

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Bhadra

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BEI	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Engineering Economics (CE 615)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. Explain with a suitable example “Engineers play key role in making economic decision of a project” [4]
2. a) Briefly explain different types of cash flows used in economic equivalence with suitable example. [4]
- b) How many deposits of Rs. 25,000 should make per month so that final accumulation amount will be Rs. 10,00,000 if the bank interest rate is 6% per year? [4]
3. a) Find the IRR and ERR of the following CF. MARR =11% and Reinvestment rate = 15%. [6]

EOY	0	1	2	3	4	5
Net Cash Flow	-50000	-20000	+25000	+35000	+30000	+25000

- b) Find both types of B/C ratio using Future Worth formulation.
Initial Investment = Rs.150,000
Project Life = 5 years
Salvage value = 50,000
Annual O & M Cost = Rs.20,000 and increasing by 8% per year
Annual Benefits = Rs.60,000 at the end of year 1 and increasing by Rs. 10,000 each year for 5 years. MARR = 15%
4. a) Select the best project using Repeatability assumption and PW formulation. if MARR= 10%. [8]

	A	B	C
Investment	4500	3470	5640
Net Annual benefit	2100	1800	2500
Useful life	3yrs	4 yrs	6yrs
Salvage value	450	280	360

- b) Evaluate the following projects using the study period of 5 years. MARR = 8%. [6]

	X	Y
Investment	1,00,000	1,50,000
Annual Cost	40,000	25,000
Useful life	5 yrs	9yrs
Salvage value	10,000	15,000

5. a) What are the differences in the process of taking decisions about replacement strategy in case of finite and infinite planning horizon? [3]
- b) Find the economic service life of "Chevrolet Spark 1.0 LT" car which costs Rs.19,00,000 at first and running since 2012 AD (end). The owner of the car wants to know the economic service life of his car for replacement purpose. He finds out the average mileage of 12km/liter and average daily run of vehicle is 25km throughout 320 days running in a year for the first year then after average operation cost of vehicle increases by Rs.20,000 every year. An average cost of petrol per liter can be assumed to be Rs.170. The annual maintenance cost for the first year is Rs.45,000 and increases by 15% per year then after. Market value of the car will be decreased by 20% annually in last year's value. Is the year 2024 a replacement year for him? Take MARR = 12% [8]
6. a) What are sources of uncertainty in the project? List out the methods of performing risk analysis. [2+1]
- b) Perform the sensitivity analysis of a project with following cash flow over a range of $\pm 30\%$ (with increment of 10%) in (i) Initial investment (ii) net annual revenue (iii) MARR, using the FW formulation. Present your result in sensitivity graph. Initial Investment = Rs.50, 000, Annual revenues = Rs.15,500, Annual expenses = Rs.3,000, salvage value= 20% of initial investment, useful life = 5 years, MARR = 15%. [8]
7. a) Explain the causes and advantages of depreciation. What are the methods of depreciation calculation? [4]
- b) A company bought a machine for Rs. 25,000 which is expected to produce benefit of Rs. 8,000 per year for five years. Its salvage value will be Rs. 10,000 at the end of life. [3+3+2]
 (i) Calculate depreciation by sinking fund method when $i = 10\%$.
 (ii) Calculate ATCF if tax is 30%.
 (iii) Calculate Present worth of ATCF.
8. a) How does Inflation impact health of Economy? [2]
- b) Calculate the Present Worth of the following CF having $f= 8 \%$ and $i = 12\%$. [4]

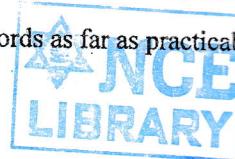
EOY	Net CF in Constant Dollar
0	-150000
1	50000
2	40000
3	35000
4	30000
5	30000

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1. How an engineer plays an important role in making the economic decisions? Explain. [4]
2. a) Suppose that you are planning to deposit the sum of Rs 10, 000 at the end of each month for the next 5 years in a bank which gives the interest rate of 12% compounded quarterly. What will be the maturity of the deposit after 10 years? [4]
- b) A process engineer starts investing his money when he graduates from college. He is able to afford investing \$25,000 a year from the time he graduates in four years until the end of eight years. He also plans to invest an additional \$ 5,000 per year (increasing by \$ 5,000 per year) at the end of the year after he graduates until year eight. How much will the process engineer have saved by the end of year eight and what is its present worth if the interest rate 10% compounding monthly? [6]
- a) The owner of the business company is considering investing Rs 50,00,000 in a new equipment. He estimates that the cash flows during the first year will be 50,000 but these will increase by Rs.25,000 per year the next year and each year thereafter. The equipment is estimated to have 10 years' service life and a net salvage at this time will be 60,000. The Firm MARR is 12%
 - (i) Determine the annual capital cost for the equipment
 - (ii) Determine the equivalent annual saving (revenues)
 - (iii) Determine if this a wise investment
- b) Calculate ERR of the project and comment on its acceptability if MARR = 20% and reinvestment rate is 15%. [6]

