



UTHM

Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION SEMESTER I SESSION 2022/2023

- COURSE NAME : ENGINEERING ECONOMICS
- COURSE CODE : BFC 44602
- PROGRAMME CODE : BFF
- EXAMINATION DATE : FEBRUARY 2023
- DURATION : 2 HOURS
- INSTRUCTION : 1. ANSWER **ALL** QUESTIONS
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

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THIS QUESTION PAPER CONSISTS OF NINE (9) PAGES

- Q1** (a) Define Engineering Economics analysis in the construction industry. (5 marks)
- (b) Formwork related activities and the type of formwork system affects the time, cost, quality, and safety of a construction project. Traditionally, timber-based formwork is used in construction projects. However, timber formwork has disadvantages, such as poor durability when exposed to weathering and poor workability, especially for high-rise buildings.
- (i) Explain in detail the implications of selecting aluminum formwork to the time and cost of a construction project. (6 marks)
- (ii) By using Decision Making Process method, discuss alternative types of formwork system apart from timber formwork for high-rise building construction projects. (14 marks)
- Q2** (a) The Vista manufacturing company is producing a new gadget. This new product is currently being sold at RM 50 per unit. If the fixed cost of manufacturing this product is RM 6,000 with the variable cost of RM 25 per unit, answer the following questions:
- (i) Construct the profit function for the product, then determine the profit gained when 1000 units are sold. (5 marks)
- (ii) Calculate the number of units have to be produced and sold to yield a profit of RM 30,000? (4 marks)
- (b) The Vista Company had decided to produce and upgrade an accessory item for the mentioned gadget with the selling price at RM 15 per unit and variable costs of RM 5 per unit. Previously, 10,000 units were sold annually with profit of RM 15,000 per year. A new design will increase the variable costs by 20% and fixed costs by 10%. However, sales will increase to 12,000 units per year.
- (i) Calculate the quantity must be sold to reach the break-even point. (9 marks)

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- (ii) With the aid of sketch, illustrate the breakeven graph that includes the breakeven point, variable cost, total cost and fixed cost. (7 marks)

Q3 (a) The interest rate is the amount a lender charges for the use of assets expressed as a percentage of the principal. The interest rate is typically noted on an annual basis. The assets borrowed could include cash, consumer goods, or large assets such as a vehicle or building. Among the interest rates involved are normal interest rates and effective interest rates.

- (i) Explain the differences between nominal rates and effective rates. (6 marks)
- (ii) Convert the given interest rates in **TABLE Q3(a)** into the desired nominal interest rates. (5 marks)

(b) Ali is a civil engineer who specializes in IBS for the construction industry. He plans to retire on his 60th birthday. On his 21st birthday, Ali started saving in a unit trust account RMxx per year for 40 years. Starting on his 61st birthday, Ali plans on withdrawing RM10,000 and will continue these annual withdrawals until the account is exhausted on his 85th birthday. Ali's unit trust account pays 6% per year.

- (i) Draw the cash flow diagram for Ali's saving plan. (4 marks)
- (ii) Determine the annual amount will Ali need to invest in his bank account to achieve his retirement goal. (5 marks)
- (iii) Determine the year that his account exhausted if the plan is to withdraw RM20,000 per year. (5 marks)

Q4 (a) A new piece of equipment has been proposed by Berjaya Consultant to upgrade the water quality at XYZ Camp Site. The investment cost is RM 35,000 with salvage value of RM 3,000 after 4 years. The revenue generated from the installation of the equipment minus the operating and maintenance cost of the equipment is RM6,500 per year with the MARR is 15% per year.

- (i) Draw the cash flow for the above scenario. (3 marks)
- (ii) Determine whether this equipment worth to be installed. Use the Future Worth (FW) method for your answer. (4 marks)
- (b) Sin Wah Construction Works has been offered a tender to install an escalator in MARA Building at Simpang Renggam, Johor. The company has two alternatives with details as shown in the **TABLE Q4(b)**. Choose the best alternative for the company using Present Worth (PW) method if the interest is 12% compounded every quarter year. Your answer should include cash flow diagrams for each alternative and solved by the formula. (18 marks)

– END OF QUESTIONS –

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TABLE Q3 (a)

