UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2020/2021

COURSE NAME	:	ENGINEERING ECONOMY
COURSE CODE	:	BDA 40902
PROGRAMME CODE	:	4 BDD
EXAMINATION DATE	:	JULY 2021
EXAMINATION PERIOD	:	2 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS IN **SECTION A**
		2. SELECT **ONE (1)** QUESTION FROM **TWO (2)** QUESTIONS PROVIDED IN **SECTION B**

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

SECTION A

Q1   (a)   Engineering economy is useful in the selection of alternatives, not their identification. Explain this statement.

(2 marks)

(b)   Two methods can be used for assembling certain components of an electron microscope. The cost of the equipment associated with each method is shown below in **Table Q1(b)**.

Table Q1(b): Cost of Equipment

Cost Items	Method X	Method Y
First cost, RM	-145,000	-195,000
M & O, RM per year	-82,000	-46,000
Savage value, RM	35,000	61,000
Life, years	4	4

(i)   At an interest rate of 10% per year, evaluate which method should be selected based on a Present Worth (PW) analysis. Your answer should include the cash flow diagram for each method.

(12 marks)

(ii)   Based on your answer, explain your rationale for the choice.

(3 marks)

(c)   A new piece of equipment has been proposed by Ahmad Consultant to upgrade the water quality at ABC Camp Site. The investment cost is RM 35,000 with salvage value of RM 3,000 after 4 years. The revenue generated from the installation of the equipment minus the operating and maintenance cost of the equipment is RM6,500 per year.

(i)   Draw a cash flow diagram to reflects the case study

(4 marks)

(ii)   If the MARR is 15% per year, evaluate whether this equipment is deserved to be installed? Use the Future Worth (FW) method for your answer.

(4 marks)

Q2   (a)   Identify each of the following cash flow to indicate whether it is a benefit, a disbenefit, or a cost

(i)   Loss of income to local business because of a new freeway

(1 mark)

(ii)   Less travel time because of a loop bypass

(1 mark)

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(iii) RM 40,000 annual income to local businesses because of tourism created by a national park

(1 mark)

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

(1 mark)

(v) Expenditure of RM 45 million for tunnel construction on an East-West coast highway

(1 mark)

(b) The Hospital Sultanah Aminah Johor Bahru intends to purchase a machine which can accurately analyse a heart disease. The detail cost and benefit of two machines proposed are shown in the **Table Q2(b)** below.

Table Q2(b): Cost and Benefit

Cost and Benefit Items	Machine A	Machine B
Initial cost, RM	15,000	19,000
Annual operation cost, RM per year	10,000	12,000
Annual income, RM per year	15,000	20,000

If MARR is at 10% per year and the life of each machine is 10 years, justify which is the most profitable machine to be used. Use annual operation cost as disbenefit and use the following methods for evaluation purposes.

(i) Conventional PW B/C ratio

(10 marks)

(ii) Modified PW B/C ratio

(10 marks)

Q3 (a) For equipment that has a first cost of RM 10,000 and the estimated operating costs and year-end salvage values shown in **Table Q3(a)** below, determine the economic service life at i = 10% per year.

Table Q3(a)

Year	Operating Cost, RM per Year	Salvage Value, RM
1	-1,000	7,000
2	-1,200	5,000
3	-1,300	4,500
4	-2,000	3,000
5	-3,000	2,000

(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

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(challenger). The details of the cost required are shown in **Table Q3(b)** below. Use an interest rate of 20% per year.

Table Q3(b)

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)   Use the replacement analysis to justify whether the existing equipment is required to be replaced with the new equipment.

(10 marks)

(ii)   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)

SECTION B

Q4   (a)   Identify each of the following cash items whether it is fixed cost, variable cost, sunk cost, or opportunity cost

(i)   Total of RM 25,000 income forgone by an engineering student that choose to further their study.

(1 mark)

(ii)   Someone gives up going to see a movie to study for a test in order to get a good grade.

(1 mark)

(iii)   Installation of a new software system and working practices.

(1 mark)

(iv)   The cost of RM 10,000 for land acquisition of building a water tank with two options of materials.

(1 mark)

(v)   Total cost of RM 245,000 for labor and materials in the construction site.

(1 mark)

(b)   The fixed costs at Company X are RM 1 million annually. The main product has revenue of RM 8 90 per unit and RM 4.50 variable cost.

(i)   Determine the breakeven quantity per year

(4 marks)

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(ii)   Calculate the annual profit if 200,000 units are sold.

