PET685 - Assignment 3

Solve the following and upload your solutions to Canvas. Make sure to include any Excel or Python files/code you have used. For the problems where it has been specified that you should use Python, you must use Python. Note that your Python answers must be in a single Jupyter Notebook file. Use your surname (as registered by UiS) as the name of the zipped filed.

Problem 1 – Four mutually exclusive alternatives are being evaluated, and their costs and revenues are itemized below. Use functional symbols (factors) to show your logic.

	Mutually Exclusive Alternative			
	I	*II*	*III*	*IV*
Capital investment	$100,000	$152,000	$184,000	$220,000
Annual revenues less expenses	15,200	31,900	35,900	41,500
Market value (end of useful life)	10,000	0	15,000	20,000
Useful life (years)	12	12	12	12

a) If the MARR is 15% per year and the analysis period is 12 years, use the PW method to determine which alternatives are economically acceptable and which one should be selected.
b) If the total capital investment budget available is $200,000, which alternative should be selected?

Problem 2 – Among stripper gas wells, data reveal that brine accumulation is the primary reason for declining natural gas production and often times subsequent well abandonment. Just a few tenths to a few barrels per day can and does kill gas production. Conventional fluid removal techniques using beam pumps, periodic swabbing of fluids with workover rigs, siphon strings and tubing plungers or rabbits have both physical limitations and significant capital, operating and maintenance cost considerations. Regular, rhythmic removal of fluids as they accumulate in the well increases gas production. Averting a brine column and a brine-wet zone in the production horizon fosters the ease of movement of gas into the well.

ISEM Well Technology Company, a maker of industrial stripper pumps has recently developed a new pump, named Gas-Operated Automatic Lift (GOAL) PetroPump, has a unique "on-tool" actuator-valve assembly. The tool is designed to freely operate within the well casing, descending downhole when wellhead pressure and production drop. Upon descending into the fluid, afforded by a through-tool passageway, a fixed column or weight of fluid accumulates atop the tool that offsets the preset actuator pressure, and the valve automatically closes.

The company has three investment alternatives to manufacture and market the new pump. Relevant data for the three alternatives are given below:

	Alternative A Invest Large Scale	Alternative B Invest Medium Scale	Alternative C Invest Small Scale
Initial Investment Cost	$600,000	$400,000	$200,000
Annual Revenue	$150,000	$124,000	$100,000
Annual O&M Cost	$10,000	$7,500	$5,000
Useful Life	9 years	6 years	3 years
Market value at EoY 3	$300,000	$150,000	$20,000
Market value at EoY 6	$150,000	$40,000	-
Market value at EoY 9	$60,000	-	-

The Company's MARR is 10%. Use functional symbols (factors) to show your logic.

a) If the study period is 9 years; i.e., the product life is expected to be 9 years, which alternative should be chosen? State the main assumptions made.
b) If the study period is 6 years, i.e., the product life is expected to be 6 years, which alternative should be chosen? State the main assumptions made.
c) Do you expect the best alternative chosen in (a) and (b) to be always the same? Explain your answers.
d) If the study period is 3 years, i.e., the product life is expected to be only 3 years, which alternative should be chosen using any Discounted Cash Flow Method? State the main assumptions made.
e) If the study period is 3 years, i.e., the product life is expected to be only 3 years, determine which alternative should be chosen using the IRR Method. You may use any equation solver to compute IRRs after stating the relevant equations that need to be solved.
f) Do you expect the best alternative chosen in (d) and (e) to be always the same? Explain your answers.

Problem 3 – The Universal Postal Service is considering the possibility of fixing wind deflectors on the tops of 500 of their long-haul tractors. Three types of deflectors, with the following characteristics, are being considered (MARR = 10% per year): Use functional symbols (factors) to show your logic.

	Windshear	Blowby	Air-vantage
Capital investment	$1,000	$400	$1,200
Drag reduction	20%	10%	25%
Maintenance per year	$10	$5	$5
Useful life	10 years	10 years	5 years

If 5% in drag reduction means 2% in fuel savings per mile, how many miles do the tractors have to be driven per year before the windshear deflector is favored over the other deflectors? Over what range of miles driven per year is air-vantage the best choice? (Note: Fuel cost is expected to be $4.00 per gallon, and average fuel consumption is 5 miles per gallon without the deflectors.) State any assumptions you make.

Problem 4 – An oil company is considering converting its office building from a coal-burning furnace to one that burns either fuel oil or natural gas. The cost of converting to fuel oil is estimated to be $80,000 initially; annual operating expenses are estimated to be $4,000 less than that experienced when using the coal furnace. Approximately 140,000 Btus are produced per gallon of fuel oil; fuel oil is anticipated to cost $2.20 per gallon.

The cost of converting to natural gas is estimated to be $60,000 initially; additionally, annual operating and maintenance expenses are estimated to be $6,000 less than that for the coal-burning furnace. Approximately 1,000 Btus are produced per cubic foot of natural gas; it is estimated that natural gas will cost $0.04 per cubic foot.

A planning horizon of 20 years is to be used. Zero market values and a MARR of 10% per year are appropriate. Perform a sensitivity analysis for the annual Btu requirement for the heating system. (Hint: First calculate the breakeven number of Btus (in thousands). Then determine AWs if Btu requirement varies over ±30% of the breakeven amount.)

Use functional symbols (factors) to show your logic and use Python or Excel to build the sensitivity graph.