**ENGINEERING ECONOMICS**

**QUESTION BANK**

**Time Value Money**

1. How much money will be accumulated in 25 years if Rs. 800 is deposited at the end of 2nd year from now, Rs. 2400 six years from now and Rs. 3300 eight years from now all at an interest rate of 18% per year. Also, find its equivalent annual worth (A) for this time period of 25 years.
2. A person plans to have a retirement policy which will give him return when he reaches an age of 50. For this person whose age is 35 years now has to make annual premium payment of Rs. 19760 till he reaches an age of 49. if the interest rate is 8% compounded annually, what is the lump sum he is getting an maturity for this policy.

(Ans: F= Rs. 5,16,765.77)

1. A couple would like to determine what amount they must deposit in a savings account bearing 12% interest rate so that they will get Rs.5000/- at the end of 10th year and will get an increase of Rs.1000/- each year for the next 10 years. Draw the cash flow diagram.
2. Determine the present amount.
3. If the interest rate is compounded quarterly what is the present amount?
4. Suppose that you have a savings plan covering the next ten years, according to which you put aside $600 today, $800 at the end of every year for the next five years, and $2000 at the end of each year for the remaining five years. As part of this plan, you expect to withdraw $300 at the end of every year for the first 3 years, and $350 at the end of every year thereafter till the 10th year. In addition to this you are expected to withdraw an amount of $50 at the end of every 2 years till 15th year. Assume interest to be 12%.
5. Draw your cash flow diagram.
6. Find the amount accumulated in the saving account at the end of 15th year.

(Answer- Amount in saving account is Rs.)

**Nominal and Effective Interest Rates**

1. An amount of 1200 per year is to be paid into an account each for the next five years. Using a interest rate of 12 % determine the total amount the account will have at the end of 5th year.

Deposit made at the end of each year with interest compounded monthly.

1. A boy is now 11 years old. On his fifth birthday he received a gift of $5,000 from his grandparents, which was invested in a 10 year fixed deposit bearing an interest rate of 6% per year compounded annually. His parents plan to have $6,000 available each year for the boy’s nineteenth to twenty second birthdays to help finance his college education. To assist the financing, the fixed deposit will be reinvested when it matures. If required how much equal amount should the parents deposit each year, beginning from his next birthday, so that one year after the last deposit they can start making payments to their son. All future investments will earn 6.5% per year compounded annually.
2. Visteon, a spin-off company of Ford Motor Company, supplies major automobile components to auto manufacturers worldwide and is Ford's largest supplier. An engineer is on a Visteon committee to evaluate bids for new-generation coordinate-measuring machinery to be directly linked to the automated manufacturing of high-precision components. Three vendor bids include the interest rates. Visteon will make payments on a semi-annual basis only. The engineer is confused about the effective interest rates. What they are annually and over the payment period (PP) of 6-months.

Bid 1: 9% per year, compounded quarterly

Bid 2: 3% per quarter, compounded quarterly

Bid 3: 8.8% per year, compounded monthly

1. Determine the effective rate for each bid on the basis of semi-annual payments, and construct cash flow diagrams for each bid rate.
2. What are the effective annual rates? These are to be a part of the final bid selection.
3. Which bid has the lowest effective annual rate?
4. A company is planning to invest Rs. 6000 once in 6 months; the investment is made at the end of every 6th month, for next 5 years. The company is planning to utilize this amount accumulated at the end of 5th year for buying an asset. Identify the amount accumulated at the end of 5th year under following cases:
5. If interest is 12% compounded semi-annually. (Ans- 79084.7)
6. If interest is 12% compounded annually. (Ans- )
7. If interest is 12% compounded quarterly. (Ans- 79419.83)

**Present Worth Method**

1. The details of the feasibility report of a project are shown below. Check the feasibility of the project based on Present Worth Method if i=20%.

