Conducting the experiment
 - C. Statistical analysis
 - D. Recognition and statement of the problem

3. Why is selecting the response variable important in DOE?
 - A. It limits data collection
 - B. It determines what will be measured in the experiment
 - C. It reduces the number of trials
 - D. It helps ignore data

4. What is the purpose of statistical analysis in the DOE process?
 - A. To interpret the experimental data and test hypotheses
 - B. To organize graphs only
 - C. To randomly guess results
 - D. To avoid drawing conclusions

5. What happens in the final step of the DOE process?
- A. You conduct a second trial
 - B. You choose a random design
 - C. You draw conclusions and make recommendations
 - D. You select factors
6. Within statistical methodology, which branch focuses on using sample data to make probabilistic statements or generalizations about population parameters?
- A. Experimental physics
 - B. Inferential statistics
 - C. Predictive analytics
 - D. Descriptive statistics
7. Which branch of statistics is primarily concerned with making probabilistic generalizations about a population based on information obtained from a sample?
- A. Predictive modeling
 - B. Inferential statistics
 - C. Experimental physics
 - D. Descriptive statistics
8. In the context of statistical analysis, which of the following best defines the arithmetic mean?
- A. The modal value representing the most frequently occurring observation
 - B. The maximum observed value within a distribution
 - C. The minimum observed value within a distribution
 - D. A measure of central tendency calculated as the total of all observed values divided by the number of observations, serving as an estimator of the population expectation under suitable assumptions

9. Which principle of DOE helps control the effect of nuisance variables?
- A. Repetition
 - B. Randomization
 - C. Blocking
 - D. Estimation
10. The pull-off force for a connector was measured in a laboratory test. The data for 14 test specimens (in Newtons) are as follows:
241, 237, 248, 250, 240, 238, 240, 239, 251, 240, 248, 251, 244, 246
What is the mean (average) ammonia concentration?
- A. 1.50
 - B. 1.48
 - C. 1.44
 - D. 1.46
11. The pull-off force for a connector was measured in a laboratory test. The data for 14 test specimens (in Newtons) are as follows:
241, 237, 248, 250, 240, 238, 240, 239, 251, 240, 248, 251, 244, 246
What is the mode of the pull-off force?
- A. 251
 - B. 240
 - C. 244
 - D. 248
12. What is a "population" in statistics?
- A. The entire group being studied or analyzed
 - B. A group of selected data points
 - C. A type of graph
 - D. A mathematical formula

13. What does the term "mode" refer to?
- A. The middle number
 - B. The total of all values
 - C. The value with the highest frequency in a data set
 - D. The average of two smallest values
14. What is a "median"?
- A. The sum of all numbers
 - B. The most frequent number in a data set
 - C. The middle value when data is arranged in order
 - D. The smallest value in the data
15. What does the term "mean" refer to in statistics?
- A. The largest number in the set
 - B. The average of a data set
 - C. The number that occurs most often
 - D. The middle number in a data set
16. Which of the following is commonly used in descriptive statistics?
- A. Regression analysis
 - B. Probability sampling
 - C. Mean, median, and mode
 - D. Hypothesis testing

17. Which of the following is a reason to use statistics in education?
- A. To ignore student performance
 - B. To guess exam results
 - C. To create harder exams
 - D. To evaluate student performance and improve teaching methods
18. Why are statistics important in scientific research?
- A. To analyze results and test hypotheses
 - B. To make research more confusing
 - C. To collect opinions only
 - D. To decorate reports with numbers
19. How do businesses benefit from using statistics?
- A. By reducing the use of computers
 - B. By analyzing customer data to improve products or services
 - C. By guessing customer behavior
 - D. By ignoring market trends
20. What does "robustness" refer to in product development?
- A. Making products heavier
 - B. Making products more colorful
 - C. Increasing design time
 - D. Making products work well under various conditions

21. What kind of evaluation is possible with experimental design?
- A. Customer emotions only
 - B. Movie reviews
 - C. Color selection for packaging
 - D. Evaluation of materials, design alternatives, and component tolerances
22. Which of the following best represents a primary method of empirical data collection in statistical research?
- A. Applying algebraic techniques to manipulate existing numerical values
 - B. Producing a qualitative narrative without systematically gathering evidence
 - C. Constructing a visualization to summarize observed variables
 - D. Implementing a structured questionnaire to gather responses on individuals' dietary preferences
23. What is the primary role of statistics within scientific inquiry and data-driven decision-making?
- A. To provide deterministic predictions based solely on numerical patterns
 - B. To ensure that all uncertainty in data can be fully eliminated through quantitative analysis
 - C. To replace theoretical reasoning with empirical observations
 - D. To summarize, model, and infer properties of populations using data obtained from samples
24. What is a common method used to present statistical data in a visual format?
- A. Verbal explanation
 - B. Dictionary definition
 - C. Essay writing
 - D. Bar graph or pie chart

25. Which of the following tools is commonly used to display data visually in statistics?
- A. Stopwatch
 - B. Ruler
 - C. Calculator
 - D. Graph or chart
26. What is the first step in the statistical problem-solving process?
- A. Collect the data
 - B. Analyze the data
 - C. Interpret the results
 - D. Pose a question
27. What is the main purpose of using statistics?
- A. To create confusing mathematical problems
 - B. To collect and guess data randomly
 - C. To express opinions without evidence
 - D. To organize, analyze, and interpret data
28. Which activity below best represents the process of data collection?
- A. Creating a pie chart from survey results
 - B. Writing a report based on analyzed data
 - C. Interpreting the meaning of a dataset
 - D. Asking 100 students about their favorite subject

