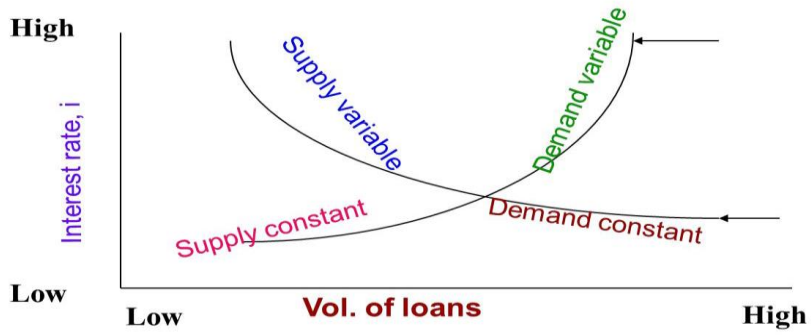
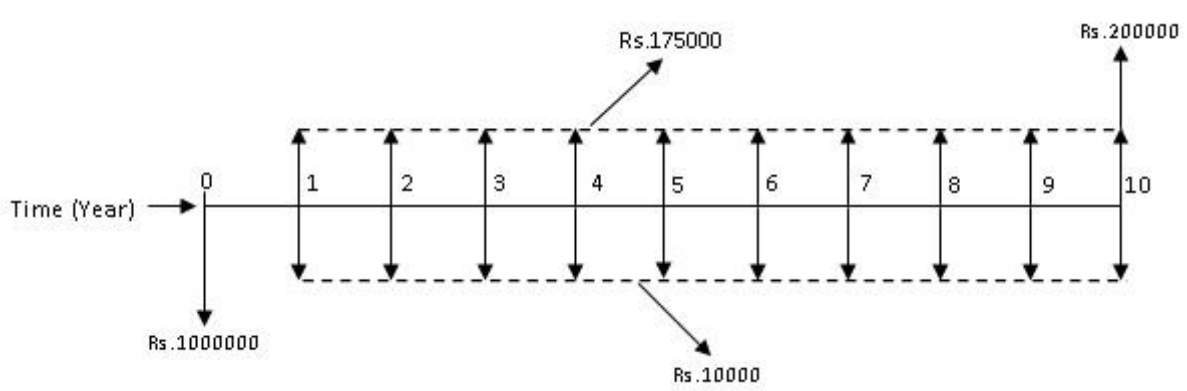
CMR INSTITUTE OF TECHNOLOGY							
Sub:	Construction Management & Entrepreneurship						
Date:	13.05.2019	Duration:	90 mins	Max Marks:	50	Sem:	VI

Question #		IAT- 3 Question And Answer
1	a	**What are the principles of Engineering Economy? [06]** Principles of Engineering Economy are: 1. Develop the Alternatives 2. Focus on the Differences 3. Use a Consistent Viewpoint 4. Use a Common Unit of Measure 5. Consider All Relevant Criteria 6. Make Uncertainty Explicit 7. Revisit Your Decisions 1. Develop the Alternatives The final choice (decision) is among alternatives. The alternatives need to be identified and then defined for subsequent analysis. 2. Focus on the Differences Only the differences in expected future outcomes among the alternatives are relevant to their comparison and should be considered in the decision. 3. Use a Consistent Viewpoint The prospective outcomes of the alternatives, economic and other, should be consistently developed from a defined viewpoint (perspective). 4. Use a Common Unit of Measure Using a common unit of measurement to enumerate as many of the prospective outcomes as possible will make easier the analysis and comparison of alternatives. 5. Consider All Relevant Criteria Selection of a preferred alternative (decision making) requires the use of a criterion (or several criteria). 6. Make Uncertainty Explicit Uncertainty is inherent in projecting (or estimating) the future outcomes of the alternatives and should be recognized in their analysis and comparison. 7. Revisit Your Decisions Improved decision making results from an adaptive process; to the extent practicable. The initial projected outcomes of the selected alternative should be subsequently compared with actual results achieved.
	b	**Rs 8071.84 every year is deposited for next 12 years at an interest rate of 12% is equivalent to Present Value of ……? [04]**