Initial outlay- Rs.50,00,000

Life of Project- 20 years

Annual Equivalent Revenues- Rs.15,00,000

Modernizing cost at the end of 10th year- Rs.20,00,000

Salvage value at the end of project life- Rs.5,00,000

1. Investment proposals A and B have the net cash flows as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Proposal | End of Years | | | | |
| 0 | 1 | 2 | 3 | 4 |
| A | -10000 | 3000 | 3000 | 7000 | 6000 |
| B | -10000 | 6000 | 6000 | 3000 | 3000 |

Which proposal should be selected with an interest rate of 18%?

1. A granite company is planning to buy a fully automated granite cutting machine. If it is purchased under down payment, the cost of the machine is Rs. 16,00,000. If it is under installment basis, the company has to pay 25% of the cost at the time of purchase and the remaining amount in ten equal installments of Rs. 2,00,000 each. Suggest the best alternative using present worth method if i= 18% compounded annually.

**Present Worth (PW) Method/Future Worth (FW) with Unequal Life**

1. Two types of trucks are available for transportation use. They are needed for 10 years. The details are.

|  |  |  |
| --- | --- | --- |
|  | **Truck A** | **Truck B** |
| First cost | 10,00,000 | 15,00,000 |
| Estimated annual maintenance cost | 20,000 | 15,000 |
| Estimated life | 5 years | 10 years |
| Estimated salvage value | 2,00,000 | 5,00,000 |

1. Determine the best alternative using the present worth method with i=18%?
2. Also, apply the future worth method to select the alternative for the same data?
3. Assets A1 and A2 have the capability of satisfactorily performing a required function. Asset A2 has an initial cost of Rs.32000 and an expected salvage value of Rs.4000 at the end of its 4 years’ service life. Assets A1 costs 9000 less initially, with an economic life 1 year shorter than that of A2; but A1 has no salvage value, and its annual operating costs exceed those of A2 by 2500. When the required rate of return is 15% state which alternative is preferred?
4. An entrepreneur intending to start a new business knows that the first few years are the most difficult. To lessen the chance of failure, a loan plan for startup capital is proposed in which interest paid during the first two years will be at 3% and at 6% for the next two years of the 6 years loan. How large a loan can be justified for proposed repayments at the end of years 2, 4, and 6 respectively Rs. 20,000, Rs. 30,000 and Rs.50,000?

**PW method- Study Period Method**

1. A new rock pit will be operated for a construction project that will last 5 years. Rock can be loaded from an elevated box loader served by a conveyor from the pit or by mobile shovel loaders. The box loader and conveyor have an initial cost of Rs.2,64,000 and will have no salvage value at the end of the project.

Two shovel loaders each priced Rs.42,000 can provide the same capacity, but their operating costs together will be Rs.36,000 per year more than the box loader. Normal service life for a shovel loader is 3 years with zero salvage value, but a 2 year old machine can likely be sold for Rs.10,000. Which alternative is preferred when the interest rate is 13%?

**Capitalized Cost**

1. The property appraisal district for Marin County has just installed new software to track residential market values for property tax computations. The manager wants to know the total equivalent cost of all future costs incurred when the three county judges agreed to purchase the software system. If the new system will be used for indefinite future, find the equivalent value *(a)* now and *(b)* for each year hereafter. The system has an installed cost of $150,000 and an additional cost of $50,000 after 10 years. The annual software maintenance contract cost is $5000 for the first 4 years and $8000 thereafter. In addition, there is expected to be a recurring major upgrade cost of $15,000 every 13 years. Assume that i = 5% per year for county funds.

**Annual Worth (AW) Method**

1. A food beverage company is planning expansion of its cold storage facility. Three alternative site design proposals are being considered that uses an interest rate of 10%. Plan A and B require an expenditure of Rs.35,00,000 for land and which will retain its value in 10 years, while plan C requires Rs.45,00,000 for land, which will also retain its value in 10 years. The estimated income increase due to facility available is annualized at Rs.24,80,000 per year. The company requires that a life of 10 years be used for analysis. Data pertaining to the project are given below,

|  |  |  |  |
| --- | --- | --- | --- |
| **In Rs.** | **Proposal A** | **Proposal B** | **Proposal C** |
| Building and installation | 60,00,000 | 70,00,000 | 40,00,000 |
| Compressor | 10,00,000 | 13,50,000 | 8,50,000 |
| Expected energy cost 1 year | 6,50,000 | 4,80,000 | 6,50,000 |
| Energy cost increase for each additional year | 30,000 | 20,000 | 35,000 |
| Annual maintenance cost | 2,00,000 | 1,50,000 | 5,00,000 |
| Estimated salvage value | 3,50,000 | 4,30,000 | 1,80,000 |

