UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	ENGINEERING ECONOMY
COURSE CODE	:	BNP 30402
PROGRAMME CODE	:	BNA/BNB/BNC
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	2 HOURS
INSTRUCTION	:	1. ANSWER **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 **EIGHT (8)** PAGES

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Q1 (a) A company manufactures desktop for global market. This industry requires total manufacturing cost of RM400,000 to produce 110 units of desktop per month. The production can be increased to 170 units per month with total manufacturing cost of RM500,000.

(i) Show the linear equations for this case

(5 marks)

(ii) Determine the fixed cost (FC) and variable cost (VC)

(10 marks)

(b) Raysah has made a windfall gain of RM80,000. She has come up with three options of investing the money. First, she could buy a house in a nice neighborhood. Second, she could invest the money in stocks and shares, which are expected to increase in value by 25% per year. This, however, is a risky option. Third, she could put her money into a fixed deposit arrangement with a bank and earn 7.5% per year. There is little risk involved in taking the third option.

(i) If Raysah decides to purchase a house, what is the opportunity cost of this choice? Explain your reasoning.

(5 marks)

(ii) If Raysah invests in the stock market, what is the opportunity cost of this choice? Demonstrate your reasoning.

(5 marks)

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Q2 (a) A certain index for the cost of purchasing and installing utility reactors is keyed to 1995; where its baseline value was arbitrarily set at 100. Company ABC installed a 60,000 lb/hour reactor for RM500,000 in 2000 when the index had a value of 480. This same company must install another reactor of the same size in 2010. The index in 2010 is 570. What is the approximate cost of the new reactor?

(5 marks)

(b) The purchase price of a natural gas-fired commercial boiler (capacity Z) was RM200,000 eight years ago. If the cost index was 155 for this type of equipment when the capacity Z boiler was purchased and is 240 now, what is your estimation of the purchase price for the boiler?

(5 marks)

(c) A commercial office building has 20,000 gross square feet of retail space in the first floor, and the second floor has the same amount planed for office use. In addition, the size and location of the parking lot and the prime road frontage available along the property may offer some additional revenue resources. The details of the retails space are as follows:

  i. In the first floor, the retail space will be designed for two different uses:
      a. 60% for a restaurant operation (utilization: 79%; yearly rent: RM25/sq.feet)
      b. 40% for a retail clothing store (utilization: 83%; yearly rent: RM20/sq.feet)

  ii. There is a high probability that all the office space in the second floor will be leased to one client (utilization: 89%; yearly rent: RM15/sq.feet)

  iii. An estimated of 30 parking spaces can be rented on a long term basis to two existing businesses that adjoin the property (rate per month per parking space: RM25)

  iv. One spot along the road frontage can be leased to a sign company, for erection of a billboard (rate per month per billboard: RM70).

Based on the information given, analyse the potential revenue impacts of the commercial office building.

(15 marks)

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Q3 (a) Analyse which investment will be more worth to Sarah in 10 years: RM10,000 invested at 8.2% simple interest, or RM10,000 invested at 5% interest, compounded monthly? Explain why you choose the investment.

(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.

(5 Marks)

(c) When Mike was born, his father deposited RM2,345 into a savings account as a present for Mike when he turns 21. If this account earns 3.7% interest compounded semi-annually, estimate the amount that Mike will have on his birthday.

(5 marks)

(d) Mr. Ahmad is planning for his son, Malik, education. He is planning to send Malik to do engineering in UTHM when the time comes. Based on his current planning, he has 10 years to save a lump-sum amount for Malik's college education. He also had done some research on the current year fees and he found that for four-year education, it will cost him RM75,000 and this is expected to increase by 10% per year into the foreseeable future.

   (i) Estimate the total cost of Malik's education based on his four-year education with 10% increment per year.

(3 marks)

   (ii) Calculate the amount Mr. Ahmad must save each year for 10 years if he invests in a highly rated tax-free municipal bond that earns 6% per year, so that he could afford Malik's education.

(3 marks)

   (iii) Draw the cash flow time lines from Mr. Ahmad's point of view for **Q3(d)(i)**

(1 marks)

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Q4 (a) Identify each of the following cash flows to indicate whether it is a benefit, a disbenefit, or a cost. Justify your answer.

