Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	ENGINEERING ECONOMY
COURSE CODE	:	BNP 30402
PROGRAMME CODE	:	BNA/BNB/BNC
EXAMINATION DATE	:	JULY 2024
DURATION	:	2 HOURS
INSTRUCTIONS	:	1. ANSWER **ALL** QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 An engineering economy study is accomplished using structured procedure and mathematical modelling techniques.

(a) Explain **FOUR (4)** solutions to engineering problems to make it economically acceptable and affordable.

(8 marks)

(b) In the construction industry, many problems can cause delays and will affect the construction cost of the project. Select one of the issues and list out the process to solve the problem by systematically applying the **SEVEN (7)** decision-making process of engineering economy.

(9 marks)

(c) The life cycle cost may be divided into two general periods: the acquisition and operation phases. Demonstrate each of these phases with relevant diagrams.

(8 marks)

Q2 Cost estimation is important in all aspects of a project, but especially in the stages of project conception, preliminary design, detailed design, and economic analysis.

(a) Five years ago, the cost for an 80-MW gas power was RM150,000. The cost index for the turbine five years ago was 180 and it is now 196. The cost capacity factor is 0.7. The plant engineering staff is considering a 100-MW unit of the same design to power a small isolated plant.

(i) Assuming an additional compressor will be added into the design, which currently cost RM25,000, analyse the total cost of the 100-MW unit gas power.

(5 marks)

(ii) If the plant engineering staff is considering using a 50-MW unit of the same design instead to power the plant, with the additional compressor of RM25,000, analyse the total cost of the 50-MW unit gas power.

(5 marks)

(iii) Calculate the difference of the total cost between the 100-MW and 50-MW unit gas power.

(3 marks)

(b) The structural engineering design section within the engineering department of a regional electrical utility corporation has developed several standard designs for a group of similar transmission line towers. The detailed design for each tower is based on one of the standard designs. A transmission line project involving 50 towers has been approved.

(i) A 95% learning curve is applied to the engineering hours required and it requires 126 hours to accomplish the first detailed tower design. Estimate the number of engineering hours needed to design the eighth tower and to design the last tower in the project.

(6 marks)

(ii) Direct and indirect labour costs an average of RM150 per engineering hour. Estimate the total labour cost for the first five designs.

(6 marks)

Q3 Engineering economy studies involve the commitment of capital for extended periods.

(a) A company has decided to invest in a production project. The initial investment cost for the first two years will be RM 1,000,000 with RM 700,000 allocated for the first year and RM 300,000 for the second year. The plan calls for producing products at the following rates: 5,000 units in Year 2; 10,000 units in Year 3; 30,000 in Year 4; 30,000 in Year 5; 10,000 in Year 6; and 5,000 in Year 7. Products will be sold for RM 50 each throughout the life of the project and cash operating expenses will be RM 60,000 per year for year 2 through year 7. Construct a cash flow diagram for the project.

(8 marks)

(b) Rebecca would like to make RM2,150 down payment for a new car in 6 months. If she has RM2,000 in her savings account, and interest is compounded daily, estimate the interest rate that she needs to earn to have enough down payment.

(5 marks)

(c) A person with money to invest wants to purchase a fixed rate bond that will allow her to receive RM 500 annually in interest payments over the next 10 years, with the bond paid off at the end of tenth year. The current rate for bonds is 4%. Construct a cash flow diagram and calculate how much money the person has to invest in this bond for this to happen.

(5 marks)

(d) An individual wishes to place an amount of money in his savings account and, at the end of one month and for every month thereafter for 30 months, draw out RM 1,000. Demonstrate the amount that must be placed in the account if the interest rate is 12% (nominal rate) compounded monthly.

(7 marks)

Q4 The B-C analysis is a systematic method of assessing the desirability of projects.

(a) Identify each of the following cash flows whether a benefit, disbenefit, or cost. Justify your answer.

(i) Cost of fish from a hatchery to stock a lake at the state park.

(ii) Less travel time because of a loop bypass.

(iii) Expenditure of RM65 million for tunnel construction on East-West Highway

(iv) RM850, 000 per year loss of revenue by farmers because of highway right-of-way purchases.

(v) RM400, 000 annual income to local business because of tourism created by a national park.

(5 marks)

(b) Three mutually exclusive project alternatives are being evaluated. The estimated cash flows for each alternative are given in **Table Q4.1** below. The MARR is 15% per year.

Table Q4.1 Description of three exclusive projects

Descriptions	**Project A (RM)**	**Project B (RM)**	**Project C (RM)**
Investment	6,000	8,000	9,000
Project life	10 years		
Annual revenue	5,200	6,000	7,500
Annual cost	2,100	1,800	2,000
Salvage value	1,200	1,500	2,500

By using the PW method,

(i) Analyse the total cost of every project.

(6 marks)

(ii) Analyse the total benefit of every project.

(6 marks)

(iii) Investigate which project is the most suitable to be recommended.

(6 marks)

(iv) Explain your answer in **Q4 (b)(iii)**.

(2 marks)

- END OF QUESTIONS -

APPENDIX

LIST OF FORMULA

(1) $$F = P(1+i)^N.$$

(2) $$P = F\left(\frac{1}{1+i}\right)^N = F(1+i)^{-N}.$$

(3) $$A = P\left[\frac{i(1+i)^N}{(1+i)^N - 1}\right]$$

(4) $$i = \sqrt[N]{F/P} - 1$$

(5) $$A = F\left[\frac{i}{(1+i)^N - 1}\right]$$

(6) $$N = \frac{\log(F/P)}{\log(1+i)}.$$

(7) $$F = A\left[\frac{(1+i)^N - 1}{i}\right].$$

(8) $$P = A\left[\frac{(1+i)^N - 1}{i(1+i)^N}\right].$$

(9) $$P = \frac{G}{i}\left[\frac{(1+i)^n - 1}{i(1+i)^n} - \frac{n}{(1+i)^n}\right]$$

(10) **Conventional B-C ratio with PW**
B-C = PW(B) / [(I – PW(MV)) + PW(O&M)]

(11) **Modified B-C ratio with PW**
B-C = [PW(B) – PW(O&M)] / [I – PW(MV)]

(12) **Conventional B-C ratio with AW**
B-C = AW(B) / [CR + AW(O&M)]

(13) **Modified B-C ratio with AW**
B-C = [AW(B) – AW(O&M)] / CR

(14) $$Z = K(U^n); n = \frac{\log s}{\log 2}$$

(15) $$T_x = \sum_{u=1}^{x} Z_u = \sum_{u=1}^{x} K(u^n) = K \sum_{u=1}^{x} u^n.$$

(16) $$C_A = C_B \left(\frac{S_A}{S_B} \right)^X$$

(17) $$C_n = C_k \left(\frac{\bar{I}_n}{\bar{I}_k} \right)$$