1. Two types of power converter Alpha and Beta are under consideration for a particular application. An economic comparison is to be made at an interest rate of 10%. Following cost estimation has been obtained. Determine the annual equivalent costs of the two systems.

|  |  |  |
| --- | --- | --- |
| **Cost Particular (in Rs.)** | **Alpha** | **Beta** |
| Purchase price | 10,000 | 25,000 |
| Estimated service life | 5 years | 9 years |
| Salvage value | 3,000 | 5,000 |
| Annual operating costs | 2,500 | 1,200 |

1. A consulting firm proposes to provide “self-inspection” training for clerks who work with insurance claims. The program lasts one year, costs Rs. 20,000 per month, and professes to improve quality while reducing clerical time. A potential user of the program estimates that savings in the first month should amount to Rs. 8000 and should increase by Rs. 4000 per month for the rest of the year. However. Operational confusion and work interference are expected to boost clerical costs by Rs.12,000 the first month but this amount should subsequently decline in equal increments at the rate of Rs.1000 per month. If the required rate of return on money is 12% compounded monthly and there is a stipulation that the program must pay for itself within 1 year, should the consultant be hired.
2. A company engaging is selling of laboratory equipment estimates that profit from sales should increase by Rs.2,00,000 per year if a mobile demonstration unit is built. A large unit with sleeping accommodation for the driver will cost Rs. 9,70,000 while a smaller unit without sleeping cabin will be Rs. 6,30,000. Salvage values for the large and small units after 5 years will be, Rs.97,000 and Rs.35000 respectively. Lodging costs saved by the larger unit should amount Rs. 1,10,000 annually, but its transportation costs will exceed those of the smaller unit by 31,000. With the money at 9% should a mobile demonstration unit be built? And if so which size is preferable?
3. Conventional agricultural equipment has a service life of 6 years. Newly designed equipment is 50% costlier than the conventional one but has more advantages. The operating costs of both these equipment are almost same and salvage value is negligible. What will be the service life of the new equipment that makes its costs comparable to that of the conventional one at i=10%?
4. Two machines models A and B perform the same function. Type A machine has a low initial cost of Rs. 95000, relatively high operating cost of Rs.19,000 per year more than those of type B machine, and a short life of 4 years. Type B machine costs Rs. 2,51,000 and can be used for 8 years. The scarp value from either machine at the end of the life will barely cover its removal cost. Which is preferred when the minimum attractive rate of return is 8%?
5. Suppose in same numerical, If machine A will produce refinements within 4 years with the availability of a modified one at a cost of Rs. 1,15,000 but reducing the operating costs to Rs.4000, then find the annual worth?

Note: If the future conditions can be estimated in confidence, excluding inflation then alternative has to be compared considering these.

**Internal Rate of return**

1. An $8200 investment returned $2000 per year over a 5-year useful life. What was the rate of return on the investment?
2. West Texas Oil has paid Rs.300000 for producing oil well. Field engineers estimate that net receipts will be Rs.120000 for the first year of operation with a reduction of 15 percent of the first year payment, for every year thereafter till the end of five years. It plans to sell well after 5 years for Rs.80000. How does this seem financially if their MARR is 20%?

A patch of land adjacent to the proposed international airport is likely to increase in value. The cost of land now is INR 8,00,000 and is expected to be worth INR 15,00,000 within 5 years. During this period it can be rented for small scale industry at INR 15000 per year. Annual taxes are presently is INR 8500 and likely to remain constant. What rate of return will be earned on the investment if the estimates are accurate?

