IE2111 ISE Principles & Practice II
Tutorial # 6 (Replacement Analysis)

Question 1 (based on Sullivan *et a*l 2014, P9-3)

The Ajax Corporation has an overhead crane that has an estimated remaining life of 10 years. The crane can be sold now for $8,000. If the crane is kept in service, it must be overhauled immediately at a cost of $5,000. Operating and maintenance costs will be $3,000 per year after the crane is overhauled. The overhauled crane will have zero MV at the end of the 8-year study period. A new crane will cost $20,000, will last for 8 years, and will have a $4,000 MV at that time. Operating and maintenance costs are $1,000 per year for the new crane. The company's before-tax *MARR* is 10% per year. Should the company replace the old crane assuming that no further replacement will be considered during the study period?

Question 2 (based on Sullivan *et al* 2020, P9-6)

A steam generation system at a biomass fueled power plant uses an electrostatic precipitator (ESP) to clean gaseous effluents. The power plant has consistently make use of the same type of ESP over the past several years. The installed cost of a new ESP has been relatively constant at $80,000. Records of operation and maintenance expenses indicate the following average expenses per year as a function of the age of the ESP. The *MV*s of the ESP are also reasonably well known as a function of age.

Year	1	2	3	4	5
O&M expense ($)	30,000	30,000	35,000	40,000	45,000
MV ($)	60,000	50,000	40,000	25,000	12,500

Use the total marginal cost approach to determine the economic service life of the ESP if the *MARR* is 15% per year.

Question 3 (based on Sullivan *et al* 2020, P9-8)

A city water and waste-water department has a four-year old sludge pump that was initially purchased for $65,000. This pump can be kept in service for an additional four years, or it can be sold for $35,000 and replaced by a new pump. The purchase price of the replacement pump is $50,000. The projected *MV*s and operating and maintenance costs over the next four years are shown in the table below. Assume *MARR* is 10%.

(*a*) Determine the *Economic Service Life* of the challenger.

(*b*) Determine when the defender should be replaced under infinite planning horizon.

	Defender		Challenger	
EoY	*MV* ($)	*O&M* Costs ($)	*MV* ($)	*O&M* Costs ($)
1	25,000	18,500	40,000	13,000
2	21,000	21,000	32,000	15,500
3	17,000	23,500	24,000	18,000
4	13,000	26,000	16,000	20,500

Question 4 (based on Sullivan *et al* 2020, P9-26)

A truck was purchased four years ago for $65,000 to move raw materials and finished goods between a production facility and four remote warehouses. This truck (the defender) can be sold at the present time for $40,000 and replaced by a new truck (the challenger) with a purchase price of $70,000. The *MV*s and O&M costs for the defender and challenger are given in the table below:

	Defender		Challenger	
EoY	*MV* ($)	*O&M* Costs ($)	*MV* ($)	*O&M* Costs ($)
1	30,000	8,500	56,000	5,500
2	20,000	10,500	44,000	6,800
3	12,000	14,000	34,000	7,400
4	4,000	16,000	22,000	9,700

Assume *MARR* = 10%.

(*a*) What is the *Economic Service Life* of the challenger?

(*b*) When should the defender be replaced by the challenger if the study period is infinity and the challenger is repeatable any number of time.

(*c*) When should the defender be replaced by the challenger if the study period is 4 years and the challenger can be repeated only once within the next 4 years.