		This Problem is about finding what will be Future Value, if for 12 years, a deposit of Rs 8071.84 is made and it carry an interest of 12% p.a Find F, when A is known. Use **(USCAF or EPSCAF) = Uniform series compound amount factor** F = A * [[(1+i)^{n}-1] / i.] ---------Equation number 05 **[F/A,i,n] , F = A * (F/A, i,n)** F = 8071.84* ({[1+12%]^12-1} / 12%) = Rs 8071.84*24.13313/12% = Rs 194798.8
2	a	**Jays is planning for his retired life. He has 15 years of service, and he wishes to deposit 20% of his salary which is 12,000/- at the end of 1st year and thereafter he wishes to increase his deposit by Rs. 200/- more every year along with Rs. 12,000/- for next 14 years. What will be the maturity amount of this deposit, if the rates are 10% and 12% per year. [06]** **Case (i):** A = 12,000/- G = 200 i = 10% n = 14 years A= A1+ G$\frac{1}{i} - \frac{n}{(1+i)^n n-1}$ = 12000 + 200(4.996) = Rs.12999.2/- F = A * $\frac{(1+i)^n-1}{i}$ = 12999.2 * 27.975 = Rs. 363652.62/- **Case (ii):** A = 12,000/- G = 200 i = 12% n = 14 years A= A1+ G$\frac{1}{i} - \frac{n}{(1+i)^n n-1}$ = 12000 + 200(4.732) = Rs.12946.4/- F = A * $\frac{(1+i)^n-1}{i}$ = 12946.4 * 32.393 = Rs. 4,19,372/-
	b	**Write the difference between Micro Economics and Macro Economics. [04]** **Micro Economics** | **Macro Economics** Microeconomics is the study of economics at an individual, group or company level | Macroeconomics is the study of a national economy as a whole.

		It focuses on issues that affect individuals and companies. This could mean studying the supply and demand for a specific product, the production that an individual or business is capable of or the effects of regulations on a business	Macroeconomics focuses on issues that affect the economy as a whole. Some of the most common focuses of macroeconomics include unemployment rates, the gross domestic product of an economy and the effects of exports and imports.
3	a	**Write about effect on Interest Rates of Supply and Demand for Loan Funds [05]**  A high demand for loans with a constant supply of funds available result in high interest rate A high supply of available funds with a constant demand results in low interest rates	
	b	**What do you understand from a Cash Flow Diagram. [05]** The use of cash flow diagram is strongly recommended for situations in which the analyst needs to visualise what is involved when flows of money occur at various times. Indeed, the usefulness of cash flow diagram for economic analysis problems is analogous to that of the free body diagrams of Engineering mechanics problems. So the graphic presentation of each value plotted at appropriate time is called a cash flow diagram. The normal conventions for cash flow diagrams are as follows: a. The horizontal line is a time scale with progression of time moving from left to right. The value indicated on time scale (viz., 0, 1, 2, ….n) indicates the end of the respective period. b. The arrows signify cash flow, normally downward arrows represent disbursement or costs and upward arrows represent receipts or benefits. OR The normal conventions for cash flow diagrams are: 1. The horizontal line is a time scale with progression of time moving from left to right. The value indicated on time scale ie 0,1,2,….n indicates the end of respective period. 2. The arrows signify cash flow, normally downward arrows represents disbursement or expenses or cash out flow or cost and upward arrow represents cash deposit or revenue or income or receipts or benefits.	

		Simple line diagram consisting of two parts the horizontal time line the vertical cash flow lines.
4	a	**A material testing laboratory has two alternatives for purchasing a compression testing machine which will be used for determining the compressive strength of different construction materials. The alternatives are from two different manufacturing companies. The cash flow details of the alternatives are as follows;Alternative-1: Initial purchase price = Rs.1000000, Annual operating cost = Rs.10000, Expected annual income to be generated from testing of different construction materials = Rs.175000, Expected salvage value = Rs.200000, Useful life = 10 years.Alternative-2: Initial purchase price = Rs.700000, Annual operating cost = Rs.15000, Expected annual income to be generated from testing of different construction materials = Rs.165000, Expected salvage value = Rs.250000, Useful life = 5 years. Using present worth method, find out the most economical alternative at the interest rate of 10% per year. [10].** The alternatives have different life spans i.e. 10 years and 5 years. Thus the comparison will be made over a time period equal to the least common multiple of the life spans of the alternatives. In this case the least common multiple of the life spans is 10 years. Thus the cash flow of Alternative-1 will be analyzed for one cycle (duration of 10 years) whereas the cash flow of Alternative-2 will be analyzed for two cycles (duration of 5 years for each cycle). The cash flow of the Alternative-2 for the second cycle will be exactly same as that in the first cycle. The cash flow diagram of Alternative-1 is shown in Fig. 2.11.  **Fig. 2.11 Cash flow diagram of Alternative-1**