EOY	NCF
0	-150,000
1	+30,000
2	+50,000
3	+60,000
4	+80,000
5	-35,000
6	+45,000

4. a) KFC is in the process of forming a separate business unit that provides crunchy fried chicken in Birtnagar. Since the meals are prepared in one central location and distributed by the food delivery throughout the city for its online order. Mr. Harka is the General manager of this unit, and he wishes to choose between two location for the cost economic delivery service as below perform analysis for infinite study period with MARR 8%. [6]

	Mahindra Chowk, Location	Khanar Location
Initial Cost, I	15 lakhs	22 Lakhs
Annual O and M Cost	6 lakhs	9 Lakhs
Refurbishment Cost	0	2 Lakhs every 4 years
Trade in value, % of I	20	30
Contract period, years	4	12

- b) Recommend the best project from the following two projects. Use IRR method.
MARR = 10% per year.

[6]

Project	A	B
Investment	350,000	500,000
Annual Revenue	130,000	175,000
Annual Cost	35,000	25,000
Salvage Value	35,000	50,000
Useful life	8 years	8 years

5. a) Write down the steps for making the replacement decision when planning horizon is infinite.

[4]

- b) An existing asset that cost \$ 16,000 two years ago has a market value of \$ 12,000 today, an expected salvage value of \$2,000 at the end of its remaining useful life of six more years, and annual operating costs of \$ 4,000. A new asset under consideration as a replacement has an initial cost of \$10,000, an expected salvage value of \$4,000 at the end of its economic life of three years , and annual operating costs of \$ 2,000. It is assumed that this new asset could be replaced by another one identical in every respect after three years at a salvage value of \$4,000, if desired. Use a MARR of 11%, a six-year study period, and PW calculations to decide whether the existing asset should be replaced by the new one.

[8]

6. a) As an economy analyst, how do you explain the risk and source in any investment?

[4]

- b) Perform the sensitivity analysis of a project with following cash flow over a range of $\pm 30\%$ (with increment of 10%) in (i) Initial investment (ii) net annual revenue using the FW formulation. Present your result in sensitivity graph.

Initial Investment, useful life = 50,00, Annual revenues = 15,500, Annual expenses = 3,000, salvage value = 20% of initial investment, useful life = 5 years, MARR = 15%.

[6]

7. a) Nova Auto Ltd. has purchased a car-painting plant for Rs.20,00,000. Its expected life is 10 years and the salvage value at the end of its useful life is Rs.1,00,000. Using the sum-of-the-year-digits (SYD) method, compute (i) depreciation cost during the third year, (ii) cumulative depreciation cost through the fifth year and (iii) book value at the end of sixth year.

[6]

- b) If the purchase price of an equipment is Rs 60,000 and its salvage value after 8 years is Rs.6,000. Calculate the annual depreciation and the resulting book value of the equipment each year. Use the sinking fund method and assume the interest rate is 10% per year.

[6]

8. Consider the following project's after-tax cash flow and the expected annual general inflation rate during the project period.

[1+2+3]

Expected		
End of Year	Cash flow (in Actual or Current Dollar)	General Inflation Rate
0	-45000	
1	32000	3.5%
2	32000	4.2%
3	32000	5.5%

- a) Determine the average annual general inflation rate over the project period.
b) Convert the cash flows in actual dollars into equivalent constant dollars with the base year 0.
c) If the annual inflation-free interest rate is 5%, what is the present worth pf the cash flow? Is this project acceptable?

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1. Explain the principle of engineering economics. [4]
2. a) Explain the concept of ‘ time value of money’ and “ interest payment schemes” with suitable examples. [2+2]
- b) while you are planning to deposit Rs 5000 in 3-months interval for 4 years in increasing trend at a 2.5 % growth rate per deposite, a bank enticing you with an interest rate of 10% pa compounded semi-annually. What will be equivalent equal annual deposite of that money? [4]
3. a) Machinery costs Rs. 250,000 and has an annual expense of 40,000. It will generate a revenue of Rs.120,000 per year and will have a salvage value of Rs.50,000 after 5 years. Calculate its conventional B/C ratio and ERR if MARR = reinvestment rate = 20%. Use AW formulation. [3+3]
- b) What are sunk costs? Calculate IRR and show the unrecovered balance diagram in both tabular and graphical form of the following cash flows. MARR = 20%. [1+7]

EOY	0	1	2	3	4	5
Outflows	60,000	10,000	0	50,000	20,000	0
Inflows	0	30,000	40,000	10,000	70,000	70,000

