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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION  
SEMESTER II  
SESSION 2022/2023

COURSE NAME : ENGINEERING ECONOMY  
COURSE CODE : BNQ21002  
PROGRAMME CODE : BNN  
EXAMINATION DATE : JULY/AUGUST 2023  
DURATION : 3 HOURS  
INSTRUCTION : 1. ANSWERS ALL QUESTIONS.  
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **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 SIX (6) PAGES

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- Q1** (a) Engineering economy involves formulating, estimating and evaluating the expected economic outcomes of alternatives designed to accomplish a detailed purpose. State **FOUR (4)** importance of Engineering Economy to engineers/engineering technologists. (4 marks)
- (b) Project monitoring refers to surveillance and tracking of the project to ensure that all the tasks are completed on time. Discuss on the importance of monitoring the project performance. (6 marks)
- (c) The management team of a small furniture-manufacturing company is under pressure to increase profitability to get a much-needed loan from the bank to purchase a more modern pattern-cutting machine. One proposed solution is to sell waste wood chips and shavings to a local charcoal manufacturer instead of using them to fuel space heaters for the company's office and factory areas. Identify the company's problem and reformulate (analyze) the problem in a variety of creative ways. (6 marks)
- (d) ProNature Living Solutions Sdn Bhd is considering the replacement an equipment in manufacturing site. It originally cost RM 60,000, is presently shown on the company records with a value of RM 30,000. That equipment can be sold for an estimated RM 12,000.
- (i) Calculate the *sunk cost* for this equipment. (2 marks)
- (ii) Determine the *opportunity cost* in this case. (2 marks)
- (iii) Besides *sunk cost* and *opportunity cost* calculated in **Q1(d)(i)** and **Q1(d)(ii)**, compare between *fixed cost* and *variable cost* by providing **FOUR (4)** examples for each of them. (5 marks)
- Q2** (a) Based on the data tabulated in **Table Q2(a)**, develop a weighted index for the price of a gallon of gasoline in 2014, when 1996 is the reference year having an index value of 99.2. Please be noted that, the weight placed on regular unleaded gasoline is three times that of either premium or unleaded plus, because roughly three times as much regular unleaded is sold compared with premium or unleaded plus. (6 marks)
- (b) From your answer in **Q2(a)**, determine the corresponding 2016 price for each types of gasoline if the index in 2016 is estimated to be 327. (7 marks)
- (c) The Chemical Engineering Technology department has a student team that is formulating a cosmeceutical product recipe for innovation competition. The time required for the team to formulate the first recipe is 100 hours. Their improvement (or learning rate) is 0.8,

which means that as output is doubled, their time to formulate a cosmeceutical product recipe is reduced by 20%.

- (i) Determine the time it will take the team to formulate the 10<sup>th</sup> product recipe. (4 marks)
- (ii) Calculate the total time required to assemble the first 10 product recipes. (5 marks)
- (iii) Evaluate the estimated cumulative average assembly time for the first 10 recipes. (3 marks)

**Q3** (a) Identify each of the following cash flows to indicate whether it is a benefit, a dis-benefit, or a cost. Justify your answer.

- (i) RM 700, 000 per year maintenance by Port Klang authority. (2marks)
- (ii) Expenditure of RM 45 million for tunnel construction on East-West Highway. (2 marks)
- (iii) Reduction of RM 375, 000 per year in car accident repairs because of improved lighting. (2 marks)
- (iv) RM 700, 000 per year loss of revenue by farmers because of highway right-of-way purchases. (2 marks)
- (v) RM 500, 000 saving in toll gate payment for new federal road. (2 marks)

(b) A high-speed train company is considering a project of constructing a new bullet train railway from Muar to Johor Bahru. The 400-kilometre project will be started with purchasing of land from local owner and state government costing about RM 26 million. Cost of construction is estimated to be RM 72 million and yearly maintenance is about RM 2 million. A traffic control building and sophisticated equipment should also be considered with a cost of RM 4 million and RM 1 million per year maintenance expenditures. Some construction equipment will be sold at the end of construction period at the market value of RM 13 million. In addition, yearly speed train ticket fees will be collected amounting to RM 9 million, petrol consumptions save by the road users for RM 4 million, revenues received through the direct and indirect businesses of RM 5 million, and fees collected by the local and state authorities of RM 3 million. The project costs breakdown is shown in **Table Q3(b)**.

