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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION**

**SEMESTER II**

**SESSION 2017/2018**

COURSE NAME : ENGINEERING ECONOMY  
COURSE CODE : BPK30902  
PROGRAMME CODE : BDD / BFF / BNC / BNB / BNA / BND /  
BNF / BNM / BNN / BNG / BNE / BDM  
EXAMINATION DATE : JUNE / JULY 2018  
DURATION : 2 HOURS  
INSTRUCTION : ANSWER ALL QUESTIONS

**TERBUKA**

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

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- Q1 (a)** In connection with surfacing a new Alor Gajah-Ayer Keroh highway, a contractor has a choice of two sites on which to set up the asphalt-mixing plant equipment. The contractor estimates that it will cost RM2.15 per cubic meter-km ( $m^3 - km$ ) to haul the asphalt-paving material from the mixing plant to job location. Factors related to the two mixing sites, assuming the production costs at each site are the same, are shown in **Table Q1(a)**.

**Table Q1(a): Factors related to the construction mixing sites**

Cost factor	Site A	Site B
Average hauling distance	9.5 km	7.3 km
Monthly rental of site	RM 2350	RM 5350
Cost to set up and remove equipment	RM 15000	RM 25000
Hauling expense	RM2.15/ $m^3 - km$	RM 2.15/ $m^3 - km$
Flagperson	Not required	RM 215 / day

The job requires 70000  $m^3$  of mixed-asphalt-paving material. It is estimated that four months (17 weeks of five working days per week) will be required for the job. Assume that the cost of the return trip is negligible.

Compute:

- (i) The fixed costs for site A and site B (4 marks)
- (ii) The variable costs for site A and site B (4 marks)
- (iii) Based on total cost, explain which site should be selected. (2 marks)
- (iv) The amount of paving material in  $m^3$ , that the contractor needs to deliver to make a profit if the contractor is paid RM 22.55 per  $m^3$ . (3 marks)

- (b) ABC Contractor is chosen to undertake the re-surface tender of the new Alor Gajah-Ayer Keroh highway project. Assume the costs information are similar to the information in **Q1(a)**. However, ABC Contractor is given additional information with regards to the project which involves changes to the allowable hauling expense for each of the site. The new hauling expenses are shown in **Table Q1(b)**.

**Table Q1(b): New hauling expenses for the construction sites**

Cost factor	Site A	Site B
Hauling expense	RM3.00/ $m^3 - km$	RM 3.50/ $m^3 - km$
Flag person	RM150 / day	RM215 / day



Compute:

- (i) The fixed costs for site A and site B. (3 marks)
- (ii) The variable costs for site A and site B. (3 marks)
- (iii) Based on total costs, explain the site that should be selected. (2 marks)
- (iv) The amount of paving material in  $m^3$ , that the contractor has to deliver to make a profit if the contractor is paid RM26 per  $m^3$ . (3 marks)

**Q2** (a) Explain the following cost estimation terms.

- (i) Top-down approach
- (ii) Bottom-up approach (4 marks)

(b) Describe the **THREE (3)** major components in the integrated cost estimation. (6 marks)

(c) Last year of 2017, a 100 MW Generator set costs RM140,000. The cost index for this genset in year 2017 was 180 and now is 195. The cost-capacity factor is 0.7.

- (i) The engineer is considering new genset with 150 MW to replace the old unit. Additional features of this genset for longer duration would costs RM20,000. Determine the total cost of the 150 MW unit. (3 marks)
- (ii) Estimate the cost of a 50 MW unit of the same design including RM20,000 for the cost of additional features. (3 marks)

- (d) The Safran Company needs 40,000 hours to produce the first unit of an aircraft engine while the next second unit production needs up to 32,000 hours. Additionally, the estimated labour cost is RM50/hour.

