***Engineering Economics, 7e* (Fraser/Jewkes/Pirnia/Schmitt)**

**Chapter 1 Engineering Decision Making**

1.1 LO 1.1 Recognize the complexity of engineering decision making.

1) Evaluation of an engineering project involves the following constraints:

A) financial, environmental, social, and political constraints.

B) technical and financial constraints.

C) technological and social constraints.

D) time and money constraints.

Answer: A

Diff: 1 Type: MC

Topic: 1.1. Engineering decision making

Skill: Recall

Category: Qualitative

1.2 LO 1.2 Be able to define engineering economics.

1) Engineering economics is

A) a body of knowledge to determine which of several alternative is technically best.

B) a collection of techniques for quantitative analysis to select a preferable alternative from several technically viable ones.

C) a set of tools to calculate an engineering project's costs.

D) a set of rules to evaluate an engineering project.

Answer: B

Diff: 1 Type: MC

Topic: 1.2. What is engineering economics?

Skill: Recall

Category: Qualitative

2) From an economic standpoint, any engineering project can be thought of in terms of

A) its costs and benefits over time.

B) its constraints.

C) its receipts and disbursements.

D) its revenues and profits over time.

Answer: A

Diff: 1 Type: MC

Topic: 1.2. What is engineering economics?

Skill: Recall

Category: Qualitative

3) All but one of the following are economic criteria to evaluate an engineering project. Which one is the non-economic criterion?

A) maximum profit

B) minimum cost

C) minimum pollution

D) maximum rate of return

Answer: C

Diff: 2 Type: MC

Topic: 1.2. What is engineering economics?

Skill: Applied

Category: Qualitative

4) Engineering economics is important because

A) it is a natural science.

B) it provides answers to all financial questions.

C) it facilitates the establishment of verifiable facts about decisions.

D) it uses mathematical models to address engineering issues.

Answer: C

Diff: 2 Type: MC

Topic: 1.2. What is engineering economics?

Skill: Recall

Category: Qualitative

5) What is the subject matter of Engineering Economics?

Answer: Engineering economics deals with techniques of quantitative analysis useful for selecting a preferable alternative from several technically viable ones. Its major objective is to allow an engineer to determine which of several alternatives is economically best.

Diff: 1 Type: ES

Topic: 1.2. What is engineering economics?

Skill: Recall

Category: Qualitative

1.3 LO 1.3 Recognize the influence and importance of quantitative analysis even if decisions are made based on other criteria.

1) You decide to buy a car. The following are some questions you have to answer with respect to your purchase. Which question is directly associated with engineering economics?

A) what colour?

B) what size?

C) CD player or tape player?

D) to lease or to own?

Answer: D

Diff: 2 Type: MC

Topic: 1.3. Making decisions

Skill: Applied

Category: Qualitative

2) When we say "let us assume that economic agents are rational," in fact we

A) precisely describe behaviour of economic agents.

B) want economic agents to behave that way.

C) make an assumption to predict the agents' behaviour.

D) impose restrictions on our model.

Answer: C

Diff: 3 Type: MC

Topic: 1.3. Making decisions

Skill: Applied

Category: Qualitative

3) Briefly describe the structure of a decision-making process as discussed in your textbook.

Answer: The textbook presents this structure in a form of a pyramid. At the top of the pyramid are preferences, which directly control the choices made. The next tier is composed of people and politics. Politics means the use of power in organizations. The next tier is a collection of facts. The facts, which may not be verifiable, contribute to the politics and people, and indirectly to the preferences. At the bottom of the pyramid are the activities that contribute to the facts. These include the history of previous similar decisions, statistics of various sorts, and a determination of costs.

Diff: 2 Type: ES

Topic: 1.3. Making decisions

Skill: Recall

Category: Qualitative

4) As a University student, when you look for a new apartment, what economic criteria consistent with the subject matter of engineering economics do you apply?

Answer: You have to understand your budget in terms of cash inflows and outflows. Cash inflows may include: a fellowship, a grant, a loan, an allowance provided by parents and others. Cash outflows to consider are: costs of utilities, transportation cost, cost of textbooks, tuition fee, food expenses, and others. As well, time should be explicitly introduced into your economic analysis. Therefore, for example, a more expensive apartment closer to the University can be preferred to a cheaper one far away, based on transportation costs.