29. Which of the following represents the beginning of the statistical investigation process?
- A. Making graphs and charts
 - B. Drawing conclusions from data
 - C. Calculating the average
 - D. Asking a statistical question
30. Which of the following is a primary benefit of applying Engineering Experiments in product development?
- A. Increasing workforce requirements
 - B. Eliminating the need for testing
 - C. Reducing time to design and develop new products
 - D. Increasing production cost
31. Engineering experiments help improve the performance of existing processes mainly by:
- A. Removing process controls
 - B. Increasing trial-and-error activities
 - C. Standardizing all materials regardless of variation
 - D. Identifying optimal process parameters
32. In the context of Engineering Experiments, improving reliability refers to:
- A. Ensuring consistent product performance over time
 - B. Reducing manufacturing speed
 - C. Increasing product complexity
 - D. Minimizing design documentation

33. Achieving robustness in product and process design means:
- A. The design is insensitive to variations and noise factors
 - B. The design is insensitive to variations and noise factors
 - C. The design depends heavily on operator skills
 - D. The design requires frequent adjustments
34. Why is evaluation of materials, design alternatives, and system tolerances important in Engineering Experiments?
- A. To increase the complexity of the design
 - B. To optimize overall system performance and quality
 - C. To reduce the number of design options
 - D. To ensure compliance with marketing strategies
35. What is the primary purpose of recognition and statement of the problem in experimental design?
- A. To define clear objectives and scope of the experiment
 - B. To analyze experimental data
 - C. To select statistical software
 - D. To determine sample size
36. What is one key benefit of using experimental design in engineering?
- A. Increases product price
 - B. Reduces time to design and develop new products
 - C. Avoids system analysis
 - D. Delays production

37. How does experimental design help improve products?
- A. By improving reliability and performance
 - B. By using cheaper materials only
 - C. By avoiding testing
 - D. By guessing improvements
38. What does replication in DOE help with?
- A. Avoiding control groups
 - B. Decreasing the sample size
 - C. Measuring the cost of the study
 - D. Estimating experimental error and improving accuracy
39. Which of the following best describes a response variable in an experiment?
- A. A variable that is controlled by the experimenter
 - B. A measurable outcome used to evaluate the effect of factors
 - C. A variable that introduces random error
 - D. A variable that is intentionally changed
40. Why is it important to follow the experimental plan during conducting?
- A. To ensure consistency and accuracy of results
 - B. To make the process faster
 - C. To reduce sample size
 - D. To guess outcomes

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Hypothesis formulation is a fundamental step in experimental research, as it provides a basis for statistical testing and data interpretation.

Based on your understanding of hypothesis testing in engineering and experimental studies, answer the following sub-questions:

- i. Define a hypothesis and explain its role in scientific research.
(5 marks)
- ii. Differentiate between the null hypothesis (H_0) and the alternative hypothesis (H_1).
(5 marks)
- iii. Explain the importance of hypothesis testing in engineering experiments.
(5 marks)
- iv. Explain how the outcome of hypothesis testing influences the interpretation of experimental results.
(5 marks)

Question 2

The Taguchi method is a robust design technique widely used in engineering experiments to optimize process parameters and improve product quality.

Based on your understanding of the Taguchi method, answer the following sub-questions:

- i. Define the Taguchi method and explain its main objective in experimental design.
(5 marks)

- ii. Explain the concept of control factors and noise factors in the Taguchi method.
(5 marks)

- iii. Explain the significance of the signal-to-noise (S/N) ratio in the Taguchi method.
(5 marks)

- iv. Discuss how the Taguchi method can be applied to optimize an engineering process.
(5 marks)

Question 3

Design of Experiments (DOE) is a systematic approach used in engineering research to plan, conduct, analyze, and interpret controlled tests in order to understand the relationship between factors and responses.

Based on the stages involved in Design of Experiments, answer the following sub-questions:

- i. Explain the importance of problem recognition and problem statement in an experimental study.
(5 marks)
- ii. Describe how factors, levels, and ranges are selected in an experimental design.
(5 marks)
- iii. Explain the role of response variables in Design of Experiments.
(5 marks)
- iv. Discuss the importance of choosing an appropriate experimental design and conducting the experiment systematically.
(5 marks)

Question 4

A machine cuts metal tubing into pieces. The lengths of the pieces are normally distributed with a standard deviation of 5 mm. After a routine overhaul of the machine, a random sample of 30 pieces is taken and found to have a mean length of 150 cm.

Assume the overhaul has **not changed the variance** of the tube lengths.

Answer the following questions:

- (a) Convert the standard deviation from millimeters to centimeters. Explain your answer. (5 marks)
- (b) Calculate the standard error of the sample mean. Show all steps. (5 marks)
- (c) Construct a 95% confidence interval for the population mean length. (5 marks)
- (d) Based on the confidence interval, can we say that the machine's overhaul affected the mean length? Justify your answer. (5 marks)

END OF EXAMINATION PAPER

