UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	ENGINEERING ECONOMY
COURSE CODE	:	BPK 30902
PROGRAMME CODE	:	BDD/ BEV/ BFF / BNN/ BND/ BNG/ BNF/ BNB/ BNC
EXAMINATION DATE	:	JUNE 2017
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) List the **SEVEN (7)** principles of Engineering Economy.

(7 marks)

(b) State the **FOUR (4)** importance of Engineering Economy to engineers.

(4 marks)

(c) Two currently owned machines by Transformers Enterprises who is the sole agent for lorry parts and components in Malaysia are being considered for the production of a new part. The capital investment associated with the machines is about the same. The important differences between the machines are their production capacities (production rate x available production hours) and their reject rates (percentage of parts produced that cannot be sold). Consider the following Table Q1:

Table Q1: Production Capacities

	Machine A	**Machine B**
Production rate	100 parts / hour	130 parts / hour
Hours available for production	7 hours / day	6 hours / day
Percent parts rejected	3%	10%

The material cost is RM6.00 per part, and all defect-free parts produced can be sold for RM12.00 each. (Rejected parts have negligible scrap value). For either machine, the operator cost is RM15.00 per hour and the variable overhead rate for traceable costs is RM5.00 per hour.

Determine:

(i) Profit for Machine A.

(4 marks)

(ii) Profit for Machine B.

(4 marks)

(iii) The maximum percentage of rejected parts produced by Machine B to be as profitable as Machine A.

(6 marks)

Q2 (a) The Table Q2 below shows the past price of Standard Malaysia Rubber (SMR) since 2012, whereby 2013 is the reference year having 246 as an index value. The weight place on SMR CV is one (1) time, SMP L is one and half (1.5) times and SMR 5 is two (2) times.

Table Q2: The Past Price of Standard Malaysia Rubber (SMR)

SMR	Price (sen/ kg) in Year		
	2012	**2013**	**2014**
SMR CV	1088	919	753
SMR L	1046	832	696
SMR 5	974	794	579

(i) Calculate a weighted index for the price of a kg of SMR in 2014.

(4 marks)

(ii) Calculate the corresponding 2015 prices of SMR from 2014 if 218 is the index value in 2015

(6 marks)

(b) The structural engineering design section of E-Energy Power Corporation, a multinational electrical utility corporation has developed several standard designs for a group of similar transmission line towers. The detailed design for each tower is based on one of the standard designs. A transmission line project involving 60 towers has been approved. The estimated number of engineering hours needed to accomplish the first detailed tower design is 123 hours.

Compute:

(i) The number of engineering hours needed to design the **EIGHTH (8^{th})** and **SIXTEENTH (16^{th})** tower using a 95% learning curve.

(ii) The reduction percentage when the production is doubled.

(iii) The estimated cumulative average hours required to produce the first five towers.

(15 marks)

Q3 (a) A new machine is proposed by Hakim Engineering Consultant to upgrade the power Quality measurement at PQ meters. The investment cost is RM 45,000 with salvage value of RM 5,000 after 5 years. The revenue generated from the installation of the equipment minus the operating and maintenance cost of the equipment is RM 7,500 per year. The MARR is 15% per year.

Draw the cash flow diagram.

(4 marks)

(b) A remotely located air sampling station can be powered by solar cells or by running an above ground electric line to the site and using conventional power. Solar cells will cost RM 15,000 to install and will have a useful life of 5 years with no salvage value. Annual costs for inspection, cleaning, maintenance and part replacement are expected to be RM 4,000. A new power line will cost RM 40,000 to install, with power costs expected to be RM 1,000 per year. Since the air sampling project will end in 10 years, the salvage value of the line is considered to be zero. At an interest rate of 6% per year compounded monthly.

(i) Calculate the effective interest rate per year.

(4 marks)

(ii) Determine which alternative should be selected on the basis of a present worth analysis.

(10 marks)

(iii) Determine the initial cost of the above ground line to make the two alternatives equally attractive economically.

(7 marks)

Q4 DuniaBaruku Corporation is considering a new project to construct a new jetty near Forest City, Johor Bahru, for the use of gateway tourism's ferry to and from Singapore and Indonesia. Also included in the project is to build custom and immigration facilities. The land acquisition is estimated to be RM1.2 million. Construction cost for the jetty and other facilities is expected to be RM1.8 million with an additional annual maintenance cost of RM 90,000. Finally, the projected increase in marina travelers will require an additional jetty traffic controller with an annual cost of RM50,000. Market value of some assets at the end of useful life is estimated RM20,000. Annual benefits of the jetty has been estimated as in **Table Q4**. The study period of this proposed project is for 10 years with the MARR of 15% per year.

Table Q4: Annual Benefits of the JAY Corporation Jetty Project

Annual Benefits	**RM**
Rental receipts from ferry & boats	300,000
Jetty charges to passengers	240,000
Convenience benefit to the local community	60,000
Additional tourism income to state of Johor	120,000

Determine:

(i) Conventional B-C ratio with PW.

(6 marks)

(ii) Modified B-C ratio with PW.

(6 marks)

(iii) Conventional B-C ratio with AW.

(6 marks)

(iv) Modified B-C ratio with AW.

(6 marks)

(v) Whether the project should be continued or not.

(1 mark)

- END OF QUESTIONS -

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

JADUAL 19 - Aliran Tunai Diskret: Faktor Faedah Kompaun **i = 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	0.09036	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	$C_n = C_k\left(\frac{I_n}{I_k}\right)$	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	$Z_u = K(u^{\left(\frac{Log\ s}{Log\ 2}\right)})$	8	$I_{effective} = \left(1 + \frac{r}{m}\right)^m - 1$
4	$p\ (1 + i)^n$		
5	$I_n = \frac{W1\ (C_{n1}/C_{k2}) + W2\ (C_{n2}/C_{k2}) + W\ldots\ (C_{n\ldots}/C_{k\ldots})}{W1 + W2 + W\ldots\ldots} X\ I_k$		