Compute the following using logarithmic model:

- (i) The time to produce the 8<sup>th</sup> unit and its labor cost. (3 marks)
- (ii) Estimate the total labor <sup>hours</sup> to produce the 8<sup>th</sup> unit. (3 marks)
- (iii) Determine the cumulative average number of labor hours per unit for the first 6 units. (3 marks)

**Q3** 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.

- (a) Compute:
- (i) The total cost of Malik's education based on his four-year education with 10% increment per year. (3 marks)
- (ii) 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)
- (b) Draw the cash flow time lines from Mr. Ahmad's point of view for **Q3(a)(i)** and **Q3(a)(ii)**. (6 marks)
- (c) Assume UTHM "freeze" the cost of education in 10 years for a lump-sum of current value RM150,000.

Explain whether the investment in Malik's education is a good deal. (2 marks)

(d) Malik has finally finished his degree from UTHM and now is leading a happy life with his own family. At the age of 50, he has been appointed as the Regional Manager of the company he is working on at the moment. To celebrate his achievement, he plans to open a saving account and able to save up to RM22,000 per year. His starting balance is RM200,000 and he saves the full amount of money available to him.

(i) Compute the amount of money, Malik will have when he is 65 years old (after 15 years of savings). Assume the interest rate is ~~8%~~ per year.

6% (6 marks)

(ii) Draw the cash flow time lines in accordance to Malik's situation above. (5 marks)

**Q4** (a) Identify each of the following cash flows to indicate whether it is a benefit, a 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 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) purposes 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)**.

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

Items	Benefits
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

Evaluate the UTHM rail project for both conventional and modified cases, assuming the study period of 10 years and a MARR of 12% per year:

20%

- (i) Using the B-C ratio method.
- (ii) Using the PW method.

(20 marks)

- END OF QUESTIONS -

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**FINAL EXAMINATION**

SEMESTER/SESSION : SEM I I / 2017/2018

PROGRAMME CODE : BDD/BSS/BFF/BNC/  
BNB

COURSE NAME : ENGINEERING ECONOMY

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**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	$F/P = (1+i)^n$	$P/F = \frac{1}{(1+i)^n}$	$\frac{F}{A} = \left[ \frac{(1+i)^n - 1}{i} \right]$	$\frac{P}{A} = \left[ \frac{(1+i)^n - 1}{i(1+i)^n} \right]$	$\frac{A}{F} = \left[ \frac{i}{(1+i)^n - 1} \right]$	$\frac{A}{P} = \left[ \frac{i(1+i)^n}{(1+i)^n - 1} \right]$
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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BNB

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Interest Table

**TABLE C-13 Discrete Compounding;  $i = 10\%$**

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

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



<b>FINAL EXAMINATION</b>			
SEMESTER/SESSION	: SEM II / 2017/2018	PROGRAMME CODE	: BDD/BSS/Bff?BNC/ BNB
COURSE NAME	: ENGINEERING ECONOMY	COURSE CODE	: BPK30902

**LIST OF FORMULA**

<b>1</b>	$C_n = C_k \left( \frac{I_n}{I_k} \right)$	<b>6</b>	Conventional B-C ratio B-C = $PW(B) \div [(I - PW(MV)) + PW(O\&M)]$ B-C = $AW(B) \div [CR + AW(O\&M)]$
<b>2</b>	$C_n - C_m \left( \frac{S_n}{S_m} \right)^x$	<b>7</b>	Modified B-C ratio with PW B-C = $[PW(B) - PW(O\&M)] \div [I - PW(MV)]$ B-C = $[AW(B) - AW(O\&M)] \div CR$
<b>3</b>	$Z_u = R \left( u \left( \frac{1-u^n}{1-u} \right) \right)$	<b>8</b>	$I_{effective} = \left( 1 + \frac{r}{m} \right)^m - 1$
<b>4</b>	$p (1 + i)^n$		
<b>5</b>	$I_n = \frac{W1 (C_{n1}/C_{k2}) + W2 (C_{n2}/C_{k2}) + W \dots (C_{n...}/C_{k...})}{W1 + W2 + W \dots} \times I_k$		

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