Given Interest Rate	Desired nominal interest rates
1 % per month	_____ per year
3 % per quarter	_____ per 6 months
2 % per quarter	_____ per year
0.28% per week	_____ per quarter
6.1% per 6 months	_____ per 2 years

TABLE Q4 (b)

Information	Alternative X (RM)	Alternative Y (RM)
First Cost	55000	85000
Operational Cost (every 3 months)	15000	3000
Salvage Value	5000	8500
Lifetime, year	2	4

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6%		TABLE 11 Discrete Cash Flow: Compound Interest Factors						6%	
n	Single Payments		Uniform Series Payments				Arithmetic Gradients		
	F/P Compound Amount	P/F Present Worth	A/F Sinking Fund	F/A Compound Amount	A/P Capital Recovery	P/A Present Worth	P/G Gradient Present Worth	A/G Gradient Uniform Series	
1	1.0600	0.9434	1.00000	1.0000	1.06000	0.9434			
2	1.1236	0.8900	0.48544	2.0600	0.54544	1.8334	0.8900	0.4854	
3	1.1910	0.8396	0.31411	3.1836	0.37411	2.6730	2.5692	0.9612	
4	1.2625	0.7921	0.22859	4.3746	0.28859	3.4651	4.9455	1.4272	
5	1.3382	0.7473	0.17740	5.6371	0.23740	4.2124	7.9345	1.8836	
6	1.4185	0.7050	0.14336	6.9753	0.20336	4.9173	11.4594	2.3304	
7	1.5036	0.6651	0.11914	8.3938	0.17914	5.5824	15.4497	2.7676	
8	1.5938	0.6274	0.10104	9.8975	0.16104	6.2098	19.8416	3.1952	
9	1.6895	0.5919	0.08702	11.4913	0.14702	6.8017	24.5768	3.6133	
10	1.7908	0.5584	0.07587	13.1808	0.13587	7.3601	29.6023	4.0220	
11	1.8983	0.5268	0.06679	14.9716	0.12679	7.8869	34.8702	4.4213	
12	2.0122	0.4970	0.05928	16.8699	0.11928	8.3838	40.3369	4.8113	
13	2.1329	0.4688	0.05296	18.8821	0.11296	8.8527	45.9629	5.1920	
14	2.2609	0.4423	0.04758	21.0151	0.10758	9.2950	51.7128	5.5635	
15	2.3966	0.4173	0.04296	23.2760	0.10296	9.7122	57.5546	5.9260	
16	2.5404	0.3936	0.03895	25.6725	0.09895	10.1059	63.4592	6.2794	
17	2.6928	0.3714	0.03544	28.2129	0.09544	10.4773	69.4011	6.6240	
18	2.8543	0.3503	0.03236	30.9057	0.09236	10.8276	75.3569	6.9597	
19	3.0256	0.3305	0.02962	33.7600	0.08962	11.1581	81.3062	7.2867	
20	3.2071	0.3118	0.02718	36.7856	0.08718	11.4699	87.2304	7.6051	
21	3.3996	0.2942	0.02500	39.9927	0.08500	11.7641	93.1136	7.9151	
22	3.6035	0.2775	0.02305	43.3923	0.08305	12.0416	98.9412	8.2166	
23	3.8197	0.2618	0.02128	46.9958	0.08128	12.3034	104.7007	8.5099	
24	4.0489	0.2470	0.01968	50.8156	0.07968	12.5504	110.3812	8.7951	
25	4.2919	0.2330	0.01823	54.8645	0.07823	12.7834	115.9732	9.0722	
26	4.5494	0.2198	0.01690	59.1564	0.07690	13.0032	121.4684	9.3414	
27	4.8223	0.2074	0.01570	63.7058	0.07570	13.2105	126.8600	9.6029	
28	5.1117	0.1956	0.01459	68.5281	0.07459	13.4062	132.1420	9.8568	
29	5.4184	0.1846	0.01358	73.6398	0.07358	13.5907	137.3096	10.1032	
30	5.7435	0.1741	0.01265	79.0582	0.07265	13.7648	142.3588	10.3422	
31	6.0881	0.1643	0.01179	84.8017	0.07179	13.9291	147.2864	10.5740	
32	6.4534	0.1550	0.01100	90.8898	0.07100	14.0840	152.0901	10.7988	
33	6.8406	0.1462	0.01027	97.3432	0.07027	14.2302	156.7681	11.0166	
34	7.2510	0.1379	0.00960	104.1838	0.06960	14.3681	161.3192	11.2276	
35	7.6861	0.1301	0.00897	111.4348	0.06897	14.4982	165.7427	11.4319	
40	10.2857	0.0972	0.00646	154.7620	0.06646	15.0463	185.9568	12.3590	
45	13.7646	0.0727	0.00470	212.7435	0.06470	15.4558	203.1096	13.1413	
50	18.4202	0.0543	0.00344	290.3359	0.06344	15.7619	217.4574	13.7964	
55	24.6503	0.0406	0.00254	394.1720	0.06254	15.9905	229.3222	14.3411	
60	32.9877	0.0303	0.00188	533.1282	0.06188	16.1614	239.0428	14.7909	
65	44.1450	0.0227	0.00139	719.0829	0.06139	16.2891	246.9450	15.1601	
70	59.0759	0.0169	0.00103	967.9322	0.06103	16.3845	253.3271	15.4613	
75	79.0569	0.0126	0.00077	1300.95	0.06077	16.4558	258.4527	15.7058	
80	105.7960	0.0095	0.00057	1746.60	0.06057	16.5091	262.5493	15.9033	
85	141.5789	0.0071	0.00043	2342.98	0.06043	16.5489	265.8096	16.0620	
90	189.4645	0.0053	0.00032	3141.08	0.06032	16.5787	268.3946	16.1891	
95	253.5463	0.0039	0.00024	4209.10	0.06024	16.6009	270.4375	16.2905	
96	268.7590	0.0037	0.00022	4462.65	0.06022	16.6047	270.7909	16.3081	
98	301.9776	0.0033	0.00020	5016.29	0.06020	16.6115	271.4491	16.3411	
100	339.3021	0.0029	0.00018	5638.37	0.06018	16.6175	272.0471	16.3711	