**Incremental Rate of Return**

1. For MARR of 6% and each alternative having a life of 20 years with no salvage value and cost information as shown in table below,

|  |  |  |  |
| --- | --- | --- | --- |
|  | **A** | **B** | **C** |
| **Initial Costs, $** | 2000 | 4000 | 5000 |
| **Uniform annual benefit,**  $/year | 410 | 639 | 700 |

Which Alternative is preferred? Use Incremental IRR method.

1. In 2000, Bell Atlantic and GTE merged to form a giant telecommunications corporation named Verizon Communications. As expected, some equipment incompatibilities had to be rectified, especially for long distance and international wireless and video services. One item had two suppliers-a U.S. firm (A) and an Asian firm (B). Approximately 3000 units of this equipment were needed. Estimates for vendors A and B are given for each unit. Determine which vendor should be selected if the MARR is 15% per year.

|  |  |  |
| --- | --- | --- |
|  | **A** | **B** |
| Initial Cost, $ | -8000 | -13000 |
| Annual Cost, $ | -3500 | -1600 |
| Salvage Value, $ | 0 | 2000 |
| Life, Years | 10 | 5 |

**Replacement Analysis**

1. A company purchased machine X a year ago for Rs.8500 with the following characteristics,

Estimated life- 6 years

Salvage value- Rs.1000

Operating expenses- Rs.8000/year

At the end of 1st year a salesman offers machine Y for Rs.11500 which has estimated life of 5 years, salvage value of Rs.1500 and an operation cost of only Rs.5500/year due to improvement. The salesman offers Rs.3500 for machine X, if machine Y is purchased.

This appears low to the company but the best offer received elsewhere is only Rs.3000

Assume an interest rate of 8% and determine the best course of action by taking outsider’s point of view?

**Policy of Using Sunk Cost**

In problem 1, if the present book value of m/c X is Rs.7250 and if the company decides to recover the sunk cost it has incurred in m/c X by m/c Y, what error in equivalent annual costs will result in making the comparison of financial desirability of the 2 machines?

**Economic Life of an Assets**

1. An asset purchased 3 years ago is now challenged by a new piece of equipment. The present market value of the defender is Rs.130000. anticipated salvage values and Annual Operating Costs (AOC) for the next 5 years are given in the table. What is the minimum cost life to be used while comparing this defender with a challenger if a 10% year return is required?

|  |  |  |
| --- | --- | --- |
| **Life in years** | **Salvage value** | **AOC** |
| 1 | Rs 90,000 | Rs 25,000 |
| 2 | Rs 80,000 | Rs 27,000 |
| 3 | Rs 60,000 | Rs 30,000 |
| 4 | Rs 20,000 | Rs 35,000 |
| 5 | Rs 0.00 | Rs 45,000 |

**Depreciation**

1. A lathe was purchased for 5 lakhs. It was estimated to have a useful life of 10 years and a salvage value of Rs. 50000. due to unexpected development the lathe was sold in the open market for Rs. 90000 at the end of 8 years of its useful life. Determine how much ‘sunk loss’ or ‘capital gain’ has occurred if the asset is being depreciated according to Straight line method.
2. An asset costs Rs.5000 now and its salvage value is Rs.1000 estimated and an estimated service life of 5 years and a depreciation rate of 30% per year. Determine the depreciation charges for 5 years and its book value on the end of year.
3. An asset was purchased for 2,50,000 Rs. It has an expected life of 10 years and a salvage value of Rs.50000 at the end of 10th year. What will be the undepreciated amount of capital remaining in the asset at the end of 6th year. If the asset is being depreciated according to the declining balance method. Also calculate the depreciation charge for the 8th year.
4. An asset was purchased 10 years ago for Rs. 5,00,000. it is depreciated according to DDB method for an estimated life of 20 years and a salvage value of Rs. 50,000. Calculate its current book value. Use Double Declining Balance Method.
5. An asset has a first cost of Rs. 48,000 with an estimated life of 20 years. What is the total accumulated depreciation charge during the first 5 years of the asset life if it is depreciated according to DDM Method?