Exam Date & Time: 18-Mar-2024 (05:30 PM - 07:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

VI SEMESTER B.TECH. (COMMON TO ALL)
MID SEMESTER EXAMINATIONS, MARCH 2024
SUBJECT: ENGINEERING ECONOMICS & FINANCIAL MANAGEMENT [HUM 3051]

ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [HUM 3051]

Marks: 30 **Duration: 120 mins.**

A

Answer all the questions. Section Duration: 20 mins

Answer ALL the questions.
Missing data may be suitably assumed.
Interest factor tables are provided, for others use formulas.
The formula book and interest factors tables are in the Reference Material Section.

1) In 2 years you are to receive $10,000. If the interest rate were to suddenly decrease, the present value of that future amount to you would _____. (0.5)

1) Rise 2) Fall 3) Remain unchanged 4) The correct answer cannot be determined without more information

2) You have a few instalments pending due to a loan that you borrowed from a bank. Your aunt has offered to give you money now which would pay off all future instalments. Assuming the bank allows closure of the loan in advance, which of the following factors is useful in calculating the amount that you need to borrow from your aunt today in order to pay off the remaining annual instalments that you owe to a bank? (0.5)

1) Equal payment series present worth factor 2) Sinking fund factor . 3) Capital recovery factor. 4) Equal payment series compound amount factor.

3) If an investment project (normal project) has an IRR equal to the MARR the NPV of the project is: (0.5)

1) Zero 2) Positive 3) Negative 4) Unable to determine

4) To get the AW of a cash flow of $10,000 that occurs every 10 years forever, with the first one occurring 10 years from now, you should: (0.5)

1) Multiply $10,000 by (A/F, i, n) and then multiply by i 2) Multiply $10,000 by (A/F, i,10) then divide by i 3) Multiply $10,000 by (A/F, i,10) 4) Multiply $10,000 by i

5) Assume that you are going to buy a mobile phone worth INR 1,25,000 on a twelve Equal Monthly Instalments (EMI) basis, with first payment due on next month. If the company's nominal rate is 18% compounded quarterly, the effective rate to be considered in the calculation of EMI amount is: (0.5)

1) 1.48% 2) 1.5% 3) 1.5% < ieff < 4.5% 4) 4.5%

6) An engineer who believed in "save now and play later" wanted to retire in 20 years with $1.5 million. At 10% per year interest, to reach the $1.5 million goal, starting 1 year from now, the engineer must annually invest: (0.5)

10% Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G
1	1.100	.9091	1.0000	1.1000	1.000	0.909	0	0
2	1.210	.8264	.4762	.5762	2.100	1.736	0.476	0.826
3	1.331	.7513	.3021	.4021	3.310	2.487	0.937	2.329
4	1.464	.6830	.2155	.3155	4.641	3.170	1.381	4.378
5	1.611	.6209	.1638	.2638	6.105	3.791	1.810	6.862
6	1.772	.5645	.1296	.2296	7.716	4.355	2.224	9.684
7	1.949	.5132	.1054	.2054	9.487	4.868	2.622	12.763
8	2.144	.4665	.0874	.1874	11.436	5.335	3.004	16.029
9	2.358	.4241	.0736	.1736	13.579	5.759	3.372	19.421
10	2.594	.3855	.0627	.1627	15.937	6.145	3.725	22.891
11	2.853	.3505	.0540	.1540	18.531	6.495	4.064	26.396
12	3.138	.3186	.0468	.1468	21.384	6.814	4.388	29.901
13	3.452	.2897	.0408	.1408	24.523	7.103	4.699	33.377
14	3.797	.2633	.0357	.1357	27.975	7.367	4.996	36.801
15	4.177	.2394	.0315	.1315	31.772	7.606	5.279	40.152
16	4.595	.2176	.0278	.1278	35.950	7.824	5.549	43.416
17	5.054	.1978	.0247	.1247	40.545	8.022	5.807	46.582
18	5.560	.1799	.0219	.1219	45.599	8.201	6.053	49.640
19	6.116	.1635	.0195	.1195	51.159	8.365	6.286	52.583
20	6.728	.1486	.0175	.1175	57.275	8.514	6.508	55.407