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12%		TABLE 17 Discrete Cash Flow: Compound Interest Factors					12%	
n	Single Payments		Uniform Series Payments				Arithmetic Gradients	
	F/P Compound Amount	P/F Present Worth	A/F Sinking Fund	F/A Compound Amount	A/P Capital Recovery	P/A Present Worth	P/G Gradient Present Worth	A/G Gradient Uniform Series
1	1.1200	0.8929	1.0000	1.0000	1.1200	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
65	1581.87	0.0006	0.00008	13174	0.12008	8.3281	69.0581	8.2922
70	2787.80	0.0004	0.00004	23223	0.12004	8.3303	69.2103	8.3082
75	4913.06	0.0002	0.00002	40934	0.12002	8.3316	69.3031	8.3181
80	8658.48	0.0001	0.00001	72146	0.12001	8.3324	69.3594	8.3241
85	15259	0.0001	0.00001		0.12001	8.3328	69.3935	8.3278

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15% TABLE 19 Discrete Cash Flow: Compound Interest Factors 15%								
n	Single Payments		Uniform Series Payments				Arithmetic Gradients	
	F/P Compound Amount	P/F Present Worth	A/F Sinking Fund	F/A Compound Amount	A/P Capital Recovery	P/A Present Worth	P/G Gradient Present Worth	A/G Gradient Uniform Series
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

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LIST OF FORMULA

1. $p (1 + i)^n$
2. $C_n = C_k (I_n / I_k)$
3. $Z_u = K(i^n)$
4. $n = \log s / \log 2$
 $W1 (C_{n1}/C_{k2}) + W2 (C_{n2}/C_{k2}) + W... (C_{n...}/C_{k...})$
5. $I_n = \frac{W1 (C_{n1}/C_{k2}) + W2 (C_{n2}/C_{k2}) + W... (C_{n...}/C_{k...})}{W1 + W2 + W...} \times I_k$
6. Conventional B-C ratio with PW
 $B-C = PW(B) \div [(I - PW(MV)) + PW(O\&M)]$
7. Modified B-C ratio with PW
 $B-C = [PW(B) - PW(O\&M)] \div [I - PW(MV)]$
8. Conventional B-C ratio with AW
 $B-C = AW(B) \div [CR + AW(O\&M)]$
9. Modified B-C ratio with AW
 $B-C = [AW(B) - AW(O\&M)] \div CR$

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