(3 marks)

(c)   A product currently sells for RM 12 per unit. The variable costs are RM 4 per unit, and 10,000 units are sold annually and a profit of RM 30,000 is realized per year. A new design will increase the variable costs by 20% and fixed costs by 10% but sales will increase to 12,000 units per year.

(i)   Calculate the new fixed cost and variable cost.

(5 marks)

(ii)   Determine the selling price at break even.

(5 marks)

(iii)   If the selling price is to be kept same (RM 12 per unit), determine what will the annual profit be.

(3 marks)

Q5   (a)   Fill in the missing values (A through D) in the **Table Q5(a)** below for a loan of RM 10,000 if the interest rate is compounded at 10% per year.

Table Q5(a)

End of Year	Interest for Year	Amount Owed After Interest	End of Year Payment	Amount Owed After Payment
0	-	-	-	10,000
1	1,000	11,000	2,000	9,000
2	900	9,900	2,000	A
3	B	C	2,000	D

(4 marks)

(b)   En. Ahmad bought a house for RM 240,000 and paid 10% deposit. The balance is paid by a loan with 4% interest per annum. The payment of the loan is paid monthly for 20 years. Calculate the equity value of the house if it is sold at the end of year five with a value of RM260,000. (Equity is the difference between house market value and balance of the loan at the end of year 5).

(8 marks)

(c)   Determine how much money can an engineer borrow now to start up his new consulting office if he commits to make payments of RM 15,000 per year for 5 years. Assume the loan interest rate is 8% per year. You answer shall include the related cash flow diagram.

(6 marks)

(d)   An entrepreneurial new civil engineering graduate started a lab for testing endocrine disrupting compounds. The lab just broke even the first year, but in years 2 through 5, it made a profit of RM 97,000 each year. Calculate what is the present worth in year 0 of the profit at an interest rate of 10% per year? You answer shall include the related cash flow diagram.

(7 marks)

- END OF QUESTION –

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LIST OF FORMULA

1	$TC = FC + VC(Q)$	9	Conventional B-C ratio with PW $B\text{-}C = PW(B) \div [(I - PW(MV)) + PW(O\&M)]$
2	$TR = P \times Q$	10	Conventional B-C ratio with AW $B\text{-}C = AW(B) \div [CR + AW(O\&M)]$
3	$I_{effective} = \left(1 + \dfrac{r}{m}\right)^m - 1$	11	Modified B-C ratio with PW $B\text{-}C = [PW(B) - PW(O\&M)] \div [I - PW(MV)]$
4	$p\,(1 + i)^n$	12	Modified B-C ratio with PW $B\text{-}C = [AW(B) \quad AW(O\&M)] \div CR$
5	$F = P\left(\dfrac{F}{P}, i, n\right) = P(1 + i)^n$	13	$P = F\left(\dfrac{P}{F}, i, n\right) - F\left[\dfrac{1}{(1 + i)^n}\right]$
6	$F = A\left(\dfrac{F}{A}, i, n\right) = A\left[\dfrac{(1 + i)^n - 1}{i}\right]$	14	$A = F\left(\dfrac{A}{F}, i, n\right) = F\left[\dfrac{i}{(1 + i)^n - 1}\right]$
7	$P = A\left(\dfrac{P}{A}, i, n\right) = A\left[\dfrac{(1 + i)^n - 1}{i(1 + i)^n}\right]$	15	$A = P\left(\dfrac{A}{P}, i, n\right) = P\left[\dfrac{i(1 + i)^n}{(1 + i)^n - 1}\right]$
8	$CR_k = -P(A/P, i, k) + S_k(A/F, i, k)$	16	$AW_k = -CR_k - AOC$