1) $26,190 2) $28,190 3) $49,350 4) $89,680

7) An investment of $75,000 in equipment that will reduce the time for machining self-locking fasteners will save $20,000 per year. At an interest rate of 10% per year, the number of years required to recover the initial investment is closest to:

10% Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G
1	1.100	.9091	1.0000	1.1000	1.000	0.909	0	0
2	1.210	.8264	.4762	.5762	2.100	1.736	0.476	0.826
3	1.331	.7513	.3021	.4021	3.310	2.487	0.937	2.329
4	1.464	.6830	.2155	.3155	4.641	3.170	1.381	4.378
5	1.611	.6209	.1638	.2638	6.105	3.791	1.810	6.862
6	1.772	.5645	.1296	.2296	7.716	4.355	2.224	9.684
7	1.949	.5132	.1054	.2054	9.487	4.868	2.622	12.763
8	2.144	.4665	.0874	.1874	11.436	5.335	3.004	16.029
9	2.358	.4241	.0736	.1736	13.579	5.759	3.372	19.421
10	2.594	.3855	.0627	.1627	15.937	6.145	3.725	22.891

(0.5)

1) 6 years 2) 5 years 3) 4 years 4) 3 years

8) Scientific Instruments, Inc. uses a MARR of 8% per year. The company is evaluating a new process to reduce water effluents from its manufacturing processes. The estimate associated with the process follows. In evaluating the process on the basis of a rate of return analysis, the correct equation to use is: (0.5)

	New Process
Frist Cost, $	- 40,000
Net Cash Flow, $ per year	+ 13,000
Salvage value, $	+ 5,000
Life, years	3

1)	0 = - 40,000 + 13,000 (P/A, i ,3) + 5000 (P/F, i, 3)		2)	0 = - 40,000 (A/P, i,3) +		3)	0 = - 40,000 (F/P, i ,3) + 13,000 (F/A, i, 3) + 5000		4)	Any of the given options	

				13,000 + 5000 (A/F, i, 3)									

9) The net annual worth of an alternative can be calculated from the alternative's:

(A) Net Present Worth multiplied by (A/P, i, n)

(B) Net Future Worth multiplied by (F/A, i, n) (0.5)

1) Only B 2) Only A 3) Either (A) or (B) 4) Neither (A) nor (B)

10) Aero Serve, Inc., manufactures cleaning nozzles for reverse-pulse jet dust collectors. The company spent $40,000 on a production control system that will result in annualized benefits of $13,400 for a period of 5 years. The rate of return per year on the investment is closest to: (0.5)

1) 20% 2) 18% 3) 16% 4) Less than 15%

B

Answer all the questions.

Answer ALL the questions.
Missing data may be suitably assumed.
Interest factor tables are provided, for others use formulas.
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11) A machine bought for INR 50 lakhs is expected to last 10 years and have a salvage value of INR 3.5 lakhs. Its annual usage rate is assumed to be a constant 7500 hours per year. The operating cost is INR350 per hour, and the maintenance cost is INR125 per hour. Determine the capital recovery cost for this asset if the MARR is 10%. (2)

10% Compound Interest Factors

	Single Payment		Uniform Payment Series				Arithmetic Gradient	
n	Compound Amount Factor Find *F* Given *P* *F/P*	Present Worth Factor Find *P* Given *F* *P/F*	Sinking Fund Factor Find *A* Given *F* *A/F*	Capital Recovery Factor Find *A* Given *P* *A/P*	Compound Amount Factor Find *F* Given *A* *F/A*	Present Worth Factor Find *P* Given *A* *P/A*	Gradient Uniform Series Find *A* Given *G* *A/G*	Gradient Present Worth Find *P* Given *G* *P/G*
1	1.100	.9091	1.0000	1.1000	1.000	0.909	0	0
2	1.210	.8264	.4762	.5762	2.100	1.736	0.476	0.826
3	1.331	.7513	.3021	.4021	3.310	2.487	0.937	2.329
4	1.464	.6830	.2155	.3155	4.641	3.170	1.381	4.378
5	1.611	.6209	.1638	.2638	6.105	3.791	1.810	6.862
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9	2.358	.4241	.0736	.1736	13.579	5.759	3.372	19.421
10	2.594	.3855	.0627	.1627	15.937	6.145	3.725	22.891