   (i) RM700, 000 per year maintenance by Port Klang authority.

   (ii) Expenditure of RM45 million for tunnel construction on East-West Highway.

   (iii) Reduction of RM375, 000 per year in car accident repairs because of improved lighting.

   (iv) RM700, 000 per year loss of revenue by farmers because of highway right-of-way purchases.

   (v) RM500, 000 saving in toll gate payment for new federal road.

(5 marks)

   (b) A new project has been proposed by UTHM management to build a new rail from UTHM Parit Raja to UTHM Pagoh for Teaching and Learning (T&L) courses related to Bachelor of Engineering Technology (Railway Transportation). The land acquisition is estimated to be RM 0.7 Million. Construction cost for the rail is expected to be RM1.2 Million with an additional annual maintenance cost of RM 80, 000. Finally, this new railway project will require a train controller with an annual cost of RM 36, 000. Annual benefits of the runaway have been estimated as in **Table Q4(b)**.

   Apply the B-C ratio method for both conventional and modified cases using PW method with a study period of 10 years and a MARR of 12% (**Table Q4(b)**) per year to determine whether the rail for UTHM should be erected.

(20 marks)

-END OF QUESTIONS-

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FINAL EXAMINATION

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LIST OF FORMULA

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

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

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

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

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

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

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

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

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

(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

6   **CONFIDENTIAL**

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FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2022/2023 PROGRAMME CODE : BNA/BNB/BNC
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6% Compound Interest Factors 6%

	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	
n	Find F Given P F/P	Find P Given F P/F	Find A Given F A/F	Find A Given P A/P	Find F Given A F/A	Find P Given A P/A	Find A Given G A/G	Find P Given G P/G	n
1	1.060	.9434	1.0000	1.0600	1.000	0.943	0	0	1
2	1.124	.8900	.4854	.5454	2.060	1.833	0.485	0.890	2
3	1.191	.8396	.3141	.3741	3.184	2.673	0.961	2.569	3
4	1.262	.7921	.2286	.2886	4.375	3.465	1.427	4.945	4
5	1.338	.7473	.1774	.2374	5.637	4.212	1.884	7.934	5
6	1.419	.7050	.1434	.2034	6.975	4.917	2.330	11.459	6
7	1.504	.6651	.1191	.1791	8.394	5.582	2.768	15.450	7
8	1.594	.6274	.1010	.1610	9.897	6.210	3.195	19.841	8
9	1.689	.5919	.0870	.1470	11.491	6.802	3.613	24.577	9
10	1.791	.5584	.0759	.1359	13.181	7.360	4.022	29.602	10
11	1.898	.5268	.0668	.1268	14.972	7.887	4.421	34.870	11
12	2.012	.4970	.0593	.1193	16.870	8.384	4.811	40.337	12
13	2.133	.4688	.0530	.1130	18.882	8.853	5.192	45.963	13
14	2.261	.4423	.0476	.1076	21.015	9.295	5.564	51.713	14
15	2.397	.4173	.0430	.1030	23.276	9.712	5.926	57.554	15
16	2.540	.3936	.0390	.0990	25.672	10.106	6.279	63.459	16
17	2.693	.3714	.0354	.0954	28.213	10.477	6.624	69.401	17
18	2.854	.3503	.0324	.0924	30.906	10.828	6.960	75.357	18
19	3.026	.3305	.0296	.0896	33.760	11.158	7.287	81.306	19
20	3.207	.3118	.0272	.0872	36.786	11.470	7.605	87.230	20

