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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019**

COURSE NAME : ENGINEERING ECONOMY
COURSE CODE : BPK 30902
PROGRAMME CODE : BNA/BNB/BNC/BNE/BNN/BFF
EXAMINATION DATE : JUNE / JULY 2019
DURATION : 2 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF NINE (9) PAGES

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- Q1 (a) Explain the differences between the bottom-up and bottom down approach to cost estimation with appropriate examples. (4 marks)
- (b) You have been asked to estimate the cost of 100 prefabricated structures to be sold to a local school district. Each structure provides 1,000 square feet of floor space, with 8-foot ceilings. In 2003, you produced 70 similar structures consisting of the same materials and having the same ceiling height, but each provided only 800 square feet of floor space. The material cost for each structure was RM25,000 in 2003, and the cost capacity factor is 0.65. The cost index values for 2003 and 2014 are 200 and 289, respectively. The estimated manufacturing cost for the first 1,000-square-foot structure is RM12,000. Assume a learning curve of 88% and use the cost of the 50th structure as your standard time for estimating manufacturing cost.
- Estimate the total material cost and the total manufacturing cost for the 100 prefabricated structures. (7 marks)
- (c) The Civil Engineering Technology Department of Universiti Tun Hussein Onn Malaysia Pagoh Campus has a student team that design a pontoon boat model for the Malaysian Technical University Network (MTUN) competition. The time required for the team to assemble the first train model is 5.5 hours. Their improvement (learning rate/curve) is 82% which means that as output is doubled, their time to assemble a train model reduced by 20%.
- (i) Compute the time it will take the team to assemble the **FIFTH (5th)** and **TENTH (10th)** pontoon boat model. (5 marks)
- (ii) Compute the total time required to assemble the first 5 and 10 pontoon boat models. (5 marks)
- (iii) Point out the estimated Cumulative Average assembly time for the first 5 and 10 pontoon boat models. (4 marks)
- Q2 (a) Differentiate between nominal rates and effective rates. (5 marks)
- (b) Ahmad took a 5-years loan of RM10,000 to buy a second hand car. The bank charged him 7% compounded interest per annum for the loan.
- Calculate the equivalent future value of this loan by using the following Table Q2(b).

Table Q2 (b): Future Value of the Loan

Year	Amount owed at beginning of year (RM)	Interest amount for year (RM)	Amount owed at end of year (RM)
1			
2			
3			
4			
5			

(5 marks)

- (c) A SME Company is considering investing RM150,000 for six (6) months in three (3) options offered by financial institutions. The alternatives are listed in **Table Q2(c)**.

Table Q2(c): Alternatives offered by financial institutions

Options	Rates
1	Quarterly compounded interest of 1.90% per annum
2	Daily compounded interest of 2.0% per annum (365 day per year)
3	Semi-annually compounded interest of 2.5% per annum

Propose the best option for the SME Company.

(15 marks)

- Q3** (a) Aman Bina Sdn Bhd is planning to increase their productivity by upgrading the machinery to higher capacity processor with initial cost of RM90,000, annual operation and maintenance cost of RM7,000 and salvage value of RM10,000 at the end of its economic life of 10 years. This is estimated to increase production volume which will generate additional income of RM30,000 per year.

Evaluate the investment based on Future Worth (FW) method with an expected MARR of 12% per year using a proper cash flow diagram.

(15 marks)

- (b) It is estimated that a certain piece of equipment can save RM22,000 per year in labour and materials costs. The equipment has an expected life of five (5) years and with market value RM5,000.

- (i) Compute how much could be justified **NOW** for the purchase of this equipment if the company earns a 15% annual return on investments.

(5 marks)

- (ii) Draw a cash flow diagram from the company's viewpoint.

(5 marks)

- Q4 (a)** 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 RM 36,000. Annual benefits of the runaway have been estimated as in **Table Q4(a)**.

Table Q4(a): Annual Benefits of the UTHM Rail Project

ITEM	RM
Rental receipt from a train carrier	RM400,000
Management charge to train passengers	RM50,000
Convenience benefit to the UTHM community	RM35,000
Additional tourism for both UTHM Parit Raja and Pagoh	RM40,000

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 erected.

(10 marks)

- (b)** Your company is invited to propose a new multipurpose transportation terminal in Iskandar Johor as a hub for air, sea and land transportation. Also included in the project is to build custom and immigration facilities. The land acquisition is estimated to be RM30 million. Construction cost for the terminal and other facilities is expected to be RM86 million with annual maintenance cost of RM9 million. The building and sophisticated equipment for traffic control should also be considered at a cost of RM27 million, with RM6 million for annual maintenance expenditures.

