Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	ENGINEERING ECONOMY
COURSE CODE	:	BDA 40902
PROGRAMME CODE	:	4 BDD
EXAMINATION DATE	:	JUNE / JULY 2019
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) Define engineering economy.

(2 marks)

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

(4 marks)

(c) A company plans to build a combined cycle power plant at Ulu Tiram, Johor. The pertinent cost data are as shown in **Table Q1** below. As an engineer, you are being asked to evaluate the combined cycle power plant using the PW method when the interest is 12% per year.

Table Q1

Items	Cost
1. Initial cost	RM 13,000
2. Annual operating expenses	RM 1,000
3. Maintenance cost (End of 5th. Year)	RM 200
4. Maintenance cost (End of 10th. Year)	RM 550
5. Salvage value (End of 15 years)	RM 3,000

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

(4 marks)

(ii) Evaluate whether the plan can be proceeded or not.

(15 marks)

Q2 (a) Identify each of the following cash flows whether it is a benefit, a disbenefit, or a cost.

(i) Decrease in property values due to the closure of a government research lab.

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

(iii) Revenue to local motels because of an extended weekend holiday.

(iv) Less tire wear because of smoother road surfaces

(v) School overcrowded because of a military base expansion

(5 marks)

(b) Oil spills in the Gulf of Mexico have been known to cause extensive damage to both public and private oyster grounds along the Louisiana and Mississippi shores. One way to protect shellfish along the shoreline is to release large volumes of freshwater from the Mississippi River to flush oil out to sea. This procedure inevitably results in death to some of the saltwater shellfish while preventing more widespread destruction to public reefs. Oil containment booms and other temporary structures can also be used to intercept floating oil before it damages sensitive fishing grounds. If the Fish and Wildlife Service spent RM 110 million in year 0 and RM 50 million in years 1 and 2 to minimize environmental damage from one particular oil spill,

determine the benefit-to-cost ratio provided the efforts resulted in saving 3,000 jobs valued at a total of RM 175 million per year? Assume disbenefits associated with oyster deaths amounted to RM 30 million in year 0. Use a 5-year study period for an interest rate of 8% per year.

(10 marks)

(c) Select the better of two proposals shown in **Table Q2** below to improve street safety and lighting in Batu Pahat central. Use a B/C analysis and an interest rate of 8% per year.

(10 marks)

Table Q2

Items	Proposal 1	Proposal 2
Initial cost (RM)	900,000	1.7 millions
Annual maitenance & operation (RM/year)	120,000	60,000
Annual benefits (RM/year)	530,000	650,000
Annual disbenefits (RM/year)	300,000	195,000
Life (years)	10	20

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** below, determine the economic service life at i = 10% per year.

Table Q3

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 will it 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) General Manager car

(ii) Water for car wash shop

(iii) Executive salaries

(iv) Electricity for the machinery in production floor

(v) Air-conditioning for the clean room in production floor

(vi) Operation and maintenance of building

(6 marks)

(b) As the price of gasoline goes up, people are willing to drive farther to fill their tank in order to save money. Assume you had been buying gasoline for RM 2.90 per gallon and that it went up to RM 2.98 per gallon at the station where you usually go. If you drive an F-150 pickup that gets 18 miles per gallon, determine how much is the round-trip distance you can drive to break even if it will take 20 gallons to fill your tank?

(4 marks)

(c) A call center in India used by U.S. and U.K. credit card holders has a capacity of 1,400,000 calls annually. The fixed cost of the center is RM 775,000 with an average variable cost of RM 1 and price of RM 2.50 per call.

(i) Calculate the percentage of the call capacity that must be placed each year to break even.

(5 marks)

(ii) The center manager expects to dedicate the equivalent of 500,000 of the 1,400,000 capacity to a new product line. This is expected to increase the center's fixed cost to RM 900,000 of which 50% will be allocated to the new product line. Determine the average price per call necessary to make 500,000 calls the breakeven point for only the new product.

(7 marks)

(iii) Compare this new required price with the current center price of RM 2.50 per call.

(3 marks)

Q5 (a) (i) Calculate how much is RM 2,500 at time zero after six years if the interest rate is 10% per year.

(5 marks)

(ii) Determine how much would is needed today to provide an annual amount of RM 50,000 each year for 20 years, at 10% interest compounded quarterly per year. (Use effective interest method)

(5 marks)

(b) A structural engineering consulting company is examining its cash flow requirements for the next 6 years. The company expects to replace office machines and computer equipment at various times over the 6-year planning period. Specifically, the company expects to spend $21,000 two years from now, $24,000 three years from now, and $10,000 five years from now. What is the present worth of the planned expenditures at an interest rate of 10% per year, compounded semi-annually?

(i) Draw a cash flow diagram to represent the planning of this company.
(5 marks)

(ii) Determine the present worth of the planned expenditures at an interest rate of 10% per year if it has been compounded semiannually.
(10 marks)

- END OF QUESTIONS –

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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

5.0%

	Single Payment		Uniform Payment Series			
	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Compound Amount Factor	Present Worth Factor
	Find F Given P	Find P Given F	Find A Given F	Find A Given P	Find F Given A	Find P Given A
n	***F/P***	***P/F***	***A/F***	***A/P***	***F/A***	***P/A***
1	1.0500	0.9524	1.0000	1.0500	1.000	0.952
2	1.1025	0.9070	0.4878	0.5378	2.050	1.859
3	1.1576	0.8638	0.3172	0.3672	3.153	2.723
4	1.2155	0.8227	0.2320	0.2820	4.310	3.546
5	1.2763	0.7835	0.1810	0.2310	5.526	4.329
6	1.3401	0.7462	0.1470	0.1970	6.802	5.076
7	1.4071	0.7107	0.1228	0.1728	8.142	5.786
8	1.4775	0.6768	0.1047	0.1547	9.549	6.463
9	1.5513	0.6446	0.0907	0.1407	11.027	7.108
10	1.6289	0.6139	0.0795	0.1295	12.578	7.722
11	1.7103	0.5847	0.0704	0.1204	14.207	8.306
12	1.7959	0.5568	0.0628	0.1128	15.917	8.863
13	1.8856	0.5303	0.0565	0.1065	17.713	9.394
14	1.9799	0.5051	0.0510	0.1010	19.599	9.899
15	2.0789	0.4810	0.0463	0.0963	21.579	10.380
16	2.1829	0.4581	0.0423	0.0923	23.657	10.838
17	2.2920	0.4363	0.0387	0.0887	25.840	11.274
18	2.4066	0.4155	0.0355	0.0855	28.132	11.690
19	2.5270	0.3957	0.0327	0.0827	30.539	12.085
20	2.6533	0.3769	0.0302	0.0802	33.066	12.462

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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

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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