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UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: BME 4023
COURSE	: ENGINEERING ECONOMICS
SEMESTER/SESSION	: 1-2022/2023
DURATION	: 2.5 HOURS

Instructions:

1. This booklet contains **5** questions. Answer all questions
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, rise up your hand and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 10 PRINTED PAGES INCLUDING COVER PAGE

Answer all five (5) questions.

Question 1

Tati Production is a major player in the Ball Valve business. Their high-end valve is uses commercially and quite popular with oil and gas industry. In the producing these valve, Tati Production's fixed cost is $55,000 per moth with a variable cost is $15.50 per unit. The selling price of the high-end valve is described by equation D = 4,375 – 50p. **Determine** optimum demand of the valve, maximum profit, breakeven volume and range of profit demand. Sketch where appropriate.

(16 marks)

Question 2

Manufacturing Company plans to purchase new grinding machine for finishing works. Cost of the machine is $20,000 and with this machine will generate income for $4,000 per year for six (6) years. Annual maintenance and service cost is $1,500. At the end of year six (6), this machine can be sold for $5,000. If the minimum attractive rate of return (MARR) is 8%, by using PW, FW and AW methods, **evaluate** whether this machine should be purchased or not. Cash flow diagram is given as Figure 1.

(25 marks)

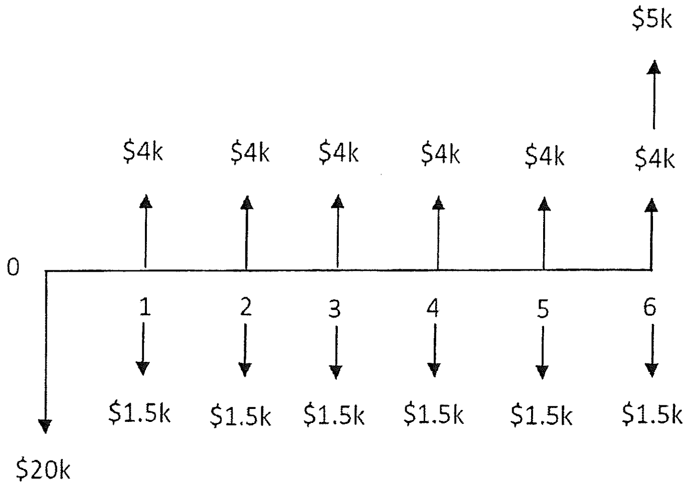

Figure 1

Question 3

As a technologist, you intend to propose to your company to purchased new tools for $2,500, but will loss $150 for the first (1st) year and $100 for the second (2nd) year. An additional $200 invested is needed during the second (2nd) year and will make $1,100 profit in the third year, $1,200 in the fourth year, $1,300 in the fifth year and $1,400 in the sixth (6th) year. At the end of year six (6), the tools can be sold for $1000. **Estimate** the Internal Rate of Return (IRR) (try with rate 6% and 12%) and External Rate of Return (ERR) (when ϵ = 15%) of this investment. Cash flow diagram is given as Figure 2. (25 marks)

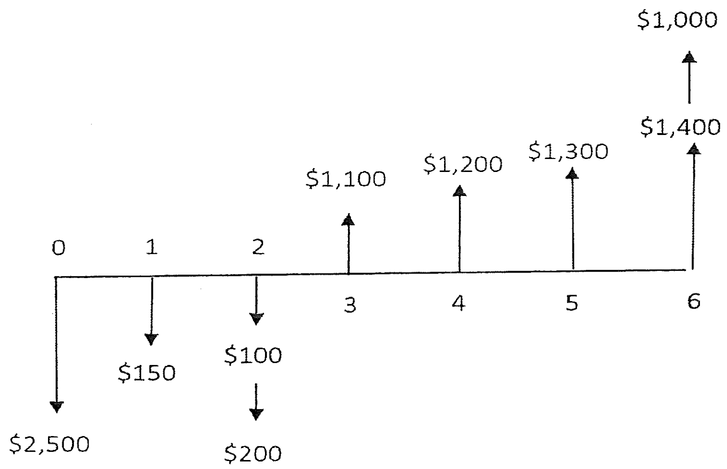

Figure 2

Question 4

Three (3) mutually exclusive alternative public-works projects are currently under consideration. Their respective costs and benefits are included in the Table 1 that follows. Each of the projects has a useful life of 20 years, and MARR is 10% per year. **Recommend** which proposal should be selected. (17 marks)

