



V SEMESTER B.TECH. MID-TERM EXAMINATION SEPTEMBER 2023

SUBJECT: ENGINEERING ECONOMICS AND FINANCIAL
MANAGEMENT [HUM 3051]

Date: 25/09/2023

Max. Marks: 30

Instructions to Candidates:

- ❖ Answer ALL the questions & missing data may be suitably assumed.
- ❖ Interest Factor Table and formulae have been provided at the end.

1	Pick the correct statement from the following sentences a) An annuity is a series of equal payments occurring at equal period of time. b) Annuity is called an equal payment or uniform payment series. c) An annuity may have periods of time of any length but should always be of equal length. d) All of the given statements are correct	0.5
2	Identify the most appropriate statement for an Arithmetic Gradient. a) Starts at the beginning of the first period and then increases by a constant amount each period. b) Starts at the end of the first period and then increases by a constant amount each period. c) Starts only at the end of the first period and then increases by a constant amount each period. d) Starts at the beginning or end of any period and then increases by a constant amount each period thereafter.	0.5
3	A series of uniform deposits 'X' are to be made starting from 4th year, till 10 th year. The equivalent worth of the deposits now, when interest rate is 10%, can be found using which of the following equation? a) $X (A/P, 10\%, 7) (P/F, 10\%, 3)$ b) $X (P/A, 10\%, 8) (F/P, 10\%, 2)$ c) $X (P/A, 10\%, 7) (P/F, 10\%, 3)$ d) $X (P/A, 10\%, 2) (P/F, 10\%, 8)$	0.5
4	The future worth (at $n=8$) of \$10,000 in year 3, \$10,000 in year 5, and \$10,000 in year 8 at an interest rate of 12% per year is closest to? a) \$32,100 b) \$39,300 c) \$41,670 d) \$46,200	0.5



5	<p>Let's suppose there is a cash flow with equal payments (receipts) worth 'C' from year 0 to 5 (6 equal payments, including payments at 0 and 5). Which of the following equations is NOT correct in calculating the Future worth, when the interest rate is 10% ?</p> <p>a) $F = C (F/A, 10\%, 6)$ b) $F = C (F/A, 10\%, 4) + C (F/A, 10\%, 2) (F/P, 10\%, 4)$ c) $F = C (F/A, 10\%, 5) + C (F/P, 10\%, 5)$ d) $F = C (F/A, 10\%, 5) + C (F/P, 10\%, 6)$</p>	0.5
6	<p>If the annual effective rate of interest compounded quarterly is 16%, then the nominal rate of interest is:</p> <p>a) 14.6% b) 15% c) 14.8% d) 15.12%</p>	0.5
7	<p>A series of uniform deposits 'X' are to be made starting from 3rd year till 10th year. The equivalent annual worth of the deposits, when interest rate is 10%, can be found using:</p> <p>a) $X (A/P, 10\%, 8) (P/F, 10\%, 2) (P/A, 10\%, 10)$ b) $X (P/A, 10\%, 8) (F/P, 10\%, 2) (A/F, 10\%, 10)$ c) $X (P/A, 10\%, 8) (P/F, 10\%, 2) (A/P, 10\%, 10)$ d) $X (P/A, 10\%, 2) (P/F, 10\%, 8) (A/P, 10\%, 10)$</p>	0.5
8	<p>The formula to calculate equivalent annuity for the cash flow diagram shown below is: (Assume an interest rate of 12 % p.a.)</p> <div style="text-align: center; margin: 20px 0;"> </div> <p>a) $100(A/P, 12, 10)$ b) $100(A/F, 12, 10)$ c) $100(A/P, 12, 5) + 100(A/F, 12, 5)$ d) $100(F/P, 12, 5)(A/F, 12, 10)$</p>	0.5
9	<p>Which of the following statement is true?</p> <p>a) The present value of a uniform series coincides with the first cash flow. b) The future value of a uniform series coincides with the last cash flow. c) The present value of a uniform series occurs only at zero. d) The future value of uniform cash flow occurs one-time period later than the last cash flow.</p>	0.5