The equivalent present worth PW_1 (in Rs.) of Alternative-1 is calculated as follows;
PW_1 = - 1000000 - 10000(*P/A, i, n*) + 175000*(P/A, i, n)* + 200000(*P/F, i, n*)
PW_1 = - 1000000 - 10000(*P/A, 10%, 10*) + 175000*(P/A, 10%, 10)* + 200000(*P/F, 10%, 10*)
PW_1 = - 1000000 + (175000 - 10000) (*P/A, 10%, 10*) + 200000(*P/F, 10%, 10*)
Putting the values of different compound interest factors in the above expression for PW_1;
PW_1 = - 1000000 + 165000 X 6.1446 + 200000 X 0.3855
PW_1 = - 1000000 + 1013859 + 77100
***PW_1* = Rs.90959**

The cash flow diagram of Alternative-2 is shown in Fig. 2.12. As the least common multiple of the life spans of the alternatives is 10 years, the cash flow of Alternative-2 is shown for two cycles with each cycle of duration 5 years.

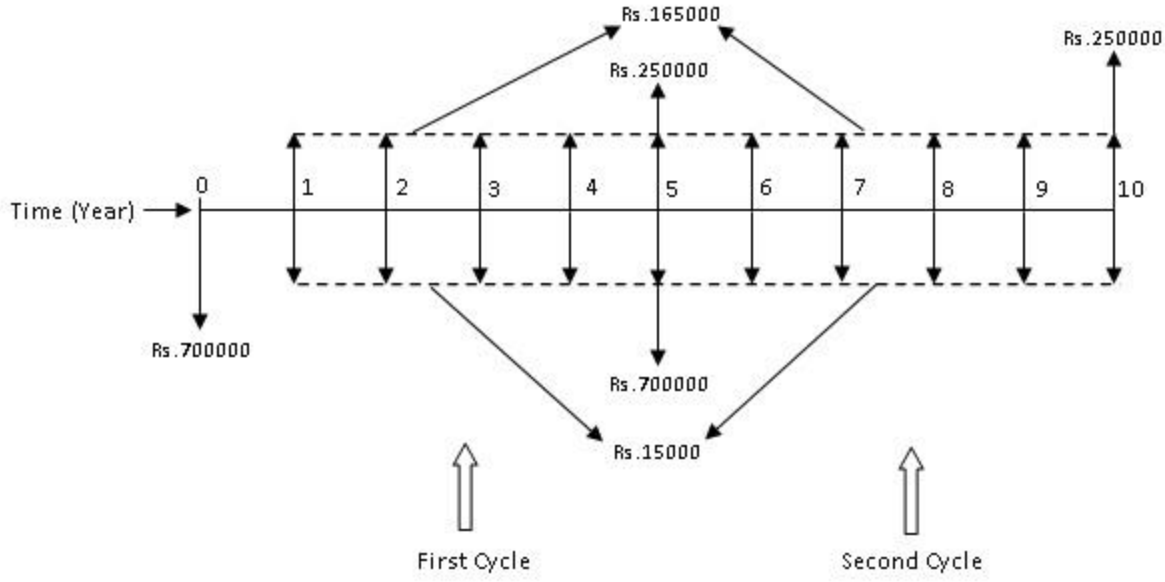
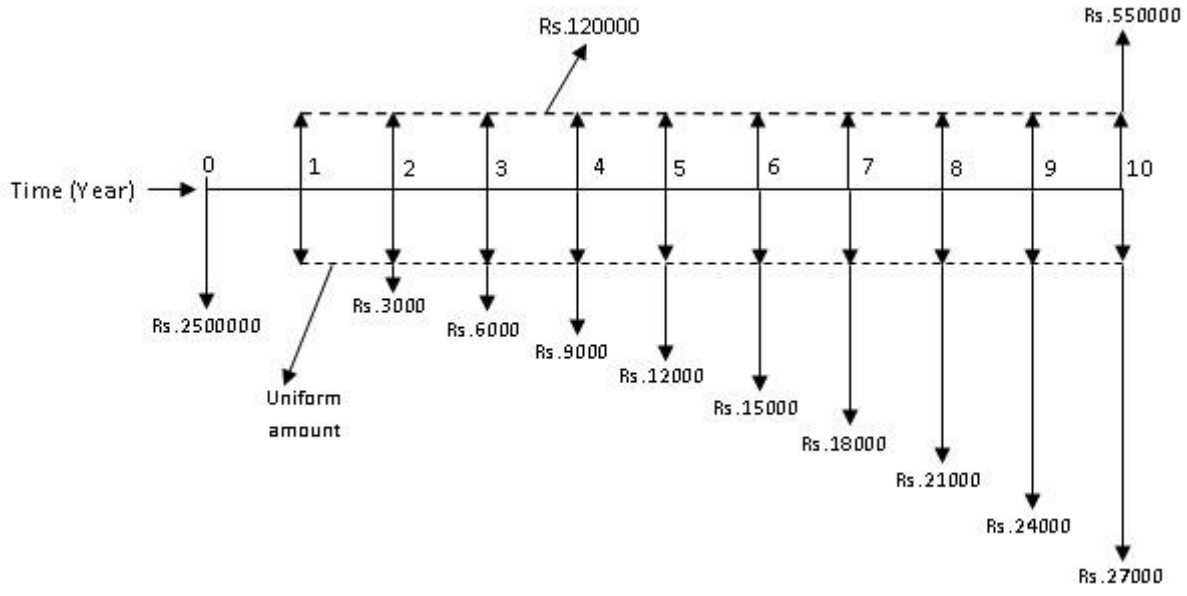