4. a) Recommend the best project from the following two projects if the study period is 5 years. [6]

Project	A	B
Investment	350,000	500,000
Annual Revenue	130,000	175,000
Annual Cost	15,000	25,000
Salvage Value	35,000	50,000
Useful life	6 years	8 years

- b) Define Independent, Contingent and Mutually exclusive project. Three projects are being considered with the estimated cash flow over 10 years. Recommend which investment alternative should be selected using IRR method? Assume MARR = 10%. [2+8]

Project	A	B	C
Initial Investment	320000	250000	720000
Annual Revenues	70000	50000	120000
Annual Expenses	7000	5000	12000
Salvage Value	40000	30000	50000

5. a) Define the terms: defender, challenger, ESL, AEC and replacement strategy. [5]
- b) You are going to purchase a new bike costing Rs 400000 with 12% interest loan from a bank, the market value of the bike is if assumed to be Rs 350000 after its 1 year use than decreases by Rs 35000 every year then after, it requires operation and maintenance cost of Rs 65000 for the first year then increases by 20% each year, what will be the ESL of this bike? [7]
6. a) What are the different techniques used to assess the riskiness of the project parameter. Explain with suitable example. [4]
- b) Perform sensitivity analysis for given parameters to find the most sensitive parameter of a project proposal having first cost Rs 50,000 Salvage value of Rs 15,000, Gross Revenue of Rs 30,000, O & M of Rs 5,000 and life of 8 years . Take 10% MARR and use Modified B/C ratio.(i) Investment (ii) MARR (iii) life span [8]
7. a) What is depreciation? What are the basic requirements for a property to be depreciated? What is a corporate tax? [1+2+1]
- b) Cost basis of a machine is Rs.20,000 and the useful life is 5 years. The estimated salvage value is Rs.4000. Compute the depreciation schedule and resulting book values (i) Double declining balance method and (ii) Sum of years' digit method. [3+3]
8. Calculate the average inflation rate for a two-year period: the first year's inflation rate is 4.5%, the second year's rate is 7.8% and the third year's rate is 6.5% on a base price of Rs 100. How deflation method can be differentiated from adjusted discount method? Explain with suitable example. [2+2]

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Year / Part	III / I	Time	3 hrs.

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1. Explain the roles of engineer in economic decision of any enterprise. [4]
2. Distinguish between nominal and effective interest rates. You have just purchased 100 shares of ABC company at RS.100 per share, hoping to sell the stock at double the market price. If the stock price is expected to increase by 20% per year. How long do you wait before selling the stock? [2+4]
3. a) Differentiate between Financial and Economic analysis of a Project.
 b) Evaluate IRR of the following project and decide whether the project is acceptable or not? Also draw investment Balance diagram. Use AW formulation for calculation. [8]
 - Initial investment = Rs. 50,000
 - Annual Revenue = Rs. 20,000
 - Salvage value = Rs.10,000
 - Useful life = 6 years
 - MARR = 10%
- c) Calculate both types of BCR of a project with following details. [8]
 - MARR = 15%
 - Initial Investment = Rs. 20,000
 - Annual income = Rs.2000 at the end of first year and increases by 15 % every year.
 - Annual expense = Rs. 100 at the beginning of first year and increases by Rs. 50 per year.
 - Salvage Value = Rs. 2500
 - Useful life = 12 years.
4. a) Compare repeatability assumption and co-terminated assumption as per their suitability. [4]
 - b) Select the best project using IRR method if MARR = 10% and market value at the end of useful life of each project is zero. [8]

Project	A	B
Initial investment	3500	5000
Annual Benefit	1900	2500
Annual O and M	645	1383
Useful life	4 years	8 years

5. A company is contemplating replacing a machine having a current market value of Rs. 9,000 which decreases each year by Rs.1500 per year. Its operating cost is Rs.3000 for the first year and increases each year by 800 Rs. Per year for 5 years. The company will have to pay Rs. 18,000 for the new machine and its market value decreases by 20% per year over the previous year for five years. The new machine needs Rs.1500 for operation in the first year and this cost increases by 25 % each year. Find the annual equivalent cost of both the machines and compute the best replacement strategy if the machine is needed for 5 years.

[5+5]

6. a) Perform sensitivity analysis for (i) MARR (ii) Annual Revenue and (iii) Investment from given information and identify the most sensitive parameters using sensitivity plot.

$$I = \text{Rs } 1000000 \quad R = \text{Rs } 400000 \quad O \text{ and } M = \text{Rs } 100000 \quad S_v = \text{Rs } 20000$$

$$\text{MARR} = 15\% \quad N = 7 \text{ yrs} \quad \text{Overhauling at the end of } 4^{\text{th}} \text{ yr} = \text{Rs } 25000$$

- b) What is break even analysis? How it can be performed for single and mutually exclusive alternatives?

