Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2017/2018

COURSE NAME	:	ENGINEERING ECONOMY
COURSE CODE	:	BPK 30902
PROGRAMME CODE	:	BPF/BFF/BDD/BDC/BDM/BNF/BNG/ BNM/BND/BNE
EXAMINATION DATE	:	DECEMBER 2017 / JANUARY 2018
EXAMINATION PERIOD	:	2 HOURS
INSTRUCTION	:	ANSWER **ALL QUESTIONS**

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

Q1 (a) Define Engineering Economy.

(1 mark)

(b) List **SEVEN (7)** steps in the fundamental principles of Engineering Economy.

(7 marks)

(c) Explain the difference between explicit and implicit costs using relevant examples.

(4 marks)

(d) DK is thinking of chartering a bus to take people to an event in a large city. He is providing transportation, tickets to the event, and refreshments on the bus. He predicted the following expenses: Bus rental is RM80.00, event ticket costs RM12.50 per person, gas expenses is RM75.00, and refreshment charge is RM7.50 per person. Other costs are fuels at RM20.00 and the bus driver allowance at RM50.00.

(i) Calculate the total fixed costs and total variable costs.

(2 marks)

(ii) Develop a formula for the total cost and evaluate the potential possibilities to make money from the trip. DK believes that he could attract 30 peoples at RM35.00 per ticket.

(3 marks)

(iii) Determine the breakeven point

(2 marks)

(e) Five years ago, a big construction company in Malaysia has invested in three machines for the construction of the Sabah - Sarawak Expressway at a total cost of RM1,000,000. The detail of each of the machine costs are shown in Table **Q1(e)** with a fixed depreciation value allocation for every machine is 10 percent per year. The company plans to replace the old machine with a brand new fully computerized machine. The old machineries will be sold at an estimated 30 percent of the original price to another company.

Table Q1(e): Types of Machines

Type of Machine	Price (RM)
Machine A	250,000
Machine B	475,000
Machine C	275,000

Determine the book value and the sunk cost for Machine A, Machine B and Machine C.

(6 marks)

Q2 (a) Site work activities associated with constructing a small bridge are shown in the **Table Q2(a)** below. The table includes the quantity of each activity, the unit of measurement associated with each activity, and the unit cost of each activity.

Table Q2(a): Site work activities

Activity	Quantity	Unit of measurement	Labor unit cost, RM	Equipment cost, RM	Material unit cost, RM
Excavation, unclassified	1667	cy	1.35	1.43	0
Excavation, structural	120	cy	21.31	5.00	0
Backfill, compacted	340	cy	7.78	1.72	0
Pile-driving rig	job	ls	5688	6420	300
Piling, steel, driving	2240	lf	3.13	2.93	16.57

Legend: cy =cubic yard; ls=lump sum; lf= linear foot

Compute:

(i) The total cost for structural excavation.

(2 marks)

(ii) The total cost for the pile-driving rig.

(2 marks)

(iii) The total labor cost for the site work

(4 marks)

(b) Assume that Tenaga Nasional Berhad plans to build a 900-MW hydroelectric power plant at Rajang River, Sarawak. It is known that a 250-MW plant cost RM1.2 billion 10 years ago with a cost index of 200. The cost capacity factor for a hydroelectric power plant is 0.85.

Compute:

(i) The current cost of 250-MW hydroelectric power plant if the cost index now is 900.

(4 marks)

(ii) The cost to build a 900-MW hydroelectric plant.

(4 marks)

(c) **Table Q2(c)** shows the prices and weightage for different grade of ready mix concrete in Johor, since the year 2014 to year 2016. Year 2015 is the reference year having 110.6 as an index value.

Table Q2(c): Prices and weightage for mix concrete

Type of Ready Mix Concrete	Prices RM/m^3			Weightage
	2014 RM/m^3	2015 RM/m^3	2016 RM/m^3	
Grade 15	188.33	190.00	208.73	1
Grade 25	198.33	200.00	219.46	1.5
Grade 35	218.33	220.00	238.54	2

Compute:

(i) A weighted index for the price of ready mix concrete in year 2016.

(4 marks)

(ii) The corresponding year 2017 prices of ready mix concrete from year 2016 if 111.4 is the index value in year 2017.