10	<p>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.</p> <p>a) Sinking fund factor b) Capital recovery factor c) Equal payment series present worth factor d) Equal payment series compound amount factor</p>	0.5
11	<p>A company needs to add boring machine capacity to handle its increased business. Typically, the products are very intricate and precise and produced in small quantities. The choice lies between one fully automatic tape-controlled machine or two manually controlled machines. The manual machines will cost \$36500 each. They have estimated life of 20 years with estimated salvage value of \$5000 for each machine. A major overhaul (repair work) will be required every five years at an estimated cost of \$3000 for each machine. Estimated cost of labour is \$24000 per year for each machine.</p> <p>The automatic tape-controlled machine consists of the basic machine and the tape control unit. The basic machine will cost \$90000 and have an estimated life of 20 years with a salvage value of \$6000. Estimated annual maintenance and energy costs are \$3500. A major overhaul will be required for every 5 years at a cost of \$6000. The tape control unit will cost \$30,000 and have estimated service life of 10 years and a salvage value of \$2500. Its annual maintenance and energy cost will be \$1000. Estimated cost of labour is \$36,000 per year.</p> <p>If the automatic machine is selected, the estimated extra income tax annually is \$5480. Compare the alternatives on the basis of present worth of the cost for 20 years using an interest rate of 8%.</p>	4



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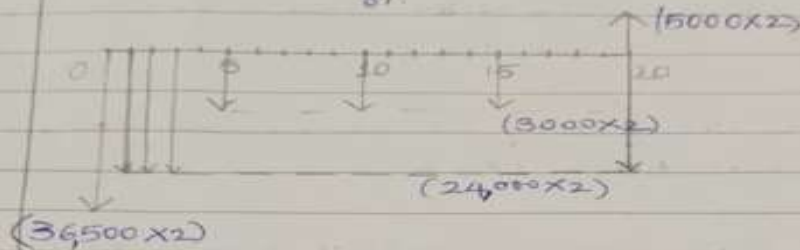
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SCHEME OF EVALUATION

C.F.D = 2% mark each; Approximation (NPV) = 0.1 mark each
Final answer = 1/2 mark each

Manually Controlled Machine

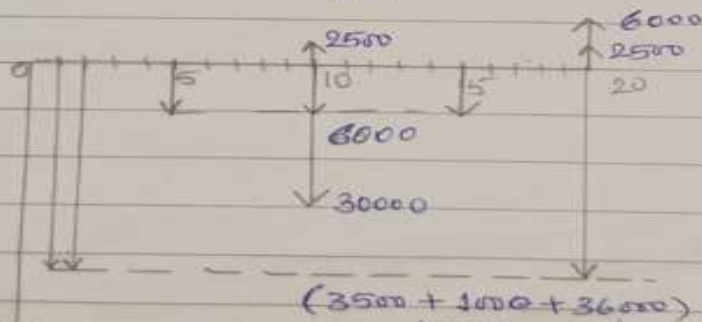
8:1



$$\begin{aligned} NPV &= 36500 \times 2 + 24000 \times 2 (P/A, 8\%, 20) + \\ & 3000 \times 2 [(P/F, 8\%, 5) (P/A, 8\%, 20) + \dots 10 \dots 15] \\ & 5000 \times 2 (P/F, 8\%, 20) \\ & = 73000 + 471268.8 + 8754 + 2145 \\ & = 555167.8 \end{aligned}$$

Automatic Tape-Controlled Machine

8:1



$$\begin{aligned} NPV &= 120000 + 45980 (P/A, 8\%, 20) \\ & + \frac{6000}{1.08^5} + \frac{6000}{1.08^{10}} + \frac{6000}{1.08^{15}} + \frac{6000}{1.08^{20}} (P/D) \\ & - 30000 \end{aligned}$$