Table 1

	Proposal W	Proposal X	Proposal Y
Capital investment, $	8.5mil	10mil	12mil
Annual M & O cost, $/year	750k	725k	700k
Market value, $	1.25mil	1.75mil	2.0mil
Annual benefit, $/year	2.15mil	2.265k	2.5k

Question 5

An asset will cost $1,750 when purchased this year. It is further expected to have a salvage value of $250 at the end of its five-year depreciable life. Using Straight-Line (SL) and Declining Balance (DB) method (R =2/N), **determine** the annual rate of depreciation and the amount of depreciation and Book Value (BV) each year until at the end of year three (3) after the purchased of the asset. (17 marks)

--End of questions -------------------------------------

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Criteria	**Marks**
All questions answered will be marked according to the answer scheme	/100

Related equations:

When price, $p = \$$

Breakeven point, $D = \dfrac{C_F}{(p - C_v)}$

Profit = $(p - C_v)D - C_F$

Total revenue = $P x D$

Total cost = $(C_v \, x \, D) + C_F$

When price, $p = a - bD$

Optimal demand / Maximum profit, $D^* = \dfrac{a - C_v}{2b}$

Profit (loss) = $- bD^2 + (a - C_v)D - C_F$

Breakeven, $D = \dfrac{-(a - c_v) \pm \sqrt{(a - c_v)^2 - 4(-b)(-C_F)}}{2(-b)}$

Simple Interest,

$I = (P)(N)(i)$

Single Cash Flow

Finding P when given F

$P = F(1+i)^{-N}$ or $P = F(P/F, i\%, N)$

Finding F when given P

$F = P(1+i)^{N}$ or $F = P(F/P, i\%, N)$

Finding the Interest rate when given P, F & N

$i = \sqrt[N]{F/P} - 1$

Finding N when given P, F, & i

$N = \dfrac{log(F/P)}{log(1+i)}$

Uniform Series (Annuity)

Finding P when given A

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

Finding F when given A

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

Finding A when given F

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

Finding A when given P

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

Present Worth, PW = PW of cash inflows – PW of cash outflows

Bond Value,

$V_N = C\ (P/F,\ i\%,\ N) + rZ\ (P/A,\ i\%,\ N)$

Future Worth, *FW = FW of cash inflows – FW of cash outflows*

Annual Worth, *AW*

$AW(i\%) = R - E - CR(i\%)$

$CR(i\%) = I(A/P, i\%, N) - S(A/F, i\%, N)$

Internal Rate of Return (IRR),

$IRR = PW = 0$

$IRR = PW = F_1(1+i)^{-k_1} + F_2(1+i)^{-k_2} \ldots - P \ldots = 0$

IRR = % Lower rate + $\left[\frac{NPV\ at\ Lower\ Rate}{NPV\ at\ Lower\ Rate - NPV\ at\ Higher\ rate}\right]$ x $(\%\ higher - \%\ lower)$

External Rate of Return (ERR),

All expenses = All revenues

$$\sum_{k=0}^{N} E_k\ (1+i)^{-k}\ (1+\ i')^{N} = \sum_{k=0}^{N} R_k\ (1+\epsilon)^{N-k}$$

Benefits Cost Ratio Analysis,

$$B/C = \frac{PW_B}{PW_C}$$

Depreciation,

$d_k = \frac{(B - SV_N)}{N}$

$d_k^* = k \cdot d_k$ For $1 \leq k \leq$

$BV_k = B - d_k^*$

$d_1 = B(R)$,

$d_k = B(1-R)^{k-1}(R)$

$d_k^* = B[1 - (1-R)^k]$

$BV_k = B(1-R)^k$

TABLE C-9 Discrete Compounding; i = 6%

	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	1.0600	0.9434	1.0000	0.9434	1.0000	1.0600	0.000	0.0000	1
2	1.1236	0.8900	2.0600	1.8334	0.4854	0.5454	0.890	0.4854	2
3	1.1910	0.8396	3.1836	2.6730	0.3141	0.3741	2.569	0.9612	3
4	1.2625	0.7921	4.3746	3.4651	0.2286	0.2886	4.946	1.4272	4
5	1.3382	0.7473	5.6371	4.2124	0.1774	0.2374	7.935	1.8836	5
6	1.4185	0.7050	6.9753	4.9173	0.1434	0.2034	11.459	2.3304	6
7	1.5036	0.6651	8.3938	5.5824	0.1191	0.1791	15.450	2.7676	7
8	1.5938	0.6274	9.8975	6.2098	0.1010	0.1610	19.842	3.1952	8
9	1.6895	0.5919	11.4913	6.8017	0.0870	0.1470	24.577	3.6133	9
10	1.7908	0.5584	13.1808	7.3601	0.0759	0.1359	29.602	4.0220	10

