



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022**

COURSE NAME : **ADVANCED ENGINEERING
MATHEMATICS**

COURSE CODE : **MEE 10103**

PROGRAMME CODE : **MEE**

EXAMINATION DATE : **JANUARY / FEBRUARY 2022**

DURATION : **3 HOURS**

INSTRUCTION : **1. ANSWER ALL QUESTIONS.
2. ANSWERS MUST BE IN FOUR (4)
DECIMAL PLACES.
3. THIS FINAL EXAMINATION IS
AN ONLINE ASSESSMENT AND
CONDUCTED VIA OPEN BOOK.**

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

Q1 (a) A company produces two types of tables, X and Y. It takes 2 hours to produce the parts of one unit of X, 1 hour to assemble and 2 hours to polish. Meanwhile for table Y, it takes 4 hours to produce the parts, 2.5 hours to assemble and 1.5 hours to polish. As per month, 8000 hours are needed for producing the parts, 3000 hours for assembling and 1500 hours for polishing. The profit per unit of X is RM75 and for Y is RM140. Determine each type of tables that should be produced in order to maximize the total monthly profit.

(i) Organize the information into a table. (2 marks)

(ii) Examine this problem as linear programming model without solving. (4 marks)

(b) Given the Linear Programming (LP) problem:

$$\begin{array}{ll} \text{Minimize} & z = 6I_d x_1 + 5x_2 \\ \text{subject to} & x_1 + x_2 \geq 7 \\ & 3x_1 + 2x_2 \geq 10 \end{array}$$

(i) Construct the primal problem and dual problem. (5 marks)

(ii) Obtain the value of I_d

$$I_d = \frac{n}{y}$$

y is year of registration and n is the last 2 digit of your matric card number.
Example: ME1800009 (y=18; n=09)

(1 mark)

(iii) Determine the solution for dual problem by using answers from Q1(b)(i) and Q1(b)(ii). (12 marks)

(iv) Proof that your answer in Q1(b)(iii) is correct. (1 mark)

Q2 (a) Consider the following linear programming problem

$$\begin{array}{ll} \text{Minimize} & z = 3x_1 + 2x_2 + x_3 \\ \text{subject to} & 3x_1 + x_2 + x_3 \geq 3 \\ & -3x_1 + 3x_2 + x_3 \geq 6 \\ & x_1 + x_2 + x_3 \geq -3I_d \\ & x_1, x_2, x_3 \geq 0 \end{array}$$

- (i) Evaluate the following linear programming problem using dual simplex method based on the answer from Q1(b)(ii). (23 marks)
- (ii) Proof that your answer in Q2(a)(i) is correct. (2 marks)
- Q3 (a)** Mobile robots are typically equipped with several sensor modalities which may include range sensors, tactile/contact sensors, encoders, and vision systems. Given such sensor modalities, the usual procedure for fuzzy control synthesis consists of first defining linguistic terminology for the inputs and outputs, partitioning the sensor space and actuator space using appropriate fuzzy sets (membership functions), and formulating fuzzy rules that satisfactorily govern the desired response of the robot in all practical situations.
- (i) Based on **Figure Q3(a)**, Justify the range of universe of discourse for Side Sonar Sensor. State the reasons. (4 marks)
- (ii) Classify the membership function to be chosen (Very Close, Close or Far) if the motion behavior of distance is 0.5 meters and 2 meters. State your reasons. (6 marks)
- (b)** Forecasting or in other words, the ability to see into the future and make predictions about any number of production elements. Based on the following data on widget production as given in **Table Q3(b)**, used curve fitting forecasting method.
- (i) Evaluate the best fitting linear function for the data. (4 marks)
- (ii) Construct the new table for predicted widget production based on Q3(b) function. (4 marks)
- (iii) Predict the production value for April 2021. (3.5 marks)
- (iv) Predict the production value for July 2021. (3.5 marks)
- Q4** Production costs reflect all of the expenses associated with a company conducting its business. **Table Q4** shows the data for operational cost to run a factory with three type of product. By using Multiple Linear Regression
- (a) Evaluate the estimated regression equation for the full model with all 3 variables with residual (12 marks)

- (b) Evaluate the estimated regression equation for the model with only *Product B* and *Product C* variables with residual. (5 marks)
- (c) Justify which model gives better estimated results for *Month 1*, where *Product A* (510 units), *Product B* (540 units) and *Product C* (920 unit). (4 marks)
- (d) Based on Q4(a), predict the operational cost for
- (i) *Product A* (1200 units), *Product B* (800 units) and *Product C* (1000 unit). (2 marks)
- (ii) *Product A* (721 units), *Product B* (701 units) and *Product C* (925 units). (2 marks)

- END OF QUESTIONS -