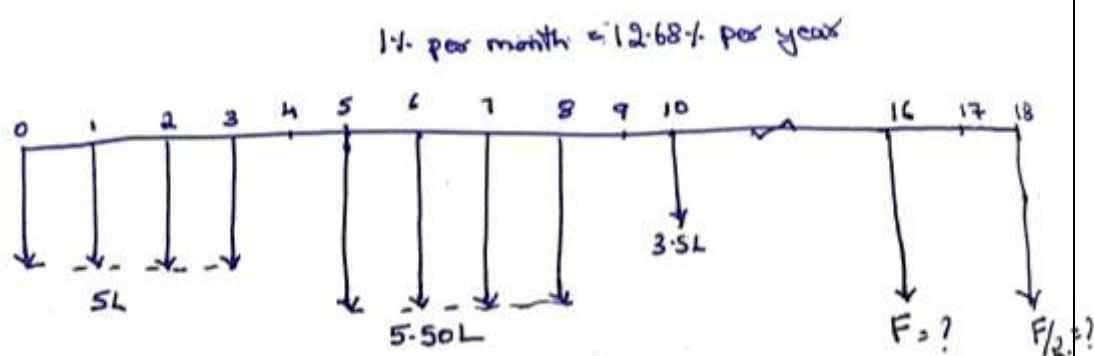
$$\begin{aligned}
 & - \frac{8500}{1.08^{30}} + \frac{2500}{1.08^{10}} \\
 & \quad \quad \quad 0.2145 \quad \quad \quad 0.4652 \\
 & -120000 + 451436.8 + 8754 - 1823.25 - 1158 \\
 & \quad \quad \quad = 577208.75
 \end{aligned}$$

The NPV (of cost) of Manually controlled Machines is smaller (less) than the Automatic type-controlled Machine.

∴ These Manually controlled Machines are preferred.

- 12 Ms. Saloni deposits an amount of 5,00,000 Indian Rupees (INR) into an investment account every year for four years (starting from now). 2 years after the last deposit, she increases the amount by 10% and continues equal yearly payments for four years. She further deposits INR 3,50,000 at the end of the tenth year. This account pays an interest rate of 12% compounded monthly. Six years after the last deposit, half of the accumulated fund is transferred to another fund paying an interest of 14% compounded quarterly. How much money will each account have after two years of this transfer?

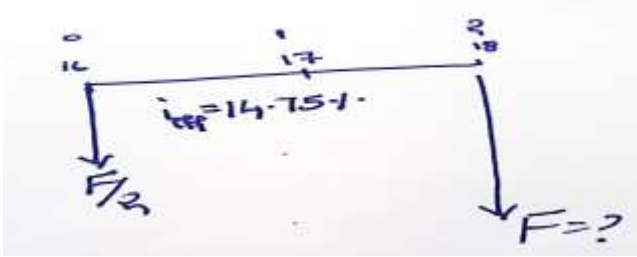
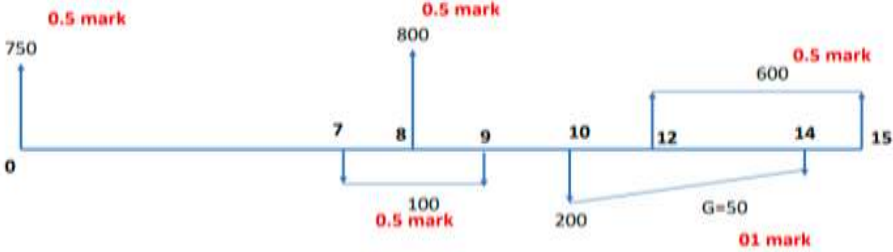
4



$$\begin{aligned}
 F_{16} &= 5L (F/A, 12.68\%, 4) (F/P, 12.68\%, 13) + 5.50L (F/A, 12.68\%, 4) (F/P, 12.68\%, 8) + 3.5L (F/P, 12.68\%, 6) \\
 & \quad \quad \quad (F/A, 12.68\%, 4) = (1.1268^4 - 1) / 0.1268 = 4.8272 \\
 F_{16} &= 5L (4.8272) (1.1268)^{13} + 5.50L (4.8272) (1.1268)^4 + 3.5L (1.1268)^6 \\
 &= 113.94 + 42.80 + 7.164 = \mathbf{163.904} \\
 \mathbf{F/2} &= \mathbf{81.952} \\
 (F/2)_{18} &= 81.952 (1.1268)^2 \\
 (F/2)_{18} &= \mathbf{104.05}
 \end{aligned}$$