(5 marks)

Q3 (a) Aziz is a formwork carpenter that specialises in building wooden formwork for concrete columns. The time required for Aziz to build the first wooden formwork for concrete column is 1.5 hours and his learning rate is 0.85.

Compute:

(i) The time Aziz takes to build the 15^{th} wooden framework.

(4 marks)

(ii) The total time for him to build the first 15 wooden frameworks.

(4 marks)

(iii) The estimated cumulative average assembly time for the first 15 wooden frameworks.

(3 marks)

(b) A manufacturer of diesel locomotives needs 50,000 hours to produce the first unit and 40,000 hours to produce the second unit. The 4^{th} unit on the other hand, took 32,000 hours to produce.

Compute the following using logarithmic model:

(i) The direct labor required for the 8^{th} unit.

(6 marks)

(ii) Estimate the total labor to produce the 8^{th} unit.

(4 marks)

(iii) Determine the cumulative average number of labor hours per unit for the first 6 units.

(4 marks)

Q4 (a) Your younger sister, Linda, will start college in five years. She has just informed your parents that she wants to go to University, which will cost RM17, 000 per year for four years (cost assumed to come at the end of each year). Anticipating Linda's ambitions, your parents started investing RM2, 000 per year five years ago and will continue to do so for five more years in future.

Compute the amount that your parents will have to invest each year for the next five years to have the necessary funds for Linda's education. Use 10 percent as the appropriate interest rate for this purpose (discounting or compounding).

(4 marks)

(b) Linda is now 18 years old (five years have passed), and she wants to get married instead of going to school. Your parents have accumulated the necessary funds for her education. Instead of her schooling, your parents are paying RM8, 000 for her upcoming wedding and plan to take year-end vacations costing RM5, 000 per year for the next three years. Assume a 10 percent interest rate throughout this problem.

Compute:

(i) The amount of money your parents have at the end of three years.

(3 marks)

(ii) The amount of time you are able to stay in school if graduate school costs RM14, 045 per year.

(3 marks)

(c) A high speed train company is considering a project of constructing a new bullet train railway from Muar to Johor Bahru. The 400 kilometer project will be started with purchasing of land from local owner and state government costing about RM26 million. Cost of construction is estimated to be RM72 million and yearly maintenance is about RM2 million. A traffic control building and sophisticated equipment should also be considered with a cost of RM4 million and RM1 million per year maintenance expenditures. Some construction equipments will be sold at the end of construction period at the market value of RM13 million. In addition, yearly speed train ticket fees will be collected amounting to RM9 million, petrol consumptions save by the road users for RM4 million, revenues received through the direct and indirect businesses of RM5 million, and fees collected by the local and state authorities of RM3 million. The project costs breakdown is shown in **Table Q4(c).**

Table Q4(c): Costs breakdown of high speed rail construction project

Item	Cost (RM)
Land purchase	26 mil
Cost of construction	72 mil
Yearly rail maintenance	2 mil
Building and equipment	4 mil
Yearly equipment maintenance	1 mil
Train fees	9 mil
Equipment scrap value	13mil
Petrol consumption saving	4 mil
Direct and indirect business revenues	5 mil
Local and state fees	3 mil

(i) Determine the value of Total Cost, Benefit and Disbenefit from the above statement.

(3 marks)

(ii) Apply the B-C ratio method for both conventional and modified cases using PW and AW methods with the study period of 30 years and a MARR of 20% per year.

Determine whether the company should proceed with the bullet train railway project.

(12 marks)