Diff: 2 Type: ES

Topic: 1.3. Making decisions

Skill: Applied

Category: Qualitative

5) Suppose that in order to finance your studies at the University, three options are available to you: (i) a student loan, (ii) a student line of credit, and (iii) a part-time job at minimum wage. In making your decision, what factors should be taken into account, and why?

Answer: Both a student loan and a student line of credit represent borrowing. There are costs associated with borrowing and it is necessary to compare them. In general, a student loan is interest-free as long as you stay in school, while a student line of credit is not interest-free. It means that the costs of borrowing associated with a student loan are lower. Of course, earning your own money is a good option since you avoid paying costs of borrowing. On the other hand, if you work you forgo opportunity to spend this time on your studies. There are some costs associated with that opportunity, called opportunity costs. If the opportunity costs of working exceed the costs of borrowing under student loan, then the latter is the best option. Otherwise, working is a better option.

Diff: 3 Type: ES

Topic: 1.3. Making decisions

Skill: Applied

Category: Qualitative

6) List at least three non-economic factors (attributes) that may be used as evaluation criteria in the decision-making process.

Answer: Non-economic factors are mainly associated with social, environmental, and political constraints. Examples are:

- Results of new elections

- Introduction of a new welfare program

- Introduction of new environmental standards

Diff: 1 Type: ES

Topic: 1.3. Making decisions

Skill: Applied

Category: Qualitative

7) When evaluating an engineering project, what types of constraints does a decision maker face?

Answer: A project might be technically feasible and the cheapest solution to a problem, but if it doesn't earn money at the minimum rate required by the company, it should not be done. The decision maker therefore has to be aware of the financial constraints on the problem. In addition, an engineering project can meet all other criteria, but may cause detrimental environmental effects, so we must also consider environmental constraints. Finally, any project can be affected by social and political constraints.

Diff: 2 Type: ES

Topic: 1.3. Making decisions

Skill: Recall

Category: Qualitative

8) Every year Stan takes a Canada student loan of $5 000 to pay his tuition fees at the University. The loan is interest-free for as long as Stan is a full-time student. After graduation, he will have to start re-paying the loan within 6 months including interest. Is this a good decision? Why?

Answer: Yes, this is a good decision. Stan can borrow $20 000 for four years or $25 000 for five years for free. If this money were invested in a mutual fund or in financial securities, it would earn some return. Or if Stan borrowed the money from a commercial bank, he would pay interest payments to service his debt. Student loan has no borrowing costs.

Diff: 2 Type: ES

Topic: 1.3. Making decisions

Skill: Applied

Category: Quantitative

9) You were notified by an economics expert that the total costs of a project you are about to start are approximately $50 000. In order to justify this project, what additional economic information do you need?

Answer: First of all, it is necessary to understand what this value includes. Usually, costs are divided into capital costs and operating costs and those are two different types of costs. Second, it is necessary to understand whether or not the value of total costs is given as of today or at some other time. Finally, the benefits of the project should be evaluated to compare them with total costs.

Diff: 1 Type: ES

Topic: 1.3. Making decisions

Skill: Recall

Category: Qualitative

10) Maintenance costs are an important component of the total costs of many engineering projects. Normally in engineering projects these costs are added to the purchase price of a piece of engineering equipment. For the following items, describe how important the maintenance costs are compared to the item's price:

(i) A tractor

(ii) A desk

(iii) A computer

(iv) An oil pump

Answer: The maintenance costs of a tractor, computer and oil pump are important. Particularly maintenance costs of a tractor are very important since the quantity and quality of the services, produced by the tractor, depend on these costs. To lesser extent maintenance costs are important in case of oil pump and computer. Maintenance costs of a desk are not important because they are very low, and have little effect on the services provided by the desk.

Diff: 1 Type: ES

Topic: 1.3. Making decisions

Skill: Applied

Category: Qualitative

11) Suppose that you want to buy a used car for $3 000, but you don't have enough cash. List some of the (legal) strategies that you might consider.

Answer: Possible alternatives for financing the purchase of a used car are:

- Not to buy (a "do nothing" alternative)

- To borrow money from your parents

- To take a loan from a commercial bank

- To finance through a car dealer

- To postpone the purchase and earn money working extra hours.

Diff: 2 Type: ES

Topic: 1.3. Making decisions

Skill: Applied

Category: Qualitative

1.4 LO 1.4 Understand how a model can be used to help manage complex decisions.

1) In the context of your textbook, abstraction means

A) a study.