Amount at New Fund for (F/2)

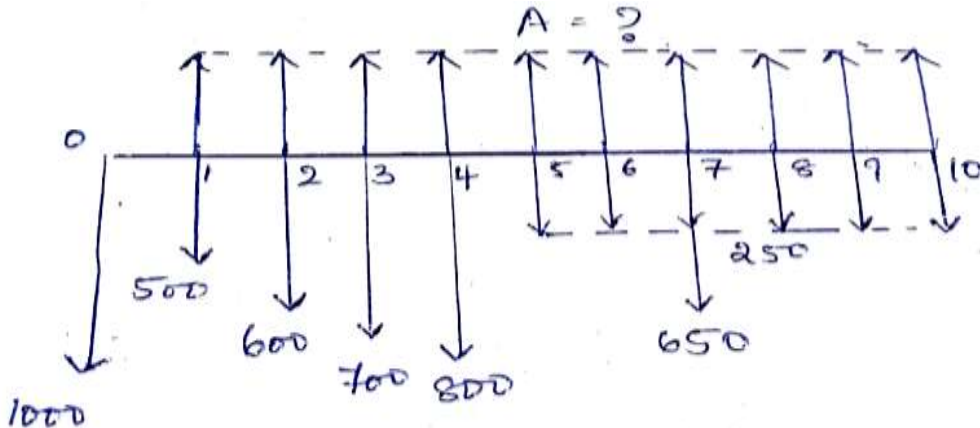
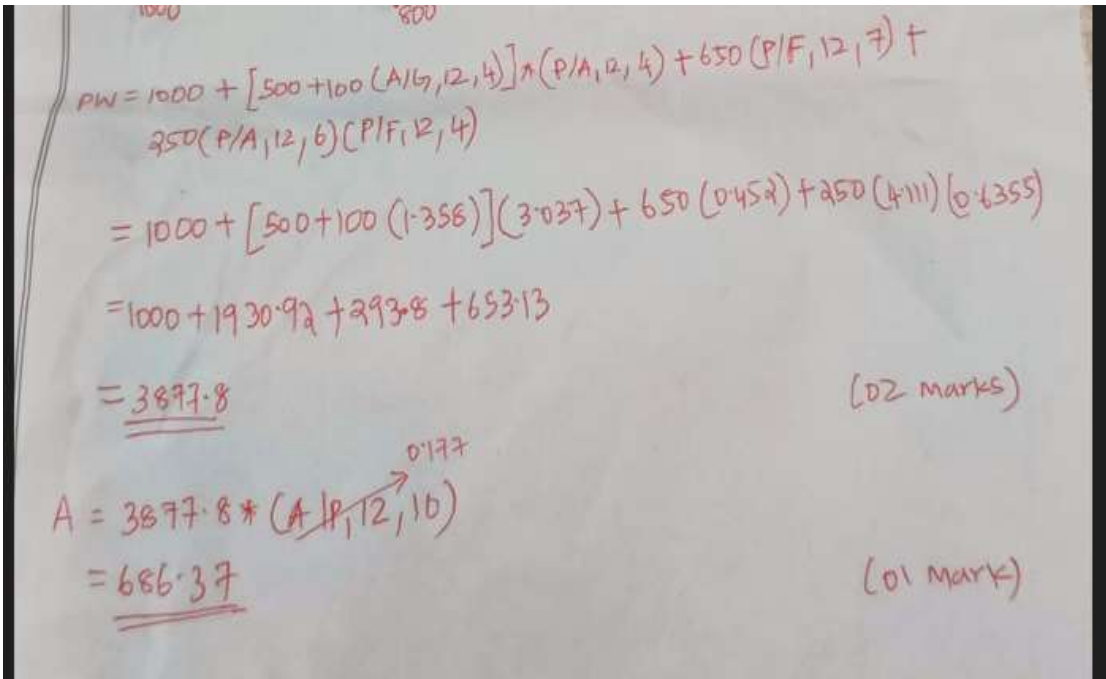