- END OF QUESTIONS –

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COURSE CODE : BPK30902

Interest Table

Years, n	Discrete Compounding; i = 6%					
Factor	Compound Amount Factor	Present Worth Factor	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor
Formula	$F/P = (1+i)^n$	$\frac{P}{F} = \frac{1}{(1+i)^n}$	$\frac{F}{A} = \left[\frac{(1+i)^n - 1}{i}\right]$	$\frac{P}{A} = \left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$	$\frac{A}{F} = \left[\frac{i}{(1+i)^n - 1}\right]$	$\frac{A}{P} = \left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$
Symbol	(F/P)	P/F	F/A	P/A	A/F	A/P
1	1.0600	0.9434	1.0000	0.9434	1.0000	1.0600
2	1.1236	0.8900	2.0600	1.8334	0.4854	0.5454
3	1.1910	0.8396	3.1836	2.6730	0.3141	0.3741
4	1.2625	0.7921	4.3746	3.4651	0.2286	0.2886
5	1.3382	0.7473	5.6371	4.2124	0.1774	0.2374
6	1.4185	0.7050	6.9753	4.9173	0.1434	0.2034
7	1.5036	0.6651	8.3938	5.5824	0.1191	0.1791
8	1.5938	0.6274	9.8975	6.2098	0.1010	0.1610
9	1.6895	0.5919	11.4913	6.8017	0.0870	0.1470
10	1.7908	0.5584	13.1808	7.3601	0.0759	0.1359
11	1.8983	0.5268	14.9716	7.8869	0.0668	0.1268
12	2.0122	0.4970	16.8699	8.3838	0.0593	0.1193
13	2.1329	0.4688	18.8821	8.8527	0.0530	0.1130
14	2.2609	0.4423	21.0151	9.2950	0.0476	0.1076
15	2.3966	0.4173	23.2760	9.7122	0.0430	0.1030
16	2.5404	0.3936	25.6725	10.1059	0.0390	0.0990
17	2.6928	0.3714	28.2129	10.4773	0.0354	0.0954
18	2.8543	0.3503	30.9057	10.8276	0.0324	0.0924
19	3.0256	0.3305	33.7600	11.1581	0.0296	0.0896
20	3.2071	0.3118	36.7856	11.4699	0.0272	0.0872
21	3.3996	0.2942	39.9927	11.7641	0.0250	0.0850
22	3.6035	0.2775	43.3923	12.0416	0.0230	0.0830
23	3.8197	0.2618	46.9958	12.3034	0.0213	0.0813
24	4.0489	0.2470	50.8156	12.5504	0.0197	0.0797
25	4.2919	0.2330	54.8645	12.7834	0.0182	0.0782
26	4.5494	0.2198	59.1564	13.0032	0.0169	0.0769
27	4.8223	0.2074	63.7058	13.2105	0.0157	0.0757
28	5.1117	0.1956	68.5281	13.4062	0.0146	0.0746
29	5.4184	0.1846	73.6398	13.5907	0.0136	0.0736
30	5.7435	0.1741	79.0582	13.7648	0.0126	0.0726
31	6.0881	0.1643	84.8017	13.9291	0.0118	0.0718
32	6.4534	0.1550	90.8898	14.0840	0.0110	0.0710
33	6.8406	0.1462	97.3432	14.2302	0.0103	0.0703
34	7.2510	0.1379	104.1838	14.3681	0.0096	0.0696
35	7.6861	0.1301	111.4348	14.4982	0.0090	0.0690
36	8.1473	0.1227	119.1209	14.6210	0.0084	0.0684
37	8.6361	0.1158	127.2681	14.7368	0.0079	0.0679
38	9.1543	0.1092	135.9042	14.8460	0.0074	0.0674
39	9.7035	0.1031	145.0585	14.9491	0.0069	0.0669
40	10.2857	0.0972	154.7620	15.0463	0.0065	0.0665