Fig. 2.12 Cash flow diagram of Alternative-2 for two cycles

In the cash flow diagram of Alternative-2, the initial purchase price of Rs.700000 is again located at the end of year '5' i.e. at the end of first cycle or the beginning of the second cycle. In addition the annual operating cost and the annual income are also repeated in the second cycle from end of year '6' till end of year '10'. Further the salvage value of Rs.250000 is also located at end of year '10' i.e. at the end of second cycle.

The equivalent present worth PW_2 (in Rs.) of Alternative-2 is determined as follows;
PW_2 = - 700000 - 15000(*P/A, 10%, 10*) + 165000*(P/A, 10%, 10)* + 250000(*P/F, 10%, 5*) - 700000*(P/F, 10%, 5)* + 250000*(P/F, 10%, 10)*
PW_2 = - 700000 + (165000 - 15000) (*P/A, 10%, 10*) - (700000 – 250000) (*P/F, 10%, 5*) + 250000*(P/F, 10%, 10)*
Putting the values of different compound interest factors in the above expression for PW_2 results in the following;
PW_2 = - 700000 + 150000 X 6.1446 - 450000 X 0.6209 + 250000 X 0.3855

		PW_2 = - 700000 + 921690 - 279405 + 96375 **PW_2= Rs.38660** Thus from the comparison of equivalent present worth of the alternatives, it is evident that Alternative-1 will be selected for purchase of the compression testing machine as it shows the higher positive equivalent present worth.
5	a	**A construction contractor has three options to purchase a dump truck for transportation and dumping of earth at a construction site. All the alternatives have the same useful life. The cash flow details of all the alternatives are presented as follows; Option-1: Initial purchase price = Rs.2500000, Annual operating cost Rs.45000 at the end of 1 st year and increasing by Rs.3000 in the subsequent years till the end of useful life, Annual income = Rs.120000, Salvage value = Rs.550000, Useful life = 10 years. Option-2: Initial purchase price = Rs.3000000, Annual operating cost = Rs.30000, Annual income Rs.150000 for first three years and increasing by Rs.5000 in the subsequent years till the end of useful life, Salvage value = Rs.800000, Useful life = 10 years. Option-3: Initial purchase price = Rs.2700000, Annual operating cost Rs.35000 for first 5 years and increasing by Rs.2000 in the successive years till the end of useful life, Annual income = Rs.140000, Expected salvage value = Rs.650000, Useful life = 10 years. Using future worth method, find out which alternative should be selected, if the rate of interest is 8% per year. [10]** The cash flow diagram of Option-1 is shown here again for ready reference.  **Fig. 2.6 Cash flow diagram of Option-1 with annual operating cost split into uniform base amount and gradient amount (shown for ready reference)**