	 <p> $i_{\text{effective}} = (1 + 0.14/4)^4 - 1 = 0.1475$ $= 81.952 (1.1475)^2$ $(F/2)_{NF} = 107.91$ </p>	
13	<p>The following equation describes the conversion of a cash flow into an equivalent Present Worth value ($n=15$).</p> $PW = +750 - 100(P/A, 10\%, 3) (P/F, 10\%, 6) + 800(P/F, 10\%, 8) - [200 - 50 (A/G, 10\%, 5)] (F/A, 10\%, 5) (P/A, 10\%, 14) + 600(F/A, 10\%, 4) (P/F, 10\%, 15)$ <p>Reconstruct the original cash flow diagram.</p> 	3
14	<p>The Cadillac Motor Car Company is advertising a 24-month contract of a Cadillac Deville for \$520, payable at the beginning of each month (total 24 payments). The lease requires a \$2,500 down payment, plus a \$500 refundable security deposit. As an alternative, the company offers a single up-front payment of \$12,780, plus a \$500 refundable security deposit. The security deposits will be refunded at the end of the 24th month. Assuming an interest rate of 6%, compounded monthly, Evaluate the alternatives using present worth.</p>	3



	<ul style="list-style-type: none"> 24-month lease plan: $P = (\\$2,500 + \\$520 + \\$500) + \\$520(P/A, 0.5\%, 23) - \\$500(P/F, 0.5\%, 24)$ $= \\$14,347$ Up-front lease plan: $P = \\$12,780 + \\$500 - \\$500(P/F, 0.5\%, 24)$ $= \\$12,836$ <p>\therefore Select up-front lease plan</p> 	
15	<p>A piece of property may be purchased for \$ 780,000 for a mining purpose. Annual net income will be \$ 200,000 per year for the first two years after which it increases by \$ 20,000 per year with respect to the previous year, till the end of the tenth year. At the end of ten years, the surface of the mined land will be restored as per the requirement of law. This will cost \$ 1,500,000 more than the resale value of the property after it is restored. Using a 12 % interest rate per year and present worth method of comparison, determine whether the project is desirable.</p> <p>[0.5 M]</p> <p>Present Worth (PW) = - 780,000 - 1,500,000(1.1210) + 200,000 (P/A, 12%, 2) + [220,000 + 20,000(A/G, 12%, 8)] (P/A, 12%, 8) x (P/F, 12%, 2) [1 M]</p> <p>= - 780,000 - 1,500,000(1.1210) + 200,000 (1.690) + [220,000 + 20,000(2.913)] (4.968) x (0.7972)</p> <p>= -780,000 – 482,959.8 + 338,000 + 1,102,045</p>	3

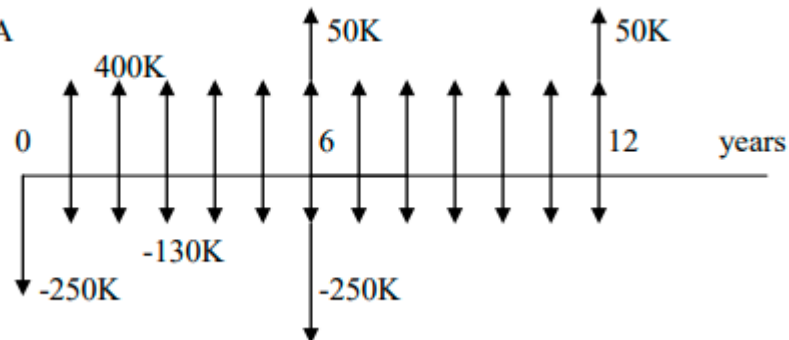


	= \$ 177,045 [1 M] Therefore desirable. [0.5]	
16	<p>Find the value of Annuity 'A' at $i = 12\%$</p>  	3
17	Which of the following alternatives should be chosen if i is 10% , use present worth method?	3