B) a method.

C) a methodology.

D) a model.

Answer: D

Diff: 1 Type: MC

Topic: 1.4. Dealing with abstractions

Skill: Recall

Category: Qualitative

2) When an engineer prepares a feasibility study, what economic information must she possess in order to do it correctly?

A) engineering specification

B) expert opinion about this project

C) macroeconomic situation in the world

D) potential future costs and benefits of the project

Answer: D

Diff: 2 Type: MC

Topic: 1.4. Dealing with abstractions

Skill: Applied

Category: Qualitative

3) In which of the following problems do you need engineering economics?

A) to choose a course in your program

B) to choose the right textbook

C) to decide whether to borrow money from parents or from a bank

D) to decide whether or not to buy a car

Answer: C

Diff: 2 Type: MC

Topic: 1.4. Dealing with abstractions

Skill: Applied

Category: Qualitative

4) Stan borrowed $5 000 one year ago. Now he has to repay $5 100. The interest Stan pays is

A) $5 100.

B) 102%.

C) $100.

D) 2%.

Answer: C

Diff: 2 Type: MC

Topic: 1.4. Dealing with abstractions

Skill: Applied

Category: Quantitative

5) Joan borrowed $1 000 one year ago. Now she has to repay $1 100. Therefore, the interest rate she pays is

A) $1 000.

B) $1 100.

C) 110%.

D) 10%.

Answer: D

Diff: 2 Type: MC

Topic: 1.4. Dealing with abstractions

Skill: Applied

Category: Quantitative

6) If you are asked to choose between $100 today and $150 one year from now, you are being asked to

A) make a guess.

B) reveal your implied interest rate.

C) compare two values which are not comparable in principle.

D) reveal your private financial information.

Answer: B

Diff: 3 Type: MC

Topic: 1.4. Dealing with abstractions

Skill: Applied

Category: Qualitative

7) Which of the following items has negligible maintenance costs?

A) computer

B) building

C) ruler

D) shoes

Answer: C

Diff: 2 Type: MC

Topic: 1.4. Dealing with abstractions

Skill: Applied

Category: Qualitative

8) Susan is evaluating an engineering project. She assumes zero inflation for the duration of the project. With respect to this situation, which statement is consistent with the subject matter of engineering economics?

A) A zero inflation assumption is always a good one.

B) A zero inflation assumption is not realistic but it is better than assuming some uncertain inflation rate.

C) A zero assumption is not a bad one for the base case, but then the project should be evaluated under different values in some range to see how inflation affects the project.

D) Since in Canada inflation is low, it is possible to neglect it.

Answer: C

Diff: 3 Type: MC

Topic: 1.4. Dealing with abstractions

Skill: Applied

Category: Qualitative

9) An owner of a small company is deciding to sell her business. She received several options specified bellow. Which one should the company's owner accept?

A) $600 000 in cash

B) $500 000 in government bonds earning a 5% rate of return over 10 years

C) $400 000 in securities earning an 8% rate of return over 8 years

D) It is impossible to compare these offers due to uncertainty about basic economic variables over time.

Answer: D

Diff: 3 Type: MC

Topic: 1.4. Dealing with abstractions

Skill: Applied

Category: Quantitative

10) Suppose that you are asked to evaluate a project of building a new bridge. Which of the following factors is the least important in terms of engineering economics?

A) service life of the bridge

B) value added by the bridge

C) cost structure

D) vehicle stock in your city

Answer: D

Diff: 3 Type: MC

Topic: 1.4. Dealing with abstractions

Skill: Applied

Category: Qualitative

11) Based on your intuition and experience, which of the following options has the highest value?

A) $100 government bond earning a 5% annual rate of return

B) $100 invested in a fund with a 10% annual rate of return

C) $200 government bond earning a 5% annual rate of return

D) $200 invested in a fund earning a 10% annual rate of return

Answer: D

Diff: 2 Type: MC

Topic: 1.4. Dealing with abstractions

Skill: Applied

Category: Quantitative

12) What is the best way to describe a mathematical model?

A) It is an exact copy of the real world.

B) It is a simplification to describe the real world in a reasonable way.

C) It is a set of mathematical relationships with assumptions based on natural laws.

D) It is a relationship that includes all aspects of a modelling situation.