On the other hand, this project fuel consumption saving by the road users is worth up to RM8 million per year. In addition, collection of terminal fees and revenues generated from businesses are anticipated to be RM18 million per year and RM10 million per year respectively. However, the total annual fees and taxes that will be collected by the authorities are estimated to be RM1.5 million.

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

(12 marks)

- (ii)** Determine whether the project should proceed.

(3 marks)

– END OF QUESTIONS –

FINAL EXAMINATION

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The following information may be useful. The symbols have their usual meaning.

B-C Ratio using present worth:

$$B - C = \frac{PW(B)}{I - PW(MV) + PW(O\&M)}$$

Modified B-C Ratio using present worth:

$$B - C = \frac{PW(B) - PW(O\&M)}{I - PW(MV)}$$

B-C Ratio using annual worth:

$$B - C = \frac{AW(B)}{CR + AW(O\&M)}$$

Modified B-C Ratio using annual worth:

$$B - C = \frac{AW(B) - AW(O\&M)}{CR}$$

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7% **TABLE 12** Discrete Cash Flow: Compound Interest Factors **7%**

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	1.0700	0.9346	1.00000	1.0000	1.07000	0.9346		
2	1.1449	0.8734	0.48309	2.0700	0.55309	1.8080	0.8734	0.4831
3	1.2250	0.8163	0.31105	3.2149	0.38105	2.6243	2.5060	0.9549
4	1.3108	0.7629	0.22523	4.4399	0.29523	3.3872	4.7947	1.4155
5	1.4026	0.7130	0.17389	5.7507	0.24389	4.1002	7.6467	1.8650
6	1.5007	0.6663	0.13980	7.1533	0.20980	4.7665	10.9784	2.3032
7	1.6058	0.6227	0.11555	8.6540	0.18555	5.3893	14.7149	2.7304
8	1.7182	0.5820	0.09747	10.2598	0.16747	5.9713	18.7889	3.1465
9	1.8385	0.5439	0.08349	11.9780	0.15349	6.5152	23.1404	3.5517
10	1.9672	0.5083	0.07238	13.8164	0.14238	7.0236	27.7156	3.9461
11	2.1049	0.4751	0.06336	15.7836	0.13336	7.4987	32.4665	4.3296
12	2.2522	0.4440	0.05590	17.8885	0.12590	7.9427	37.3506	4.7025
13	2.4098	0.4150	0.04965	20.1406	0.11965	8.3577	42.3302	5.0648
14	2.5785	0.3878	0.04434	22.5505	0.11434	8.7455	47.3718	5.4167
15	2.7590	0.3624	0.03979	25.1290	0.10979	9.1079	52.4461	5.7583
16	2.9522	0.3387	0.03586	27.8881	0.10586	9.4466	57.5271	6.0897
17	3.1588	0.3166	0.03243	30.8402	0.10243	9.7632	62.5923	6.4110
18	3.3799	0.2959	0.02941	33.9990	0.09941	10.0591	67.6219	6.7225
19	3.6165	0.2765	0.02675	37.3790	0.09675	10.3356	72.5991	7.0242
20	3.8697	0.2584	0.02439	40.9955	0.09439	10.5940	77.5091	7.3163
21	4.1406	0.2415	0.02229	44.8652	0.09229	10.8355	82.3393	7.5990
22	4.4304	0.2257	0.02041	49.0057	0.09041	11.0612	87.0793	7.8725
23	4.7405	0.2109	0.01871	53.4361	0.08871	11.2722	91.7201	8.1369
24	5.0724	0.1971	0.01719	58.1767	0.08719	11.4693	96.2545	8.3923
25	5.4274	0.1842	0.01581	63.2490	0.08581	11.6536	100.6765	8.6391
26	5.8074	0.1722	0.01456	68.6765	0.08456	11.8258	104.9814	8.8773
27	6.2139	0.1609	0.01343	74.4838	0.08343	11.9867	109.1656	9.1072
28	6.6488	0.1504	0.01239	80.6977	0.08239	12.1371	113.2264	9.3289
29	7.1143	0.1406	0.01145	87.3465	0.08145	12.2777	117.1622	9.5427
30	7.6123	0.1314	0.01059	94.4608	0.08059	12.4090	120.9718	9.7487
31	8.1451	0.1228	0.00980	102.0730	0.07980	12.5318	124.6550	9.9471
32	8.7153	0.1147	0.00907	110.2182	0.07907	12.6466	128.2120	10.1381
33	9.3253	0.1072	0.00841	118.9334	0.07841	12.7538	131.6435	10.3219
34	9.9781	0.1002	0.00780	128.2588	0.07780	12.8540	134.9507	10.4987
35	10.6766	0.0937	0.00723	138.2369	0.07723	12.9477	138.1353	10.6687
40	14.9745	0.0668	0.00501	199.6351	0.07501	13.3317	152.2928	11.4233
45	21.0025	0.0476	0.00350	285.7493	0.07350	13.6055	163.7559	12.0360
50	29.4570	0.0339	0.00246	406.5289	0.07246	13.8007	172.9051	12.5287
55	41.3150	0.0242	0.00174	575.9286	0.07174	13.9399	180.1243	12.9215
60	57.9464	0.0173	0.00123	813.5204	0.07123	14.0392	185.7677	13.2321