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INTEREST TABLE

8.0% — Compound Interest Factors

	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
1	1.0800	0.9259	1.0000	1.0800	1.0000	0.926	0.000	0.000
2	1.1664	0.8573	0.4808	0.5608	2.080	1.783	0.481	0.857
3	1.2597	0.7938	0.3080	0.3880	3.246	2.577	0.949	2.445
4	1.3605	0.7350	0.2219	0.3019	4.506	3.312	1.404	4.650
5	1.4693	0.6806	0.1705	0.2505	5.867	3.993	1.846	7.372
6	1.5869	0.6302	0.1363	0.2163	7.336	4.623	2.276	10.523
7	1.7138	0.5835	0.1121	0.1921	8.923	5.206	2.694	14.024
8	1.8509	0.5403	0.0940	0.1740	10.637	5.747	3.099	17.806
9	1.9990	0.5002	0.0801	0.1601	12.488	6.247	3.491	21.808
10	2.1589	0.4632	0.0690	0.1490	14.487	6.710	3.871	25.977
11	2.3316	0.4289	0.0601	0.1401	16.645	7.139	4.240	30.266
12	2.5182	0.3971	0.0527	0.1327	18.977	7.536	4.596	34.634
13	2.7196	0.3677	0.0465	0.1265	21.495	7.904	4.940	39.046
14	2.9372	0.3405	0.0413	0.1213	24.215	8.244	5.273	43.472
15	3.1722	0.3152	0.0368	0.1168	27.152	8.559	5.594	47.886
16	3.4259	0.2919	0.0330	0.1130	30.324	8.851	5.905	52.264
17	3.7000	0.2703	0.0296	0.1096	33.750	9.122	6.204	56.588
18	3.9960	0.2502	0.0267	0.1067	37.450	9.372	6.492	60.843
19	4.3157	0.2317	0.0241	0.1041	41.446	9.604	6.770	65.013
20	4.6610	0.2145	0.0219	0.1019	45.762	9.818	7.037	69.090
21	5.0338	0.1987	0.0198	0.0998	50.423	10.017	7.294	73.063
22	5.4365	0.1839	0.0180	0.0980	55.457	10.201	7.541	76.926
23	5.8715	0.1703	0.0164	0.0964	60.893	10.371	7.779	80.673
24	6.3412	0.1577	0.0150	0.0950	66.765	10.529	8.007	84.300
25	6.8485	0.1460	0.0137	0.0937	73.106	10.675	8.225	87.804
26	7.3964	0.1352	0.0125	0.0925	79.954	10.810	8.435	91.184
27	7.9881	0.1252	0.0114	0.0914	87.351	10.935	8.636	94.439
28	8.6271	0.1159	0.0105	0.0905	95.339	11.051	8.829	97.569
29	9.3173	0.1073	0.0096	0.0896	103.966	11.158	9.013	100.574
30	10.063	0.0994	0.0088	0.0888	113.283	11.258	9.190	103.456

	Discrete compounding; $i = 10\%$					
Factor	Compound Amount	Present Worth	Capital Recovery	Present Worth	Compound Amount	Sinking Fund
n	F/P	P/F	A/P	P/A	F/A	A/F
1	1.1000	0.9091	1.1000	0.9091	1.0000	1.0000
2	1.2100	0.8264	0.5762	1.7355	2.1000	0.4762
3	1.3310	0.7513	0.4021	2.4869	3.3100	0.3021
4	1.4641	0.6830	0.3155	3.1699	4.6410	0.2155
5	1.6105	0.6209	0.2638	3.7908	6.1051	0.1638
6	1.7716	0.5645	0.2296	4.3553	7.7156	0.1296
7	1.9487	0.5132	0.2054	4.8684	9.4872	0.1054
8	2.1436	0.4665	0.1874	5.3349	11.4359	0.0874
9	2.3579	0.4241	0.1736	5.7590	13.5795	0.0736
10	2.5937	0.3855	0.1627	6.1446	15.9374	0.0627
11	2.8531	0.3505	0.1540	6.4951	18.5312	0.0540
12	3.1384	0.3186	0.1468	6.8137	21.3843	0.0468
13	3.4523	0.2897	0.1408	7.1034	24.5227	0.0408
14	3.7975	0.2633	0.1357	7.3667	27.9750	0.0357
15	4.1772	0.2394	0.1315	7.6061	31.7725	0.0315
16	4.5950	0.2176	0.1278	7.8237	35.9497	0.0278
17	5.0545	0.1978	0.1247	8.0216	40.5447	0.0247
18	5.5599	0.1799	0.1219	8.2014	45.5992	0.0219
19	6.1159	0.1635	0.1195	8.3649	51.1591	0.0195
20	6.7275	0.1486	0.1175	8.5136	57.2750	0.0175
21	7.4002	0.1351	0.1156	8.6487	64.0025	0.0156
22	8.1403	0.1228	0.1140	8.7715	71.4027	0.0140
23	8.9543	0.1117	0.1126	8.8832	79.5430	0.0126
24	9.8497	0.1015	0.1113	8.9847	88.4973	0.0113
25	10.8347	0.0923	0.1102	9.0770	98.3471	0.0102

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| JADUAL 19 - Aliran Tunai Diskret: Faktor Faedah Kompaun | | | | | | | i = 15% |