12) Calculate the present value of Alternative A that must be considered if the MARR is 16% when comparing Alternatives, A and B. The information on alternatives are provided below. (3)

In INR	Alternative A	Alternative B
First Cost	5,00,000	13,00,000
Annual Maintenance Cost	50,000	44,000
Annual Operating Cost	60,000	43,000
Annual increase in operating costs	2,000	4,000
Salvage Value	2,00,000	4,20,000
Life n, in years	7	14

16% End-of-Period Compound Interest Factors

N	Single Payment: Compound Amount Factor F/P	Single Payment: Present Worth Factor P/F	Uniform Payment Series: Capital Recovery Factor A/P	Uniform Payment Series: Present Worth Factor P/A	Uniform Payment Series: Sinking Fund Factor A/F	Uniform Payment Series: Compound Amount Factor F/A	Arithmetic Gradient: Present Worth Factor P/G	Arithmetic Gradient: Uniform Payment Factor A/G
1	1.160	.8621	1.1600	.862	1.0000	1.000	0	0
2	1.346	.7432	.6230	1.605	.4630	2.160	.743	.463
3	1.561	.6407	.4453	2.246	.2853	3.506	2.024	.901
4	1.811	.5523	.3574	2.798	.1974	5.066	3.681	1.316
5	2.100	.4761	.3054	3.274	.1454	6.877	5.586	1.706
6	2.436	.4104	.2714	3.685	.1114	8.977	7.638	2.073
7	2.826	.3538	.2476	4.039	.0876	11.414	9.761	2.417
8	3.278	.3050	.2302	4.344	.0702	14.240	11.896	2.739
9	3.803	.2630	.2171	4.607	.0571	17.519	14.000	3.039
10	4.411	.2267	.2069	4.833	.0469	21.321	16.040	3.319
11	5.117	.1954	.1989	5.029	.0389	25.733	17.994	3.578
12	5.936	.1685	.1924	5.197	.0324	30.850	19.847	3.819
13	6.886	.1452	.1872	5.342	.0272	36.786	21.590	4.041
14	7.988	.1252	.1829	5.468	.0229	43.672	23.217	4.246
15	9.266	.1079	.1794	5.575	.0194	51.660	24.728	4.435
16	10.748	.0930	.1764	5.668	.0164	60.925	26.124	4.609
17	12.468	.0802	.1740	5.749	.0140	71.673	27.407	4.768
18	14.463	.0691	.1719	5.818	.0119	84.141	28.583	4.913
19	16.777	.0596	.1701	5.877	.0101	98.603	29.656	5.046
20	19.461	.0514	.1687	5.929	.00867	115.4	30.632	5.167

13) An industrial engineer is considering two robots for purchase by a fibre-optic manufacturing company. Robot X will have a first cost of $80,000, an annual maintenance and operation (M&O) cost of $30,000, and a $40,000 salvage value. Robot Y will have a first cost of $97,000, an annual M&O cost of $27,000, and a $50,000 salvage value. Which should be selected on the basis of a future worth comparison at an interest rate of 16% per year? Use a 3-year study period for comparison, and the above mentioned salvage value is applicable during this time.

