UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	ENGINEERING ECONOMY
COURSE CODE	:	BDA 40902
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	JULY 2024
DURATION	:	2 HOURS
INSTRUCTIONS	:	1. PART A: ANSWER ALL QUESTIONS 2. PART B: ANSWER **ONE(1)** FROM TWO(2) QUESTIONS ONLY 3. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 4. 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

PART A

Q1 (a) Using a suitable graph, briefly explain **FOUR (4)** stages of product life cycle and its marketing implications.

(7 marks)

(b) A Cake & Pastry shop plans to install a solar photovoltaic system (SPS) to reduce their electricity consumption. There are two equal-service 20-year life SPS capacities to be considered. **Table Q1.1** shows the estimation of installation cost, electricity bill reduction, maintenance cost for every three (3) years, and salvage value if they sell the shop after 7 years.

Table Q1.1 Cash flow data for SPS alternatives

Cash flow estimation	**9 kWp**	**13 kWp**
Installation cost (RM)	45,000	60,000
Electricity bill reduction (RM)	450 per month	700 per month
Maintenance cost per 3 years (RM)	3000	5000
Salvage value (RM)	20,000	35,000

(i) Draw the cash-flow diagrams for these alternatives.

(6 marks)

(ii) Estimate the future worth (FW) value of each alternative. Assume the MARR is 5% per year.

(10 marks)

(iii) Justify which alternative is the most economics.

(2 marks)

Q2 (a) The federal government is considering widening the old road in the state of Johor. The total construction costs are RM100 million (one off), and the annual maintenance will increase to RM10 million. If the project is conducted, maximum 250 roadside stalls will be affected by reduction in annual income of RM12,000 per stall. At the same time, the need for new contract workers will increase to 1,500 people at a minimum salary of RM24,000 per year. Another annual benefit of the project are speeding up government affairs (RM1 million per year) and reduction in vehicle maintenance costs (RM 500,000 per year). Apply the benefit over cost ratio (conventional), benefit over cost ratio (modified), and benefit over cost net value to conduct a feasibility study. Consider the 10-year feasibility study period at MARR 5% per year.

(20 marks)

(b) Using a suitable example, demonstrate the cash flow diagram of a private project that consist of an initial investment, annual profit gain, maintenance cost, and salvage value.

(5 marks)

Q3 (a) A three (3) year old backup power system is being considered for early replacement. Its current market value is RM 20,000. **Table Q3.1** shows the estimated future market values and annual operating costs for the next 5 years. What is the economic service life of this defender if the interest rate is 10% per year?

Table Q3.1 Market value and annual operating cost

Year	Market Value (RM)	Annual Operating Cost (AOC) (RM)
1	10,000	-5,000
2	8,000	-6,500
3	6,000	-8,000
4	2,000	-9,500
5	0	-12,500

(10 marks)

(b) A furniture company intends to evaluate whether they want to stick with the existing equipment (defender) or replace them with the new productive equipment (challenger). The details of the cost required are shown in **Table Q3.2**. The MARR is 20% per year.

Table Q3.2 Data for defender and challenger

Items	Defender	Challenger
Initial cost eight (8) years ago (RM)	450,000	-
Market value (RM)	25,000	700,000
Yearly handling cost (RM)	160,000	70,000
Life time (year)	5	10
Salvage value (RM)	0	50,000

(i) Justify whether the existing equipment is required to be replaced with the new equipment.

(10 marks)

(i) If the existing equipment (defender) could be sold in international market, determine how much is the minimum value of the defender so that the challenger could replace the defender now?

(5 marks)

PART B

Q4 (a) Using a suitable example, demonstrate the cash flow diagram of a civil project that consist of an initial investment, benefit, disbenefit, and operations and maintenance costs.

(6 marks)

(b) Ms. Asha made two (2) personal loans to pay fees for her academic program. Four years ago, she received RM15,000 from Bank-A when the interest rate was 5% per year. One year later, she made another RM 15,000 loan from Bank-B when the interest rate was 4% per year. Currently, she is under bank blacklisted record due to her unpaid dept. Fortunately, she got offer from the Centre of Bank to consolidate her dept into a single 10-years loan.

(i) Draw a cash flow diagram to represent this situation.

(6 marks)

(ii) If she agrees to take offer from the Centre of Bank, what is the minimum amount of the 10-years loan to settle her previous depts.

(6 marks)

(iii) If the 10-year loan is charged with basic interest rate 3% per year, how much the repayment amount per month.

(7 marks)

Q5 (a) State **FOUR (4)** important things of engineering economics for engineers.