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12% TABLE 17 Discrete Cash Flow: Compound Interest Factors 12%

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	1.1200	0.8929	1.00000	1.0000	1.12000	0.8929		
2	1.2544	0.7972	0.47170	2.1200	0.59170	1.6901	0.7972	0.4717
3	1.4049	0.7118	0.29635	3.3744	0.41635	2.4018	2.2208	0.9246
4	1.5735	0.6355	0.20923	4.7793	0.32923	3.0373	4.1273	1.3589
5	1.7623	0.5674	0.15741	6.3528	0.27741	3.6048	6.3970	1.7746
6	1.9738	0.5066	0.12323	8.1152	0.24323	4.1114	8.9302	2.1720
7	2.2107	0.4523	0.09912	10.0890	0.21912	4.5638	11.6443	2.5512
8	2.4760	0.4039	0.08130	12.2997	0.20130	4.9676	14.4714	2.9131
9	2.7731	0.3606	0.06768	14.7757	0.18768	5.3282	17.3563	3.2574
10	3.1058	0.3220	0.05698	17.5487	0.17698	5.6502	20.2541	3.5847
11	3.4785	0.2875	0.04842	20.6546	0.16842	5.9377	23.1288	3.8953
12	3.8960	0.2567	0.04144	24.1331	0.16144	6.1944	25.9523	4.1897
13	4.3635	0.2292	0.03568	28.0291	0.15568	6.4235	28.7024	4.4683
14	4.8871	0.2046	0.03087	32.3926	0.15087	6.6282	31.3624	4.7317
15	5.4736	0.1827	0.02682	37.2797	0.14682	6.8109	33.9202	4.9803
16	6.1304	0.1631	0.02339	42.7533	0.14339	6.9740	36.3670	5.2147
17	6.8660	0.1456	0.02046	48.8837	0.14046	7.1196	38.6973	5.4353
18	7.6900	0.1300	0.01794	55.7497	0.13794	7.2497	40.9080	5.6427
19	8.6128	0.1161	0.01576	63.4397	0.13576	7.3658	42.9979	5.8375
20	9.6463	0.1037	0.01388	72.0524	0.13388	7.4694	44.9676	6.0202
21	10.8038	0.0926	0.01224	81.6987	0.13224	7.5620	46.8188	6.1913
22	12.1003	0.0826	0.01081	92.5026	0.13081	7.6446	48.5543	6.3514
23	13.5523	0.0738	0.00956	104.6029	0.12956	7.7184	50.1776	6.5010
24	15.1786	0.0659	0.00846	118.1552	0.12846	7.7843	51.6929	6.6406
25	17.0001	0.0588	0.00750	133.3339	0.12750	7.8431	53.1046	6.7708
26	19.0401	0.0525	0.00665	150.3339	0.12665	7.8957	54.4177	6.8921
27	21.3249	0.0469	0.00590	169.3740	0.12590	7.9426	55.6369	7.0049
28	23.8839	0.0419	0.00524	190.6989	0.12524	7.9844	56.7674	7.1098
29	26.7499	0.0374	0.00466	214.5828	0.12466	8.0218	57.8141	7.2071
30	29.9599	0.0334	0.00414	241.3327	0.12414	8.0552	58.7821	7.2974
31	33.5551	0.0298	0.00369	271.2926	0.12369	8.0850	59.6761	7.3811
32	37.5817	0.0266	0.00328	304.8477	0.12328	8.1116	60.5010	7.4586
33	42.0915	0.0238	0.00292	342.4294	0.12292	8.1354	61.2612	7.5302
34	47.1425	0.0212	0.00260	384.5210	0.12260	8.1566	61.9612	7.5965
35	52.7996	0.0189	0.00232	431.6635	0.12232	8.1755	62.6052	7.6577
40	93.0510	0.0107	0.00130	767.0914	0.12130	8.2438	65.1159	7.8988
45	163.9876	0.0061	0.00074	1358.23	0.12074	8.2825	66.7342	8.0572
50	289.0022	0.0035	0.00042	2400.02	0.12042	8.3045	67.7624	8.1597
55	509.3206	0.0020	0.00024	4236.01	0.12024	8.3170	68.4082	8.2251
60	897.5969	0.0011	0.00013	7471.64	0.12013	8.3240	68.8100	8.2664