	Single Payments		Uniform Series Payments				Arithmetic Gradients	
n	Compound Amount F/P	Present Worth P/F	Sinking Fund A/F	Compound Amount F/A	Capital Recovery A/P	Present Worth P/A	Gradient Present Worth P/G	Gradient Uniform Series A/G
1	1.1500	0.8696	1.00000	1.0000	1.15000	0.8696		
2	1.3225	0.7561	0.46512	2.1500	0.61512	1.6257	0.7561	0.4651
3	1.5209	0.6575	0.28798	3.4725	0.43798	2.2832	2.0712	0.9071
4	1.7490	0.5718	0.20027	4.9934	0.35027	2.8550	3.7864	1.3263
5	2.0114	0.4972	0.14832	6.7424	0.29832	3.3522	5.7751	1.7228
6	2.3131	0.4323	0.11424	8.7537	0.26424	3.7845	7.9368	2.0972
7	2.6600	0.3759	0.09036	11.0668	0.24036	4.1604	10.1924	2.4498
8	3.0590	0.3269	0.07285	13.7268	0.22285	4.4873	12.4807	2.7813
9	3.5179	0.2843	0.05957	16.7858	0.20957	4.7716	14.7548	3.0922
10	4.0456	0.2472	0.04925	20.3037	0.19925	5.0188	16.9795	3.3832
11	4.6524	0.2149	0.04107	24.3493	0.19107	5.2337	19.1289	3.6549
12	5.3503	0.1869	0.03448	29.0017	0.18448	5.4206	21.1849	3.9082
13	6.1528	0.1625	0.02911	34.3519	0.17911	5.5831	23.1352	4.1438
14	7.0757	0.1413	0.02469	40.5047	0.17469	5.7245	24.9725	4.3624
15	8.1371	0.1229	0.02102	47.5804	0.17102	5.8474	26.6930	4.5650
16	9.3576	0.1069	0.01795	55.7175	0.16795	5.9542	28.2960	4.7522
17	10.7613	0.0929	0.01537	65.0751	0.16537	6.0472	29.7828	4.9251
18	12.3755	0.0808	0.01319	75.8364	0.16319	6.1280	31.1565	5.0843
19	14.2318	0.0703	0.01134	88.2118	0.16134	6.1982	32.4213	5.2307
20	16.3665	0.0611	0.00976	102.4436	0.15976	6.2593	33.5822	5.3651
21	18.8215	0.0531	0.00842	118.8101	0.15842	6.3125	34.6448	5.4883
22	21.6447	0.0462	0.00727	137.6316	0.15727	6.3587	35.6150	5.6010
23	24.8915	0.0402	0.00628	159.2764	0.15628	6.3988	36.4988	5.7040
24	28.6252	0.0349	0.00543	184.1678	0.15543	6.4338	37.3023	5.7979
25	32.9190	0.0304	0.00470	212.7930	0.15470	6.4641	38.0314	5.8834
26	37.8568	0.0264	0.00407	245.7120	0.15407	6.4906	38.6918	5.9612
27	43.5353	0.0230	0.00353	283.5688	0.15353	6.5135	39.2890	6.0319
28	50.0656	0.0200	0.00306	327.1041	0.15306	6.5335	39.8283	6.0960
29	57.5755	0.0174	0.00265	377.1697	0.15265	6.5509	40.3146	6.1541
30	66.2118	0.0151	0.00230	434.7451	0.15230	6.5660	40.7526	6.2066
31	76.1435	0.0131	0.00200	500.9569	0.15200	6.5791	41.1466	6.2541
32	87.5651	0.0114	0.00173	577.1005	0.15173	6.5905	41.5006	6.2970
33	100.6998	0.0099	0.00150	664.6655	0.15150	6.6005	41.8184	6.3357
34	115.8048	0.0086	0.00131	765.3654	0.15131	6.6091	42.1033	6.3705
35	133.1755	0.0075	0.00113	881.1702	0.15113	6.6166	42.3586	6.4019
40	267.8635	0.0037	0.00056	1779.09	0.15056	6.6418	43.2830	6.5168
45	538.7693	0.0019	0.00028	3585.13	0.15028	6.6543	43.8051	6.5830
50	1083.66	0.0009	0.00014	7217.72	0.15014	6.6605	44.0958	6.6205
55	2179.62	0.0005	0.00007	14524	0.15007	6.6636	44.2558	6.6414
60	4384.00	0.0002	0.00003	29220	0.15003	6.6651	44.3431	6.6530
65	8817.79	0.0001	0.00002	58779	0.15002	6.6659	44.3903	6.6593
70	17736	0.0001	0.00001		0.15001	6.6663	44.4156	6.6627
75	35673				0.15000	6.6665	44.4292	6.6646
80	71751				0.15000	6.6666	44.4364	6.6656
85					0.15000	6.6666	44.4402	6.6661