Name:

|  |  |  |
| --- | --- | --- |
| Problem | Points | Score |
| 1(a) | 5 |  |
| 1(b) | 5 |  |
| 1(c) | 5 |  |
| 1(d) | 10 |  |
| 2(a) | 5 |  |
| 2(b) | 5 |  |
| 2(c) | 5 |  |
| 2(d) | 10 |  |
| 3(a) | 5 |  |
| 3(b) | 10 |  |
| 3(c) | 5 |  |
| 3(d) | 5 |  |
| 4(a) | 5 |  |
| 4(b) | 5 |  |
| 4(c) | 5 |  |
| 4(d) | 10 |  |
| Total | 100 |  |

Notes:

1. The exam is closed books and notes except for four double-sided sheet of notes. You must use Excel to do these problems.
2. Please indicate clearly your answer to the problem. Circle your answers.
3. The details of your solutions are more important than the answers. Please explain your solutions clearly and include as many details as possible.
4. EMAIL ME YOUR EXCEL SPREADSHEET.

**1.** Consider two investment alternatives. Investment A is simple: invest $10,000 in year 0 at 5% interest, and let the investment compound over 6 years. Investment B has a cash flow shown below:

|  |  |
| --- | --- |
| Year | Credit/Debit |
| 0 | $5,000 |
| 1 | $2,000 |
| 2 | -$750 |
| 3 | $10,000 |
| 4 | -$250 |
| 5 | $1,000 |
| 6 | -$2,000 |

Assume a 28% income tax bracket and an interest rate of 5% for both investments. Assume interest is calculated on the beginning of year balance (e.g., for year 1, the interest earned would be $1,000 multiplied by the interest rate), and credits/debits occur at the end of the year.

(a) For both investments, create a cash flow diagram that includes the year, the credit/debit, the interest earned, the before-tax cash flow, the income tax paid and the after-tax cash flow. Put both investments side-by-side in one spreadsheet – investment A in the first N columns followed by investment B.

(b) Compute the present worth of each investment after taxes and decide which is the better investment.

(c) Compute the effective interest rate of each investment after taxes and decide which is the better investment. Does your answer agree with (b)?

(d) Assume a MARR of 10%. What must be the future worth of investment A if it were to meet your requirements for a MARR of 10%? Do either of the investments achieve this?

**2.** A machine is purchased for a manufacturing facility with an initial cost of $100K, annual maintenance costs of $10K (assume these occur at the end of the year), and annual revenues of $30K per year (also assume these occur at the end of the year). Assume the company purchasing this machine is in a 40% income tax bracket. Assume the machine has a 5-year lifetime with a $10K salvage value. Use straight-line depreciation (note: take into account the salvage value).

(a) Construct a cash flow diagram that includes the year, revenue/expense, depreciation, taxable income, income tax due, and after-tax cash flow. Remember that revenue and salvage value are taxable.

(b) What is the present worth of this investment assuming a MARR of 10%?

(c) What is the future worth of this investment assuming a MARR of 10%?

(d) What amount of money could have been invested at year 0 to produce the same balance at the end of 5 years using a MARR of 10%?

**3.** You have decided to purchase a house for $350K. You will make a downpayment of $50K. Assume the closing costs were $0. Assuming you obtain a 15-year mortgage at an annual interest rate of 3.5% compounded monthly:

(a) What is the monthly payment?

(b) By the end of the loan, how much money will you have paid in interest? Does this surprise you?

(c) What would the monthly payment have been if the closing costs were $10K, and were included in the loan?

(d) By the end of the loan, how much money will you have paid in interest on the $10K closing costs? Is this surprising?

**4.** Congratulations – you started your first engineering job. Your starting salary is $75K per year. You plan to save $7.5K per year pre-tax because your economic analysis professor told you this was a good thing to do. Assume you plan to retire in 40 years.

(a) What interest rate must you average on your portfolio so that when you retire after 40 years, the balance in your account will be $1M?

(b) Assume you decide to invest this $7.5K post-tax, and your income tax rate is 28%. What interest rate must you average on your portfolio so that when you retire after 40 years, the balance in your account will be $1M?

(c) Why should you invest pre-tax? How much additional money would you earn? Where does this money come from? Where did it go?

(d) Assume your salary increases by X% each year. What is the value of X that will result in a retirement balance of $2M instead of $1M? What is the value of X that will result in a balance of $4M instead of $1M? (and remember... work hard... you need your salary to increase faster than the rate of inflation!)