16% End-of-Period Compound Interest Factors

N	Single Payment: Compound Amount Factor F/P	Single Payment: Present Worth Factor P/F	Uniform Payment Series: Capital Recovery Factor A/P	Uniform Payment Series: Present Worth Factor P/A	Uniform Payment Series: Sinking Fund Factor A/F	Uniform Payment Series: Compound Amount Factor F/A	Arithmetic Gradient: Present Worth Factor P/G	Arithmetic Gradient: Uniform Payment Factor A/G
1	1.160	.8621	1.1600	.862	1.0000	1.000	0	0
2	1.346	.7432	.6230	1.605	.4630	2.160	.743	.463
3	1.561	.6407	.4453	2.246	.2853	3.506	2.024	.901
4	1.811	.5523	.3574	2.798	.1974	5.066	3.681	1.316
5	2.100	.4761	.3054	3.274	.1454	6.877	5.586	1.706
6	2.436	.4104	.2714	3.685	.1114	8.977	7.638	2.073
7	2.826	.3538	.2476	4.039	.0876	11.414	9.761	2.417
8	3.278	.3050	.2302	4.344	.0702	14.240	11.896	2.739
9	3.803	.2630	.2171	4.607	.0571	17.519	14.000	3.039
10	4.411	.2267	.2069	4.833	.0469	21.321	16.040	3.319
11	5.117	.1954	.1989	5.029	.0389	25.733	17.994	3.578
12	5.936	.1685	.1924	5.197	.0324	30.850	19.847	3.819
13	6.886	.1452	.1872	5.342	.0272	36.786	21.590	4.041
14	7.988	.1252	.1829	5.468	.0229	43.672	23.217	4.246
15	9.266	.1079	.1794	5.575	.0194	51.660	24.728	4.435

(3)

14) A new construction house costs INR 1,50,00,000. The house needs a renovation every 20 years at a cost of INR 10,00,000. Annual repairs and maintenance are estimated to be INR 5000 for the first five years and then about INR 8000 till the end of 12th year, thereafter it is assumed to be a constant amount of INR 20,000 per year forever. It requires to be painted once in every 6 years at a cost of INR 1,40,000. If the interest rate is 10%, determine the capitalized cost of this house construction project. (3)

10% Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G
1	1.100	.9091	1.0000	1.1000	1.000	0.909	0	0
2	1.210	.8264	.4762	.5762	2.100	1.736	0.476	0.826
3	1.331	.7513	.3021	.4021	3.310	2.487	0.937	2.329
4	1.464	.6830	.2155	.3155	4.641	3.170	1.381	4.378
5	1.611	.6209	.1638	.2638	6.105	3.791	1.810	6.862
6	1.772	.5645	.1296	.2296	7.716	4.355	2.224	9.684
7	1.949	.5132	.1054	.2054	9.487	4.868	2.622	12.763
8	2.144	.4665	.0874	.1874	11.436	5.335	3.004	16.029
9	2.358	.4241	.0736	.1736	13.579	5.759	3.372	19.421
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15	4.177	.2394	.0315	.1315	31.772	7.606	5.279	40.152
16	4.595	.2176	.0278	.1278	35.950	7.824	5.549	43.416
17	5.054	.1978	.0247	.1247	40.545	8.022	5.807	46.582
18	5.560	.1799	.0219	.1219	45.599	8.201	6.053	49.640
19	6.116	.1635	.0195	.1195	51.159	8.365	6.286	52.583
20	6.728	.1486	.0175	.1175	57.275	8.514	6.508	55.407

15) An investment of INR 50,00,000 is required for business now. It is expected to generate an income of INR 7,00,000 for the first three years and then onwards it increases by an amount of INR 1,00,000 each year to the previous year income. It is also expected to have removal costs in the end which is INR 90,000 more than that of salvage value. The annual operating and maintenance cost is expected to be INR 1,50,000. If the project life is 15 years determine the internal rate of return and comment on its feasibility. (4)

16) A person who is 30 years old is planning his retirement at the age of 60. He expects to live for 15 years after retirement, requiring $5,00,000 in the 60th year itself and this requirement increases by $25,000 each year until the end. For this requirement, he intends to make twelve equal semi-annual payments over the first six years with the first instalment beginning six months from now. In addition, he makes an equal annual payment of $50 beginning in his 7th year and continuing until his 55th year. Determine the value of his equal semi-annual payments if the money grows at 15% compounded quarterly until the 60th year, after which it grows at 10%. (4)

10% Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G
1	1.100	.9091	1.0000	1.1000	1.000	0.909	0	0
2	1.210	.8264	.4762	.5762	2.100	1.736	0.476	0.826
3	1.331	.7513	.3021	.4021	3.310	2.487	0.937	2.329
4	1.464	.6830	.2155	.3155	4.641	3.170	1.381	4.378
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18	5.560	.1799	.0219	.1219	45.599	8.201	6.053	49.640
19	6.116	.1635	.0195	.1195	51.159	8.365	6.286	52.583
20	6.728	.1486	.0175	.1175	57.275	8.514	6.508	55.407
21	7.400	.1351	.0156	.1156	64.003	8.649	6.719	58.110
22	8.140	.1228	.0140	.1140	71.403	8.772	6.919	60.689
23	8.954	.1117	.0126	.1126	79.543	8.883	7.108	63.146
24	9.850	.1015	.0113	.1113	88.497	8.985	7.288	65.481
25	10.835	.0923	.0102	.1102	98.347	9.077	7.458	67.696

17) A California utility firm is considering building a 50-megawatt geothermal plant that generates electricity from naturally occurring underground heat. The binary geothermal system will cost $85 million to build and $6 million (including any income-tax effect) to operate per year. (Virtually no fuel costs will accrue compared with fuel costs related to a conventional fossil-fuel plant.) The geothermal plant is to last for 25 years. At that time, its expected salvage value will be about the same as the cost to remove the plant. The plant will be in operation for 70% (plant utilization factor) of the year (or 70% of 8,760 hours per year). If the firm's MARR is 10% per year, determine the cost per kilowatt-hour of generating electricity.

10% Compound Interest Factors

	Single Payment		Uniform Payment Series				Arithmetic Gradient	
n	Compound Amount Factor Find *F* Given *P* *F/P*	Present Worth Factor Find *P* Given *F* *P/F*	Sinking Fund Factor Find *A* Given *F* *A/F*	Capital Recovery Factor Find *A* Given *P* *A/P*	Compound Amount Factor Find *F* Given *A* *F/A*	Present Worth Factor Find *P* Given *A* *P/A*	Gradient Uniform Series Find *A* Given *G* *A/G*	Gradient Present Worth Find *P* Given *G* *P/G*
1	1.100	.9091	1.0000	1.1000	1.000	0.909	0	0
2	1.210	.8264	.4762	.5762	2.100	1.736	0.476	0.826
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15	4.177	.2394	.0315	.1315	31.772	7.606	5.279	40.152
16	4.595	.2176	.0278	.1278	35.950	7.824	5.549	43.416
17	5.054	.1978	.0247	.1247	40.545	8.022	5.807	46.582
18	5.560	.1799	.0219	.1219	45.599	8.201	6.053	49.640
19	6.116	.1635	.0195	.1195	51.159	8.365	6.286	52.583
20	6.728	.1486	.0175	.1175	57.275	8.514	6.508	55.407
21	7.400	.1351	.0156	.1156	64.003	8.649	6.719	58.110
22	8.140	.1228	.0140	.1140	71.403	8.772	6.919	60.689
23	8.954	.1117	.0126	.1126	79.543	8.883	7.108	63.146
24	9.850	.1015	.0113	.1113	88.497	8.985	7.288	65.481
25	10.835	.0923	.0102	.1102	98.347	9.077	7.458	67.696

(3)

18) The net present worth equation for the series of cash inflows and outflows with 10%, is given below. You are required to reconstruct the original cash-flow diagram representing the given equation.

NPW = 150 (P/F, 10%, 3) + [700 – 100 (A/G, 10%, 5)] (P/A, 10%, 5) (P/F, 10%, 5) – [50 + 50 (A/G, 10%, 6)] (P/A, 10%, 6) – [250 – 50 (A/G, 10%, 3)] (P/A, 10%, 3) (P/F, 10%, 6) (3)

-----End-----