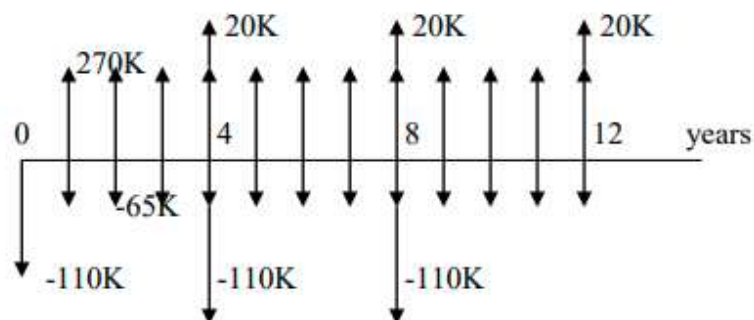


	A (\$)	B (\$)
First Cost	-250,000	-110,000
Annual Operating Costs	-130,000	-65,000
Annual Revenues	400,000	270,000
Salvage Value	50,000	20,000
Life	6	4

Cash flow for A



Cash flow for B



A

$$PW = -250,000 - 130,000(P/A, 10\%, 12) - 200,000(P/F, 10\%, 5) + 400,000(P/A, 10\%, 12) + 50,000(P/F, 10\%, 12) \quad (1m)$$

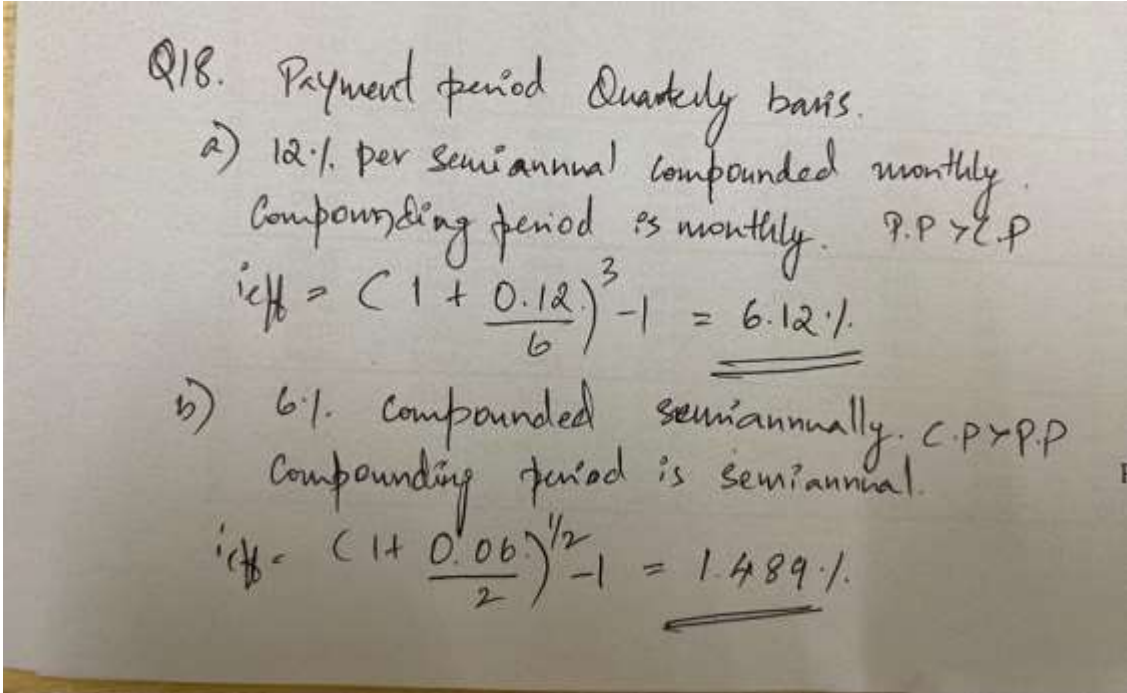
$$= \$1,492,810 \quad (0.5m)$$

B

$$PW = -110,000 - 90,000(P/F, 10\%, 4) - 90,000(P/F, 10\%, 8) + 205,000(P/A, 10\%, 12) + 20,000(P/F, 10\%, 12) \quad (1m)$$

$$= \$1,189,787 \quad (0.5m)$$



18	<p>Calculate the effective interest rate for the payment period which is on Quarterly basis, for the following interest rate:</p> <p>A) 12% per semi-annual compounded monthly. B) 6% compounded semi-annually</p> 	2