The equivalent future worth (in Rs.) of Option-1 is determined as follows;

$$FW_1 = -2500000(F/P,8\%,10) - 45000(F/A,8\%,10) - 3000(F/G,8\%,10) + 120000(F/A,8\%,10) + 550000$$

$$FW_1 = -2500000(F/P,8\%,10) + (120000 - 45000)(F/A,8\%,10) - 3000(F/G,8\%,10) + 550000$$

Now putting the values of different compound interest factors in the above expression for *FW 1*results in the following;

$$FW_1 = -2500000 \times 2.1589 + 75000 \times 14.4866 - 3000 \times 56.0820 + 550000$$

$$FW_1 = -5397250 + 1086495 - 168246 + 550000$$

***FW₁* = - Rs.3929001**

The cash flow diagram of Option-2 is shown again for ready reference.

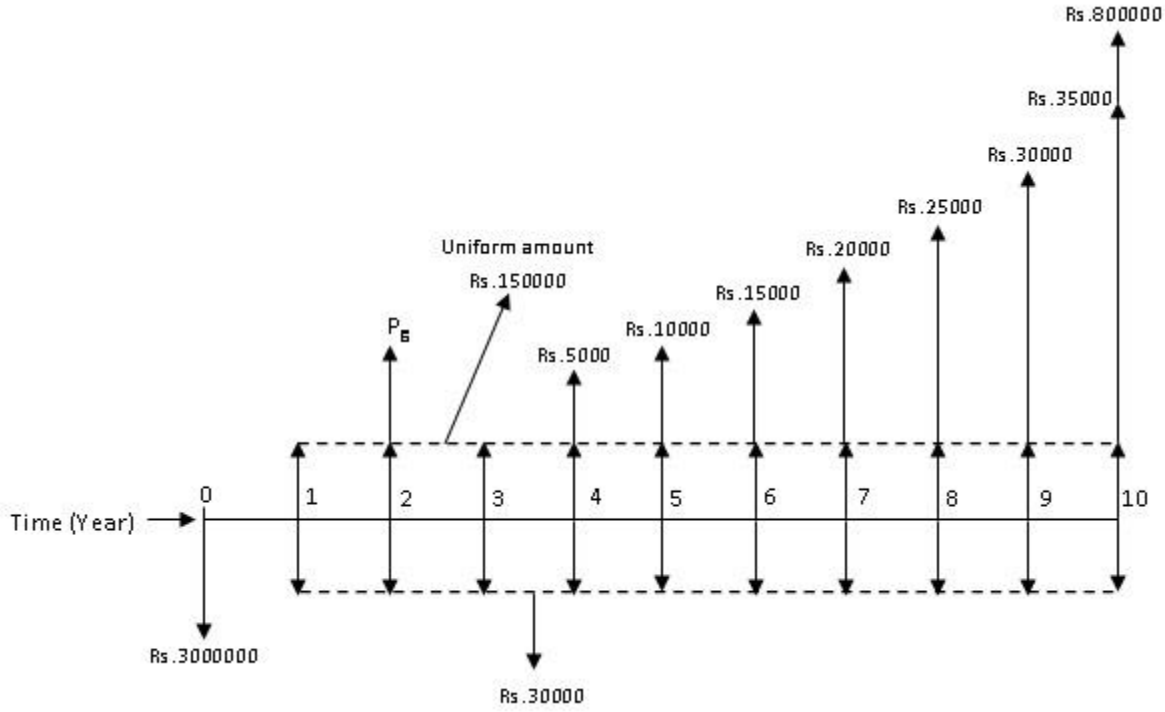


Fig. 2.8 Cash flow diagram of Option-2 with annual income split into uniform base amount and gradient amount (shown for ready reference)