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Interest Table

TABLE C-13 Discrete Compounding; i = 10%

	Single Payment		Uniform Series				Uniform Gradient		
	Compound Amount Factor	Present Worth Factor	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Gradient Present Worth Factor	Gradient Uniform Series Factor	
N	To Find F Given P F/P	To Find P Given F P/F	To Find F Given A F/A	To Find P Given A P/A	To Find A Given F A/F	To Find A Given P A/P	To Find P Given G P/G	To Find A Given G A/G	N
1	1.1000	0.9091	1.0000	0.9091	1.0000	1.1000	0.000	0.0000	1
2	1.2100	0.8264	2.1000	1.7355	0.4762	0.5762	0.826	0.4762	2
3	1.3310	0.7513	3.3100	2.4869	0.3021	0.4021	2.329	0.9366	3
4	1.4641	0.6830	4.6410	3.1699	0.2155	0.3155	4.378	1.3812	4
5	1.6105	0.6209	6.1051	3.7908	0.1638	0.2638	6.862	1.8101	5
6	1.7716	0.5645	7.7156	4.3553	0.1296	0.2296	9.684	2.2236	6
7	1.9487	0.5132	9.4872	4.8684	0.1054	0.2054	12.763	2.6216	7
8	2.1436	0.4665	11.4359	5.3349	0.0874	0.1874	16.029	3.0045	8
9	2.3579	0.4241	13.5795	5.7590	0.0736	0.1736	19.422	3.3724	9
10	2.5937	0.3855	15.9374	6.1446	0.0627	0.1627	22.891	3.7255	10
11	2.8531	0.3505	18.5312	6.4951	0.0540	0.1540	26.396	4.0641	11
12	3.1384	0.3186	21.3843	6.8137	0.0468	0.1468	29.901	4.3884	12
13	3.4523	0.2897	24.5227	7.1034	0.0408	0.1408	33.377	4.6988	13
14	3.7975	0.2633	27.9750	7.3667	0.0357	0.1357	36.801	4.9955	14
15	4.1772	0.2394	31.7725	7.6061	0.0315	0.1315	40.152	5.2789	15
16	4.5950	0.2176	35.9497	7.8237	0.0278	0.1278	43.416	5.5493	16
17	5.0545	0.1978	40.5447	8.0216	0.0247	0.1247	46.582	5.8071	17
18	5.5599	0.1799	45.5992	8.2014	0.0219	0.1219	49.640	6.0526	18
19	6.1159	0.1635	51.1591	8.3649	0.0195	0.1195	52.583	6.2861	19
20	6.7275	0.1486	57.2750	8.5136	0.0175	0.1175	55.407	6.5081	20
21	7.4002	0.1351	64.0025	8.6487	0.0156	0.1156	58.110	6.7189	21
22	8.1403	0.1228	71.4027	8.7715	0.0140	0.1140	60.689	6.9189	22
23	8.9543	0.1117	79.5430	8.8832	0.0126	0.1126	63.146	7.1085	23
24	9.8497	0.1015	88.4973	8.9847	0.0113	0.1113	65.481	7.2881	24
25	10.8347	0.0923	98.3471	9.0770	0.0102	0.1102	67.696	7.4580	25
30	17.4494	0.0573	164.4940	9.4269	0.0061	0.1061	77.077	8.1762	30
35	28.1024	0.0356	271.0244	9.6442	0.0037	0.1037	83.987	8.7086	35
40	45.2593	0.0221	442.5926	9.7791	0.0023	0.1023	88.953	9.0962	40
45	72.8905	0.0137	718.9048	9.8628	0.0014	0.1014	92.454	9.3740	45
50	117.3909	0.0085	1163.9085	9.9148	0.0009	0.1009	94.889	9.5704	50
60	304.4816	0.0033	3034.8164	9.9672	0.0003	0.1003	97.701	9.8023	60
80	2048.4002	0.0005	20474.0021	9.9951	a	0.1000	99.561	9.9609	80
100	13780.6123	0.0001	137796.1234	9.9993	a	0.1000	99.920	9.9927	100
∞				10.0000		0.1000			∞

