Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	ENGINEERING ECONOMY
COURSE CODE	:	BDA 40902
PROGRAMME CODE	:	4 BDD
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
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 **NINE (9)** PAGES

SECTION A

Q1 (a) Define engineering economy.

(2 marks)

(b) Describe why engineering economy is important to engineers?

(4 marks)

(c) CGK Rheosystems makes high-performance rotational viscometers capable of steady shear and yield stress testing in a rugged, compact footprint. Determine how much could the company afford to spend now on new equipment in lieu of spending RM200,000 one year from now and RM300,000 three years from now, if the company uses an interest rate of 15% per year?

(5 marks)

(d) A company is considering constructing a plant to manufacture a proposed new product. The land costs RM300,000, the building costs RM600,000, the equipment costs RM250,000, and RM100,000 additional working capital is required. It is expected that the product will result in sales of RM750,000 per year for 10 years, at which time the land can be sold for RM400,000, the building for RM350,000, and the equipment for RM50,000. All of the working capital would be recovered at the end of year 10. The annual expenses for labor, materials, and all other items are estimated to total RM475,000. If the company requires a MARR of 15% per year on projects of comparable risk, determine if it should invest in the new product line. Use the AW method.

(14 marks)

Q2 (a) Identify each of the following cash flows whether it is a benefit, dis-benefit 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 a East-West coast highway.

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

(iv) RM650,000 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 RM0.7 Million. Construction cost for the rail is expected to be RM1.2 Million with an additional annual maintenance cost of RM80,000. Finally, this new railway project will require a train controller with an annual

cost of RM36, 000. Annual benefits of the runaway have been estimated as in **Table Q2(b).**

Table Q2(b): Annual Benefits of the UTHM Rail Project

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

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

(i) Conventional B-C with PW

(10 marks)

(ii) Modified B-C with PW

(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) (i) State the difference between today's RM and constant-value RM.

(3 marks)

(ii) Determine the annual inflation rate is implied from an inflation-adjusted interest rate of 10% per year, when the real interest rate is 4% per year.

(4 marks)

(iii) Assume that you want to retire 30 years from now with an amount of money that will have the same value (same purchasing power) as RM 1.5 million today. If you estimate the inflation rate will be 4% per year, determine the future (then- current) RM will you need.

(4 marks)

(iv) If the inflation rate is 7% per year, calculate how many years it will take for the cost of something to double when prices increase at exactly the same rate as inflation.

(4 marks)

SECTION B

Q4 (a) Classify each of the following cost items as either fixed or variable cost;

(i) Director of the company's car

(ii) Water for ice cube company

(iii) Engineers salaries

(iv) Electricity for machinery in production floor

(v) Land taxes

(5 marks)

(b) Describe the life-cycle cost concept and justify why is the potential for achieving life-cycle cost savings greatest in the acquisition phase of the life cycle.

(5 marks)

(c) State which of the following statements are true and which are false.

(i) Working capital is a variable cost.

(ii) The greatest potential for cost savings occurs in the operation phase of the life cycle

(iii) If the capacity of an operation is significantly changed (e.g., a manufacturing plant), the fixed costs will also change.

(iv) Indirect costs can normally be allocated to a specific output or work activity.

(v) Standard costs per unit of output are established in advance of actual production or service delivery.

(5 marks)

(d) Tech Engineering Inc. makes a consumer product with the fixed cost/year = RM130,000 and variable cost/unit = RM15.

(i) Determine the breakeven production quantity per year for the current process, if the selling price/unit is RM40 at all production levels.

(5 marks)

(ii) Suppose Tech Engineering has the opportunity to switch to a new production process with fixed cost/year = RM110,000 and variable cost/unit = RM20.

The selling price/unit will not be affected. Determine what range of production the new process would be preferred over the current process.

(5 marks)

Q5 (a) Major overhaul expenses of RM5,000 each are anticipated for a large piece of earthmoving equipment. The expenses will occur at the end of year four and will continue every three years thereafter up to and including year 13. The interest rate is 12% per year

(i) Draw a cash flow diagram.

(2 marks)

(ii) Determine what is the present equivalent of the overhaul expenses at time 0.

(5 marks)

(iii) Calculate how much is the annual equivalent expense during only years 5–13.