(8 marks)

(b) KASTURI Industry plans to run an advanced technology project in a new facility. The location of the new facility needs to be selected properly based on demand forecasting (quantity), initial investment (fixed cost), and direct production investment (variable cost per quantity) as shown in **Table Q5.1**.

(i) Based on a maximum production capacity of 20,000 unit per year, plot a graph of Total Cost vs Quantity.

(10 marks)

(ii) If the demand forecasting range is between 10 to 12 thousand unit per year, determine the most economics location for developing the new facility. Use numerical method for the determination process.

(7 marks)

Table Q5.1 Investment data

Candidate Location	Initial Investment (RM)	Direct Production Investment (RM)
Plant P (Malaysia)	3.0 million	150 / unit
Plant Q (Thailand)	2.5 million	120 / unit
Plant R (Bangladesh)	750,000	310 / unit
Plant S (Indonesia)	1.5 mil	190 / unit

- END OF QUESTIONS -

APPENDIX A

3% Compound Interest Factors 3%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Compound Amount Factor	Present Worth Factor	Gradient Uniform Series	Gradient Present Worth	
	Find *F* Given *P*	Find *P* Given *F*	Find *A* Given *F*	Find *A* Given *P*	Find *F* Given *A*	Find *P* Given *A*	Find *A* Given *G*	Find *P* Given *G*	
n	*F/P*	*P/F*	*A/F*	*A/P*	*F/A*	*P/A*	*A/G*	*P/G*	*n*
1	1.030	.9709	1.0000	1.0300	1.000	0.971	0	0	1
2	1.061	.9426	.4926	.5226	2.030	1.913	0.493	0.943	2
3	1.093	.9151	.3235	.3535	3.091	2.829	0.980	2.773	3
4	1.126	.8885	.2390	.2690	4.184	3.717	1.463	5.438	4
5	1.159	.8626	.1884	.2184	5.309	4.580	1.941	8.889	5
6	1.194	.8375	.1546	.1846	6.468	5.417	2.414	13.076	6
7	1.230	.8131	.1305	.1605	7.662	6.230	2.882	17.955	7
8	1.267	.7894	.1125	.1425	8.892	7.020	3.345	23.481	8
9	1.305	.7664	.0984	.1284	10.159	7.786	3.803	29.612	9
10	1.344	.7441	.0872	.1172	11.464	8.530	4.256	36.309	10

APPENDIX B

4% Compound Interest Factors 4%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Compound Amount Factor	Present Worth Factor	Gradient Uniform Series	Gradient Present Worth	
	Find *F* Given *P*	Find *P* Given *F*	Find *A* Given *F*	Find *A* Given *P*	Find *F* Given *A*	Find *P* Given *A*	Find *A* Given *G*	Find *P* Given *G*	
n	*F/P*	*P/F*	*A/F*	*A/P*	*F/A*	*P/A*	*A/G*	*P/G*	*n*
1	1.040	.9615	1.0000	1.0400	1.000	0.962	0	0	1
2	1.082	.9246	.4902	.5302	2.040	1.886	0.490	0.925	2
3	1.125	.8890	.3203	.3603	3.122	2.775	0.974	2.702	3
4	1.170	.8548	.2355	.2755	4.246	3.630	1.451	5.267	4
5	1.217	.8219	.1846	.2246	5.416	4.452	1.922	8.555	5

APPENDIX C

5% Compound Interest Factors 5%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Compound Amount Factor	Present Worth Factor	Gradient Uniform Series	Gradient Present Worth	
	Find *F* Given *P*	Find *P* Given *F*	Find *A* Given *F*	Find *A* Given *P*	Find *F* Given *A*	Find *P* Given *A*	Find *A* Given *G*	Find *P* Given *G*	
n	*F/P*	*P/F*	*A/F*	*A/P*	*F/A*	*P/A*	*A/G*	*P/G*	*n*
1	1.050	.9524	1.0000	1.0500	1.000	0.952	0	0	1
2	1.102	.9070	.4878	.5378	2.050	1.859	0.488	0.907	2
3	1.158	.8638	.3172	.3672	3.152	2.723	0.967	2.635	3
4	1.216	.8227	.2320	.2820	4.310	3.546	1.439	5.103	4
5	1.276	.7835	.1810	.2310	5.526	4.329	1.902	8.237	5
6	1.340	.7462	.1470	.1970	6.802	5.076	2.358	11.968	6
7	1.407	.7107	.1228	.1728	8.142	5.786	2.805	16.232	7
8	1.477	.6768	.1047	.1547	9.549	6.463	3.244	20.970	8
9	1.551	.6446	.0907	.1407	11.027	7.108	3.676	26.127	9
10	1.629	.6139	.0795	.1295	12.578	7.722	4.099	31.652	10