- (i) Determine the value of Total Cost, Benefit and Disbenefit from the above statement. (3 marks)
- (ii) Apply the B-C ratio method for both conventional and modified cases using PW and AW methods with the study period of 30 years and a MARR of 20% per year (12 marks)
- Q4** (a) Differentiate between *cash inflows* and *cash outflows* by giving **FOUR (4)** examples each. (6 marks)
- (b) A new freeze dry machine used in food production is proposed by Dr A's Lab Consultant to upgrade the power quality measurement at PQ meters. The investment cost is RM 45,000 with salvage value of RM 5,000 after 5 years. The revenue generated from the installation of the equipment minus the operating and maintenance cost of the equipment is RM 7,500 per year. The MARR is 15% per year. Draw the cash flow diagram. (4 marks)
- (c) Two feasible alternatives for upgrading the heating, ventilation, and air conditioning (HVAC) system have been identified and the cost is presented in **Table Q4(c)**. Either Alternative A or Alternative B must be implemented. At the end of eight years, the estimated market value for Alternative A is \$2,000 and for Alternative B it is \$8,000. Assume that both alternatives will provide comparable service (comfort) over an eight-year period, and assume that the major component replaced in Alternative B will have no market value at EOY eight. By using a cash-flow table and end-of-year convention, calculate the net cash flows for both alternatives. (15 marks)

-END OF QUESTIONS -

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**Table Q2(a): The Past Price of Gasoline**

Gasoline	Price (Cents/Gal) in Year		
	1996	2010	2014
Premium	114	240	315
Unleaded plus	103	230	305
Regular unleaded	93	221	285

**Table Q3(b): Costs Breakdown High-Speed Rail Construction Project**

Item	Cost (RM)
Land purchase	26 mil
Cost of construction	72 mil
Yearly rail maintenance	2 mil
Building and equipment	4 mil
Yearly equipment maintenance	1 mil
Train fees	9 mil
Equipment scrap value	13mil
Petrol consumption saving	4 mil
Direct and indirect business revenues	5 mil
Local and state fees	3 mil

**Table Q4(c): The Cost for Upgrading the HVAC system**

<b>Alternative A Rebuild (overhaul) the existing HVAC system</b>	
Equipment, labor, and materials to rebuild	\$18,000
Annual cost of electricity	\$32,000
Annual maintenance expenses	\$2,400
<b>Alternative B Install a new HVAC system that utilizes existing ductwork</b>	
Equipment, labor, and materials to install	\$60,000
Annual cost of electricity	\$9,000
Annual maintenance expenses	\$16,000
Replacement of a major component four years hence	\$9,400

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**LIST OF EQUATIONS:**

1	$C_n = C_k \left(\frac{I_n}{I_k}\right)$	6	Conventional B-C ratio $B-C = PW(B) \pm [(I - PW(MV)) + PW(O\&M)]$ $B-C = AW(B) \pm [CR + AW(O\&M)]$
2	$C_n = C_k \left(\frac{S_n}{S_k}\right)^x$	7	Modified B-C ratio with PW $B-C = [PW(B) - PW(O\&M)] \div [I - PW(MV)]$ $B-C = [AW(B) - AW(O\&M)] \div CR$
3	$Z_n = K \left( \frac{1+i}{1+i} \right)^n$	8	$I_{effective} = \left(1 + \frac{r}{m}\right)^m - 1$
4	$p(1+i)^n$		
5	$I_n = \frac{W1(C_{n1}/C_{k1}) + W2(C_{n2}/C_{k2}) + W... (C_{ni}/C_{ki})}{W1 + W2 + W...} X I_k$		

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