(3 marks)

(b) A company airline intends to buy an engine system to be mounted on its new aircraft. There are two engine systems in the market and the cost information for both systems are as illustrated in **Table Q5(b)**. The useful life of each engine system is 5 years. At the end of the life cycle, each system has a salvage value of 10% of the initial cost. If the fuel cost is RM 1.25 per gallon and assume the aircraft operates for 2,000 hours per year and the MARR is 10% per year

Table Q5(b)

System A	System B
Initial cost = RM100,000	Initial cost = RM200,000
Fuel usage = 40,000 gllons for 1,000 hours of operation	Fuel usage = 32,000 gllons for 1,000 hours of operation
Operation and Maintenance cost = RM10,000 per year	Operation and Maintenance cost = RM10,000 per year

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

(6 marks)

(ii) Apply the PW method and propose the suitable engine system that the company should purchase.

(9 marks)

- END OF QUESTION -

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LIST OF FORMULA

1	TC = FC + VC(Q)	9	Conventional B-C ratio with PW B-C = PW(B) ÷ [(I – PW(MV)) +PW(O&M)]
2	TR = P x Q	10	Conventional B-C ratio with AW B-C = AW(B) ÷ [CR + AW(O&M)]
3	$I_{effective} = \left(1 + \frac{r}{m}\right)^m - 1$	11	Modified B-C ratio with PW B-C = [PW(B) – PW(O&M)] ÷ [I – PW(MV)]
4	$p\,(1+i)^n$	12	Modified B-C ratio with PW B-C = [AW(B) – AW(O&M)] ÷ CR
5	$F = P\left(\frac{F}{P}, i, n\right) = P(1+i)^n$	13	$P = F\left(\frac{P}{F}, i, n\right) = F\left[\frac{1}{(1+i)^n}\right]$
6	$F = A\left(\frac{F}{A}, i, n\right) = A\left[\frac{(1+i)^n - 1}{i}\right]$	14	$A = F\left(\frac{A}{F}, i, n\right) = F\left[\frac{i}{(1+i)^n - 1}\right]$
7	$P = A\left(\frac{P}{A}, i, n\right) = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$	15	$A = P\left(\frac{A}{P}, i, n\right) = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$
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

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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Discrete compounding; i = 12%						
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	1.1200	0.8929	1.1200	0.893	1.000	1.0000
2	1.2544	0.7972	0.5917	1.690	2.120	0.4717
3	1.4049	0.7118	0.4163	2.402	3.374	0.2963
4	1.5735	0.6355	0.3292	3.037	4.779	0.2092
5	1.7623	0.5674	0.2774	3.605	6.353	0.1574
6	1.9738	0.5066	0.2432	4.111	8.115	0.1232
7	2.2107	0.4523	0.2191	4.564	10.089	0.0991
8	2.4760	0.4039	0.2013	4.968	12.300	0.0813
9	2.7731	0.3606	0.1877	5.328	14.776	0.0677
10	3.1058	0.3220	0.1770	5.650	17.549	0.0570
11	3.4785	0.2875	0.1684	5.938	20.655	0.0484
12	3.8960	0.2567	0.1614	6.194	24.133	0.0414
13	4.3635	0.2292	0.1557	6.424	28.029	0.0357
14	4.8871	0.2046	0.1509	6.628	32.393	0.0309
15	5.4736	0.1827	0.1468	6.811	37.280	0.0268
16	6.1304	0.1631	0.1434	6.974	42.753	0.0234
17	6.8660	0.1456	0.1405	7.120	48.884	0.0205
18	7.6900	0.1300	0.1379	7.250	55.750	0.0179
19	8.6128	0.1161	0.1358	7.366	63.440	0.0158
20	9.6463	0.1037	0.1339	7.469	72.052	0.0139
21	10.804	0.0926	0.1322	7.562	81.699	0.0122
22	12.100	0.0826	0.1308	7.645	92.503	0.0108
23	13.552	0.0738	0.1296	7.718	104.603	0.0096
24	15.179	0.0659	0.1285	7.784	118.155	0.0085
25	17.000	0.0588	0.1275	7.843	133.334	0.0075

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

n	Single Payments		Uniform Series Payments				Arithmetic Gradients	
	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