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COURSE NAME	: ENGINEERING ECONOMY	COURSE CODE	: BPK30902

Interest Table

TABLE C-17 Discrete Compounding; i = 20%

	Single Payment		Uniform Series				Uniform Gradient		
	Compound Amount Factor	Present Worth Factor	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Gradient Present Worth Factor	Gradient Uniform Series Factor	
N	To Find F Given P F/P	To Find P Given F P/F	To Find F Given A F/A	To Find P Given A P/A	To Find A Given F A/F	To Find A Given P A/P	To Find P Given G P/G	To Find A Given G A/G	N
1	1.2000	0.8333	1.0000	0.8333	1.0000	1.2000	0.000	0.0000	1
2	1.4400	0.6944	2.2000	1.5278	0.4545	0.6545	0.694	0.4545	2
3	1.7280	0.5787	3.6400	2.1065	0.2747	0.4747	1.852	0.8791	3
4	2.0736	0.4823	5.3680	2.5887	0.1863	0.3863	3.299	1.2742	4
5	2.4883	0.4019	7.4416	2.9906	0.1344	0.3344	4.906	1.6405	5
6	2.9860	0.3349	9.9299	3.3255	0.1007	0.3007	6.581	1.9788	6
7	3.5832	0.2791	12.9159	3.6046	0.0774	0.2774	8.255	2.2902	7
8	4.2998	0.2326	16.4991	3.8372	0.0606	0.2606	9.883	2.5756	8
9	5.1598	0.1938	20.7989	4.0310	0.0481	0.2481	11.434	2.8364	9
10	6.1917	0.1615	25.9587	4.1925	0.0385	0.2385	12.887	3.0739	10
11	7.4301	0.1346	32.1504	4.3271	0.0311	0.2311	14.233	3.2893	11
12	8.9161	0.1122	39.5805	4.4392	0.0253	0.2253	15.467	3.4841	12
13	10.6993	0.0935	48.4966	4.5327	0.0206	0.2206	16.588	3.6597	13
14	12.8392	0.0779	59.1959	4.6106	0.0169	0.2169	17.601	3.8175	14
15	15.4070	0.0649	72.0351	4.6755	0.0139	0.2139	18.510	3.9588	15
16	18.4884	0.0541	87.4421	4.7296	0.0114	0.2114	19.321	4.0851	16
17	22.1861	0.0451	105.9306	4.7746	0.0094	0.2094	20.042	4.1976	17
18	26.6233	0.0376	128.1167	4.8122	0.0078	0.2078	20.681	4.2975	18
19	31.9480	0.0313	154.7400	4.8435	0.0065	0.2065	21.244	4.3861	19
20	38.3376	0.0261	186.6880	4.8696	0.0054	0.2054	21.740	4.4643	20
21	46.0051	0.0217	225.0256	4.8913	0.0044	0.2044	22.174	4.5334	21
22	55.2061	0.0181	271.0307	4.9094	0.0037	0.2037	22.555	4.5941	22
23	66.2474	0.0151	326.2369	4.9245	0.0031	0.2031	22.887	4.6475	23
24	79.4968	0.0126	392.4842	4.9371	0.0025	0.2025	23.176	4.6943	24
25	95.3962	0.0105	471.9811	4.9476	0.0021	0.2021	23.428	4.7352	25
30	237.3763	0.0042	1181.8816	4.9789	0.0008	0.2008	24.263	4.8731	30
35	590.6682	0.0017	2948.3411	4.9915	0.0003	0.2003	24.661	4.9406	35
40	1469.7716	0.0007	7343.8578	4.9966	0.0001	0.2001	24.847	4.9728	40
45	3657.2620	0.0003	18281.3099	4.9986	0.0001	0.2001	24.932	4.9877	45
50	9100.4382	0.0001	45497.1908	4.9995	a	0.2000	24.970	4.9945	50
60	56347.5144	a	281732.5718	4.9999	a	0.2000	24.994	4.9989	60
80	2160228.4620	a	10801137.3101	5.0000	a	0.2000	25.000	5.0000	80
∞				5.0000		0.2000			∞

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LIST OF FORMULA

1	$C_n = C_k \left(\frac{I_n}{I_k}\right)$	6	Conventional B-C ratio B-C = PW(B) ÷ [(I – PW(MV)) +PW(O&M)] B-C = AW(B) ÷ [CR + AW(O&M)]
2	$C_A = C_B \left(\frac{S_A}{S_B}\right)^x$	7	Modified B-C ratio with PW B-C = [PW(B) – PW(O&M)] ÷ [I – PW(MV)] B-C = [AW(B) – AW(O&M)] ÷ CR
3	$Z_u = K(u^{(\frac{\log r}{\log 2})})$	8	$I_{effective} = \left(1 + \frac{r}{m}\right)^m - 1$
4	$p\,(1+i)^n$		
5	$I_n = \frac{W1\,(C_{n1}/C_{k2}) + W2\,(C_{n2}/C_{k2}) + W\ldots\,(C_{n\ldots}/C_{k\ldots})}{W1 + W2 + W\ldots\ldots} \times I_k$		