TABLE C-11 Discrete Compounding; i = 8%

	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	1.0800	0.9259	1.0000	0.9259	1.0000	1.0800	0.000	0.0000	1
2	1.1664	0.8573	2.0800	1.7833	0.4808	0.5608	0.857	0.4808	2
3	1.2597	0.7938	3.2464	2.5771	0.3080	0.3880	2.445	0.9487	3
4	1.3605	0.7350	4.5061	3.3121	0.2219	0.3019	4.650	1.4040	4
5	1.4693	0.6806	5.8666	3.9927	0.1705	0.2505	7.372	1.8465	5
6	1.5869	0.6302	7.3359	4.6229	0.1363	0.2163	10.523	2.2763	6
7	1.7138	0.5835	8.9228	5.2064	0.1121	0.1921	14.024	2.6937	7
8	1.8509	0.5403	10.6366	5.7466	0.0940	0.1740	17.806	3.0985	8
9	1.9990	0.5002	12.4876	6.2469	0.0801	0.1601	21.808	3.4910	9
10	2.1589	0.4632	14.4866	6.7101	0.0690	0.1490	25.977	3.8713	10

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	
	To Find F Given P	To Find P Given F	To Find F Given A	To Find P Given A	To Find A Given F	To Find A Given P	To Find P Given G	To Find A Given G	
N	F/P	P/F	F/A	P/A	A/F	A/P	P/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

TABLE C-14 Discrete Compounding; i = 12%

	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	
	To Find F Given P	To Find P Given F	To Find F Given A	To Find P Given A	To Find A Given F	To Find A Given P	To Find P Given G	To Find A Given G	
N	F/P	P/F	F/A	P/A	A/F	A/P	P/G	A/G	N
1	1.1200	0.8929	1.0000	0.8929	1.0000	1.1200	0.000	0.0000	1
2	1.2544	0.7972	2.1200	1.6901	0.4717	0.5917	0.797	0.4717	2
3	1.4049	0.7118	3.3744	2.4018	0.2963	0.4163	2.221	0.9246	3
4	1.5735	0.6355	4.7793	3.0373	0.2092	0.3292	4.127	1.3589	4
5	1.7623	0.5674	6.3528	3.6048	0.1574	0.2774	6.397	1.7746	5
6	1.9738	0.5066	8.1152	4.1114	0.1232	0.2432	8.930	2.1720	6
7	2.2107	0.4523	10.0890	4.5638	0.0991	0.2191	11.644	2.5515	7
8	2.4760	0.4039	12.2997	4.9676	0.0813	0.2013	14.471	2.9131	8
9	2.7731	0.3606	14.7757	5.3282	0.0677	0.1877	17.356	3.2574	9
10	3.1058	0.3220	17.5487	5.6502	0.0570	0.1770	20.254	3.5847	10

TABLE C-15 Discrete Compounding; i = 15%

	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	
	To Find F Given P	To Find P Given F	To Find F Given A	To Find P Given A	To Find A Given F	To Find A Given P	To Find P Given G	To Find A Given G	
N	F/P	P/F	F/A	P/A	A/F	A/P	P/G	A/G	N
1	1.1500	0.8696	1.0000	0.8696	1.0000	1.1500	0.000	0.0000	1
2	1.3225	0.7561	2.1500	1.6257	0.4651	0.6151	0.756	0.4651	2
3	1.5209	0.6575	3.4725	2.2832	0.2880	0.4380	2.071	0.9071	3
4	1.7490	0.5718	4.9934	2.8550	0.2003	0.3503	3.786	1.3263	4
5	2.0114	0.4972	6.7424	3.3522	0.1483	0.2983	5.775	1.7228	5
6	2.3131	0.4323	8.7537	3.7845	0.1142	0.2642	7.937	2.0972	6
7	2.6600	0.3759	11.0668	4.1604	0.0904	0.2404	10.192	2.4498	7
8	3.0590	0.3269	13.7268	4.4873	0.0729	0.2229	12.481	2.7813	8
9	3.5179	0.2843	16.7858	4.7716	0.0596	0.2096	14.755	3.0922	9
10	4.0456	0.2472	20.3037	5.0188	0.0493	0.1993	16.980	3.3832	10

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	
	To Find F Given P	To Find P Given F	To Find F Given A	To Find P Given A	To Find A Given F	To Find A Given P	To Find P Given G	To Find A Given G	
N	F/P	P/F	F/A	P/A	A/F	A/P	P/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