The equivalent present worth of the gradient series (of the annual income) starting from end of year '4' will be located at the end of year '2'. The future worth of this amount at end of year '10' will be obtained by multiplying the equivalent present worth ' P_g '(shown in Fig. 2.8) at the end of

year '2' with the single payment compound amount factor *(F/P, i, n)* . The equivalent future worth (in Rs.) of Option-2 is determined as follows;

Now replacing P_g with *G (P/G, i, n)* i.e. 5000(*P/G, 8%, 8*) in the above expression;

$$FW_2 = -3000000(F/P,8\%,10)+(150000-30000)(F/A,8\%,10)+5000(P/G,8\%,8)(F/P,8\%,8) +800000$$

It may be noted here that, in the above expression, 5000 *(P/G, 8%, 8) (F/P, 8%, 8)* can be replaced by 5000 *(F/G, 8%, 8)* and will result in the same value.

Now putting the values of different compound interest factors in the above expression;

$$FW_2 = -3000000\times 2.1589+120000\times 14.4866+ 5000\times 17.8061\times 1.8509+800000$$

FW_2= - 6476700 + 1738392 + 164787 + 800000

***FW_2* = - Rs.3773521**

The cash flow diagram of Option-3 is shown here again for ready reference.

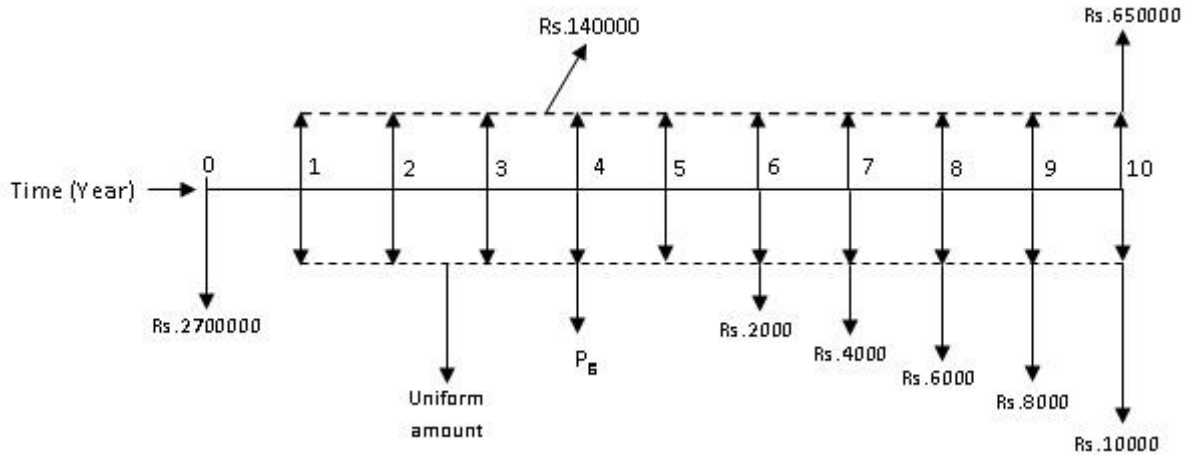


Fig. 2.10 Cash flow diagram of Option-3 with annual operating cost split into uniform base amount and gradient amount (shown for ready reference)

For the annual operating cost, the equivalent present worth of the gradient series starting from end of year '6' will be located at the end of year '4'. The future worth of this amount at end of year '10' will be determined by multiplying the equivalent present worth ' P_g '(shown in Fig. 2.10) at the end of year '4' with the single payment compound amount factor *(F/P, i, n)* .