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15%		TABLE 19 Discrete Cash Flow: Compound Interest Factors					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	0.09026	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

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20% TABLE 22 Discrete Cash Flow: Compound Interest Factors **20%**

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	1.2000	0.8333	1.00000	1.0000	1.20000	0.8333		
2	1.4400	0.6944	0.45455	2.2000	0.65455	1.5278		
3	1.7280	0.5787	0.27473	3.6400	0.47473	2.1065	0.6944	0.4545
4	2.0736	0.4823	0.18629	5.3680	0.38629	2.5887	1.8519	0.8791
5	2.4883	0.4019	0.13438	7.4416	0.33438	2.9906	3.2986	1.2742
6	2.9860	0.3349	0.10071	9.9299	0.30071	3.3255	4.9061	1.6405
7	3.5832	0.2791	0.07742	12.9159	0.27742	3.6046	6.5806	1.9788
8	4.2998	0.2326	0.06061	16.4991	0.26061	3.8372	8.2551	2.2902
9	5.1598	0.1938	0.04808	20.7989	0.24808	4.0310	9.8831	2.5756
10	6.1917	0.1615	0.03852	25.9587	0.23852	4.1925	11.4335	2.8364
11	7.4301	0.1346	0.03110	32.1504	0.23110	4.3271	12.8871	3.0739
12	8.9161	0.1122	0.02526	39.5805	0.22526	4.4392	14.2330	3.2893
13	10.6993	0.0935	0.02062	48.4966	0.22062	4.5327	15.4667	3.4841
14	12.8392	0.0779	0.01689	59.1959	0.21689	4.6106	16.5883	3.6597
15	15.4070	0.0649	0.01388	72.0351	0.21388	4.6755	17.6008	3.8175
16	18.4884	0.0541	0.01144	87.4421	0.21144	4.7296	18.5095	3.9588
17	22.1861	0.0451	0.00944	105.9306	0.20944	4.7746	19.3208	4.0851
18	26.6233	0.0376	0.00781	128.1167	0.20781	4.8122	20.0419	4.1976
19	31.9480	0.0313	0.00646	154.7400	0.20646	4.8435	20.6805	4.2975
20	38.3376	0.0261	0.00536	186.6880	0.20536	4.8696	21.2439	4.3861
22	55.2061	0.0181	0.00369	271.0307	0.20369	4.9094	21.7395	4.4643
24	79.4968	0.0126	0.00255	392.4842	0.20255	4.9371	22.5546	4.5941
26	114.4755	0.0087	0.00176	567.3773	0.20176	4.9563	23.1760	4.6943
28	164.8447	0.0061	0.00122	819.2233	0.20122	4.9697	23.6460	4.7709
30	237.3763	0.0042	0.00085	1181.88	0.20085	4.9789	23.9991	4.8291
32	341.8219	0.0029	0.00059	1704.11	0.20059	4.9854	24.2628	4.8731
34	492.2235	0.0020	0.00041	2456.12	0.20041	4.9898	24.4588	4.9061
35	590.6682	0.0017	0.00034	2948.34	0.20034	4.9915	24.6038	4.9308
36	708.8019	0.0014	0.00028	3539.01	0.20028	4.9929	24.6614	4.9406
38	1020.67	0.0010	0.00020	5098.37	0.20020	4.9951	24.7108	4.9491
40	1469.77	0.0007	0.00014	7343.86	0.20014	4.9966	24.7894	4.9627
45	3657.26	0.0003	0.00005	18281	0.20005	4.9986	24.8469	4.9728
50	9100.44	0.0001	0.00002	45497	0.20002	4.9995	24.9316	4.9877
55	22645		0.00001		0.20001	4.9998	24.9698	4.9945
							24.9868	4.9976