10% Compound Interest Factors 10%

	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	
n	Find F Given P F/P	Find P Given F P/F	Find A Given F A/F	Find A Given P A/P	Find F Given A F/A	Find P Given A P/A	Find A Given G A/G	Find P Given G P/G	n
1	1.100	.9091	1.0000	1.1000	1.000	0.909	0	0	1
2	1.210	.8264	.4762	.5762	2.100	1.736	0.476	0.826	2
3	1.331	.7513	.3021	.4021	3.310	2.487	0.937	2.329	3
4	1.464	.6830	.2155	.3155	4.641	3.170	1.381	4.378	4
5	1.611	.6209	.1638	.2638	6.105	3.791	1.810	6.862	5
6	1.772	.5645	.1296	.2296	7.716	4.355	2.224	9.684	6
7	1.949	.5132	.1054	.2054	9.487	4.868	2.622	12.763	7
8	2.144	.4665	.0874	.1874	11.436	5.335	3.004	16.029	8
9	2.358	.4241	.0736	.1736	13.579	5.759	3.372	19.421	9
10	2.594	.3855	.0627	.1627	15.937	6.145	3.725	22.891	10
11	2.853	.3505	.0540	.1540	18.531	6.495	4.064	26.396	11
12	3.138	.3186	.0468	.1468	21.384	6.814	4.388	29.901	12
13	3.452	.2897	.0408	.1408	24.523	7.103	4.699	33.377	13
14	3.797	.2633	.0357	.1357	27.975	7.367	4.996	36.801	14
15	4.177	.2394	.0315	.1315	31.772	7.606	5.279	40.152	15
16	4.595	.2176	.0278	.1278	35.950	7.824	5.549	43.416	16
17	5.054	.1978	.0247	.1247	40.545	8.022	5.807	46.582	17
18	5.560	.1799	.0219	.1219	45.599	8.201	6.053	49.640	18
19	6.116	.1635	.0195	.1195	51.159	8.365	6.286	52.583	19
20	6.728	.1486	.0175	.1175	57.275	8.514	6.508	55.407	20

7

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Table Q4(b): Annual Benefit of the UTHM Rail Project

Rental receipt from a train carrier	RM 400, 000
Management charge to train passengers	RM 50, 000
Convenience benefit to the UTHM community	RM 35, 000
Additional tourism for both UTHM Parit Raja and Pagoh	RM 40, 000

12%   **Compound Interest Factors**   **12%**

	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 F/P	Find P Given F P/F	Find A Given F A/F	Find A Given P A/P	Find F Given A F/A	Find P Given A P/A	Find A Given G A/G	Find P Given G P/G	
n									n
1	1.120	.8929	1.0000	1.1200	1.000	0.893	0	0	1
2	1.254	.7972	.4717	.5917	2.120	1.690	0.472	0.797	2
3	1.405	.7118	.2963	.4163	3.374	2.402	0.925	2.221	3
4	1.574	.6355	.2092	.3292	4.779	3.037	1.359	4.127	4
5	1.762	.5674	.1574	.2774	6.353	3.605	1.775	6.397	5
6	1.974	.5066	.1232	.2432	8.115	4.111	2.172	8.930	6
7	2.211	.4523	.0991	.2191	10.089	4.564	2.551	11.644	7
8	2.476	.4039	.0813	.2013	12.300	4.968	2.913	14.471	8
9	2.773	.3606	.0677	.1877	14.776	5.328	3.257	17.356	9
10	3.106	.3220	.0570	.1770	17.549	5.650	3.585	20.254	10
11	3.479	.2875	.0484	.1684	20.655	5.938	3.895	23.129	11
12	3.896	.2567	.0414	.1614	24.133	6.194	4.190	25.952	12
13	4.363	.2292	.0357	.1557	28.029	6.424	4.468	28.702	13
14	4.887	.2046	.0309	.1509	32.393	6.628	4.732	31.362	14
15	5.474	.1827	.0268	.1468	37.280	6.811	4.980	33.920	15
16	6.130	.1631	.0234	.1434	42.753	6.974	5.215	36.367	16
17	6.866	.1456	.0205	.1405	48.884	7.120	5.435	38.697	17
18	7.690	.1300	.0179	.1379	55.750	7.250	5.643	40.908	18
19	8.613	.1161	.0158	.1358	63.440	7.366	5.838	42.998	19
20	9.646	.1037	.0139	.1339	72.052	7.469	6.020	44.968	20
21	10.804	.0926	.0122	.1322	81.699	7.562	6.191	46.819	21
22	12.100	.0826	.0108	.1308	92.503	7.645	6.351	48.554	22
23	13.552	.0738	.00956	.1296	104.603	7.718	6.501	50.178	23
24	15.179	.0659	.00846	.1285	118.155	7.784	6.641	51.693	24
25	17.000	.0588	.00750	.1275	133.334	7.843	6.771	53.105	25

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