[4]

7. An asset has installed value of Rs. 60,000 and Salvage value zero. It is classed as 5 years property. Determine MACRS depreciation schedule. This asset is used for 8 years and revenue generated is Rs.15,000 first year Rs 25,000 each year thereafter. While annual operating cost is Rs. 5,000. Calculate After Tax Cash Flow if tax rate is 25 %. Is the investment of this asset profitable? Check your decision using PW method. Take MARR = 14%.

[4+6+2]

8. Explain the impact of inflation on economic evaluation. Define constant dollar and actual dollar analysis.

[2+2]

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1. "Engineers make good decision-makers." Justify this statement. [4]
2. Compute the equivalent linear growth rupees to make economic equivalence for present deposit of Rs. 38,281.23 against one-year withdrawals at the end of two months each (6 number of linearly increased withdrawals in total) with base amount Rs. 5000 at first (at the end of 2nd months) with 12% interest rate compounding quarterly. [6]
3. a) Explain drawbacks of IRR with examples. Differentiate between financial analysis and economic analysis. [3+3]
- b) If a machine will be operated according to varying hours. 1200 hrs in the first year, 2100 hrs in the second year, 1800 hrs in the third year and 1500 hrs in the fourth year. Compute the annual equivalent saving or cost per machine hour, If the firm's MARR is 13% with annual worth of Rs. 7500. [5]
- c) Calculate ERR of the following cash flow MARR = 11%, reinvestment rate 13%. [5]

EOY	0	1	2	3	4	5
C/F	-80,000	22,000	38,000	45,000	-17,000	48,000

4. a) Compute the Imputed Market Value (IMV) for study period 4 years if initial investment is Rs. 1000 and market value after 8 years is Rs. 200. Take MARR = 10%. [4]
- b) Prepare all possible mutual exclusive combinations for the following properties of projects A, B, C, D and E. [4]
 - Project A and B are mutually exclusive projects.
 - Project C and D are mutually exclusive and contingent on acceptance of Project A.
 - Project E is contingent an acceptance of Project D
- c) Select the best project using ERR method. Take MARR = 10% and Reinvestment rate = 20%. [4]

	Project ABC	Project XYZ
Initial investment	Rs. 12,000	Rs. 16,000
Annual revenue	Rs. 5,000	Rs. 6,000
Annual expenses	Rs. 500	Rs. 600
Useful life	5 years	5 years
Salvage value	Rs. 2,000	Rs. 2,500

5. A company is considering the replacement of old machine. If the machine is repaired, it can be used for 5 more years. It can be sold to the other firm in Rs. 5000. If the machine is kept it will require an immediate overhaul (renovation) of Rs. 1200 to make it operable condition. Overhaul charge is not extended for service life. The operation cost is estimated at Rs. 2000 during first year and these are expected to increase by Rs. 1500 per year thereafter. Further market values are expected to decline by Rs. 1000 per year. The new machine cost Rs. 10000 and will have operating costs of Rs. 2000 in the first year, increasing Rs. 800 per year thereafter. Salvage Value is Rs. 6000 after one year and will decline by 15% each year. The company requires a rate of return of 15%. Determine economic life of each option and when the defender should be replaced?

[12]

6. a) Perform Sensitivity Analysis of the following project over a range of $\pm 15\%$ with an increment of 5% in (i) Initial Investment (ii) Net annual revenue (iii) Useful life (iv) MARR. Use AW formulation. Also draw sensitivity graph and find the order of sensitivity from high to low.

[8]

Initial investment = Rs. 5,00,000
 Net annual revenue = Rs. 1,20,000

Salvage value = Rs. 80,000

Useful life = 6 years

MARR = 8%

- b) Explain with examples, how the project risk is determined using Scenario Analysis? [4]

7. a) Differentiate between tax depreciation and book depreciation. Why recovery period called as depreciable life. For $I = 10,000$, $N = 5$ yrs, $SV = 2,000$. Calculate depreciation amount and resultant book value using SOYD method. [2+2+2]

- b) If an organization has annual revenue generation of Rs. 18,000 and operation and maintenance cost is about Rs. 9000 annually. If cost basis of 5 years project is Rs. 80,000 then determine after tax cash flow. (Use sinking fund method of depreciation) use tax rate = 38%.

[6]

8. Which project is most feasible? MARR = 12%, general inflation rate is 8%.

[6]

EOY	CF of Project A ('000') in Constant Dollar	CF of Project B ('000') in Actual Dollar
0	-800	-1200
1	+300	+600
2	+400	+400
3	+800	+700