		The equivalent future worth (in Rs.) of Option-3 is determined as follows; $FW_3 = -2700000(F/P,8\%,10) - 35000(F/A,8\%,10) - P_g(F/P,8\%,6) + 140000(F/A,8\%,10) + 650000$ Now replacing P_g with *G (P/G, i, n)* i.e. 2000(*P/G, 8%, 6*) in the above expression; $FW_3 = -2700000(F/P,8\%,10) + (140000 - 35000)(F/A,8\%,10) - 2000(P/G,8\%,6)(F/P,8\%,6) + 650000$ In the above expression, 2000 *(P/G, 8%, 6) (F/P, 8%, 6)* can also be replaced by 2000 *(F/G, 8%, 6)* . Now putting the values of different compound interest factors in the above expression; $FW_3 = -2700000 \times 2.1589 + 105000 \times 14.4866 - 2000 \times 10.5233 \times 1.5869 + 650000$ $FW_3 = -5829030 + 1521093 - 33399 + 650000$ ***FW 3* = - Rs.3691336** Comparing the equivalent future worth of all the three alternatives, it is evident that Option-3 shows lowest negative equivalent future worth as compared to other options. Thus Option-3 will be selected for the purchase of the dump truck. This outcome obtained by future worth method is same as that obtained from the present worth method (Example-3) i.e. Option-3 is the most economical alternative. After carrying out the comparison of equal life span mutually exclusive alternatives, now the illustration of future worth method for comparison of different life span mutually exclusive alternatives is presented.
6	a	**If Shivaraj deposits Rs. 35,000/- into his savings account which earns 12% Rate of interest per year. What is the uniform annual amount that could be withdrawn at the end of each year for the next 10 Years so that nothing would be left in the account after 15th withdrawal. [04]**
	b	**Alternative-1: Initial purchase cost = Rs.5,00,000, Annual operating and maintenance cost = Rs.25000, Expected salvage value = Rs.1,35,000, Useful life = 5 years. Alternative-2: Initial purchase cost = Rs.3,00,000, Annual operating and maintenance cost = Rs.40000, Expected salvage value = Rs.90,000, Useful life = 5 years. The annual revenue to be generated from by doing excavation work from Alternative-1 and Alternative-2 are Rs.55,000 and Rs.50,000 respectively. Compute the equivalent present worth of the**

alternatives at the same rate of interest 12% per year and find out the economical alternative. [06]

The cash flow diagram of Alternative-1 is shown in Fig. 2.3.

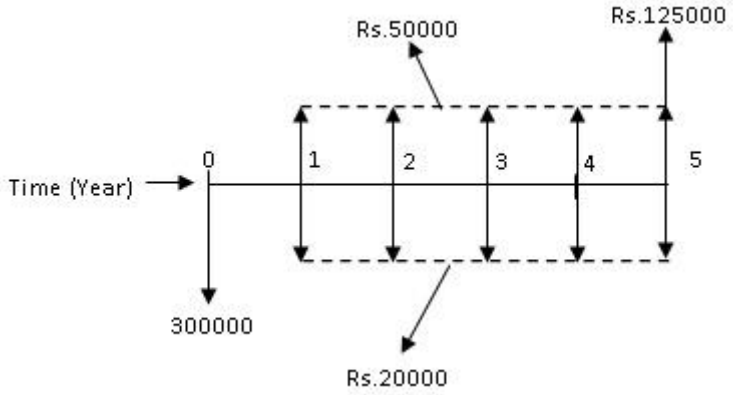


Fig. 2.3 Cash flow diagram of Alternative-1

The equivalent present worth of Alternative-1 is calculated as follows;

PW_1 = - 3,00,000 - 20,000 (*P/A, i, n*) + 50,000 *(P/A, i, n)* + 1,25,000 (*P/F, i, n*)

PW_1 = - 3,00,000 - 20,000 (*P/A, 10%, 5*) + 50,000 (*P/A, 10%, 5*) + 1,25,000 (*P/F, 10%, 5*)

PW_1 = - 3,00,000 + (50,000 – 20,000) (*P/A, 10%, 5*) + 1,25,000 (*P/F, 10%, 5*)

PW_1= - 3,00,000 + 30,000 (*P/A, 10%, 5*) + 1,25,000 (*P/F, 10%, 5)*

$$PW_1 = -3,00,000 + 30,000 \times \frac{(1+i)^n - 1}{i(1+i)^n} + 1,25,000 \times \frac{1}{(1+i)^n}$$

$$PW_1 = -3,00,000 + 30,000 \times \frac{(1+0.1)^5 - 1}{0.1(1+0.1)^5} + 1,25,000 \times \frac{1}{(1+0.1)^5}$$

PW_1 = - 2,00,000 - 35,000 X 3.7908 + 70,000 X 0.6209

PW_1 = - 3,00,000 + 1,13,724 + 77,613

***PW*$_1$ = - Rs.1,08,663**

The cash flow diagram of Alternative-2 is shown in Fig. 2.4.

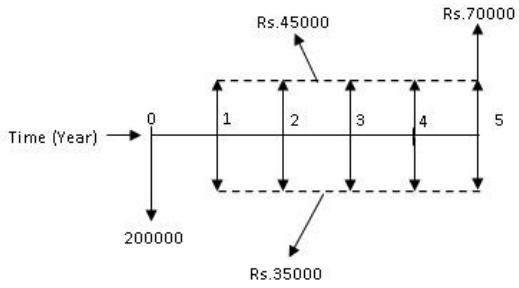
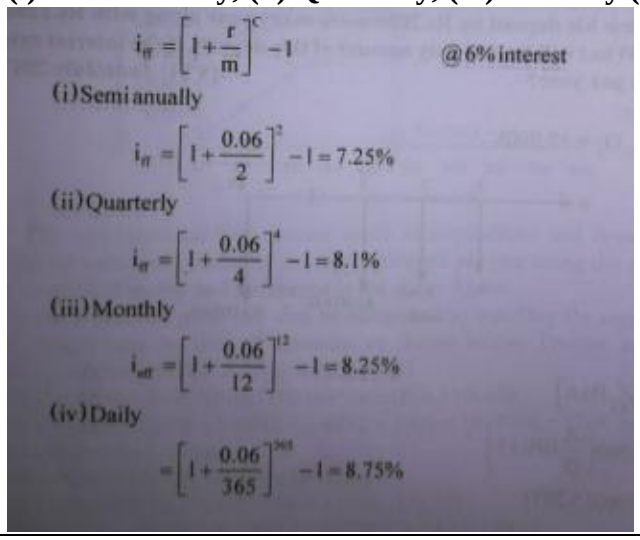


		Fig. 2.4 Cash flow diagram of Alternative-2 Now the equivalent present worth of Alternative-2 i.e. PW_2 (in Rs.) is calculated as follows; PW_2= - 2,00,000 - 35,000 (*P/A, i, n*) + 45,000 *(P/A, i, n)* + 70,000 (*P/F, i, n*) PW_2 = - 2,00,000 - 35,000 (*P/A, 10%, 5*) + 45,000 *(P/A, 10%, 5)* + 70,000 (*P/F, 10%, 5*) PW_2 = - 2,00,000 + (45,000 – 35,000) (*P/A, 10%, 5*) + 70,000 (*P/F, 10%, 5*) PW_2 = - 2,00,000 + 10,000 (*P/A, 10%, 5*) + 70,000 (*P/F, 10%, 5*) $$PW_2 = -2{,}00{,}000 + 10{,}000 \times \frac{(1+i)^n - 1}{i(1+i)^n} + 70{,}000 \times \frac{1}{(1+i)^n}$$ $$PW_2 = -2{,}00{,}000 + 10{,}000 \times \frac{(1+0.1)^5 - 1}{0.1(1+0.1)^5} + 70{,}000 \times \frac{1}{(1+0.1)^5}$$ $$PW_2 = -200000 + 10000 \times 3.7908 + 70000 \times 0.6209$$ PW_2 = - 2,00,000 + 37,908 + 43,463 **PW_2= - Rs.1,18,629**
7		**Determine the effective interest rate for a nominal annual rate of 6% that is compounded:** **(i) Semiannually, (ii) Quarterly, (iii) Monthly (iv) Daily. [05]**  $i_{eff} = \left[1 + \frac{r}{m}\right]^c - 1$ @6% interest (i) Semi anually $i_{eff} = \left[1 + \frac{0.06}{2}\right]^2 - 1 = 7.25\%$ (ii) Quarterly $i_{eff} = \left[1 + \frac{0.06}{4}\right]^4 - 1 = 8.1\%$ (iii) Monthly $i_{eff} = \left[1 + \frac{0.06}{12}\right]^{12} - 1 = 8.25\%$ (iv) Daily $= \left[1 + \frac{0.06}{365}\right]^{365} - 1 = 8.75\%$

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