Answer: B

Diff: 2 Type: MC

Topic: 1.4. Dealing with abstractions

Skill: Recall

Category: Qualitative

13) Explain the role of a mathematical model in engineering economics.

Answer: When one describes something, one does so for a purpose. In the description, one selects aspects of the real world that are relevant to that purpose. The process of simplifying the complexities of the real world is necessary for any engineering analysis. This process of simplification is called abstraction or a model. Once a model is developed, it is used to analyze a situation, and perhaps make some predictions about the real world. The analysis and the predictions are then related back to the real world to make sure that the model is valid. The role of abstractions is to develop a viable mode of the real world.

Diff: 2 Type: ES

Topic: 1.4. Dealing with abstractions

Skill: Recall

Category: Qualitative

14) Suppose that you are about to start a new business: You will provide consulting services for those who want to launch their own websites. What major decisions based on the subject matter of engineering economics should be made before you set up your business activities?

Answer: You have to evaluate the expected future costs and benefits of your enterprise. In doing so, you have to understand your final product and identify a market for that product. As a result, you will be able to evaluate your expected revenues. This is known as demand-side analysis. On the supply side, you have to understand all materials, efforts and services involved in producing and/or providing your product. This will give you a cost structure. Then you have to define your planning horizon in order to use economic forecasts of major macroeconomic variables such as interest rate, inflation and others. You have to understand the Canadian tax system as well. If you are uncertain about values of some variables involved, you have to use principles of sensitivity analysis. All this is the subject matter of engineering economics.

Diff: 3 Type: ES

Topic: 1.4. Dealing with abstractions

Skill: Applied

Category: Qualitative

15) Suppose that a local government decides to build a bridge. In order to justify this project, economists want to ask people directly about their willingness to pay for the bridge. Using the discussion in your textbook, list at least three problems with this economic measure.

Answer: The following three problems can be mentioned in this regard: (i) willingness to pay for a non-market good is very difficult to define; (ii) willingness to pay for non-market good is very subjective measure; (ii) it will require a lot of data and comprehensive statistical analysis to evaluate total willingness to pay for the bridge.

Diff: 3 Type: ES

Topic: 1.4. Dealing with abstractions

Skill: Applied

Category: Qualitative

1.5 LO 1.5 Recognize ethical issues inherent in some complex engineering decisions.

1) Which of the following statements best describes the moral issues faced by engineers while evaluating projects?

A) Moral issues are clearly defined in engineering design.

B) Moral issues do not matter as long as technical goals are achieved.

C) Your employer is the only person who can define what is ethical or unethical.

D) There are no general answers to moral questions.

Answer: D

Diff: 3 Type: MC

Topic: 1.5. The moral question: Three true stories

Skill: Applied

Category: Qualitative

2) The best way to find some answers to difficult moral questions in engineering design and project evaluation is

A) to ask your friends.

B) to consult professional engineering associations.

C) to search the web.

D) to read newspapers.

Answer: B

Diff: 2 Type: MC

Topic: 1.5. The moral question: Three true stories

Skill: Recall

Category: Qualitative

3) How should engineers address moral questions associated with economic evaluation of engineering projects?

Answer: Engineers have a responsibility to society to behave ethically and responsibly in all ways. When many different issues must be taken into account in engineering decision making, it is often difficult to determine what course of action is ethical. There are no general answers to difficult moral questions. Practicing engineers often have to make choices with an ethical component, and can sometimes rely on no stronger foundation than their own sense of right and wrong. More information about ethical issues for engineers can be obtained from provincial professional engineering organizations.

Diff: 1 Type: ES

Topic: 1.5. The moral question: Three true stories

Skill: Recall

Category: Qualitative

1.6 LO 1.6 Understand that quantitative analysis uses estimates for future quantities, and that this inherent uncertainty must always be considered.

1) Analyze the following statement: "There is 50% probability of raining." This statement concerns

A) extrapolation.

B) risk.

C) precise description.

D) abstraction.

Answer: B

Diff: 2 Type: MC

Topic: 1.6. Uncertainty and sensitivity analysis

Skill: Applied

Category: Qualitative

2) To resolve uncertainty, engineers apply

A) marginal analysis.

B) cash-flow analysis.

C) sensitivity analysis.

D) risk analysis.

Answer: C

Diff: 2 Type: MC

Topic: 1.6. Uncertainty and sensitivity analysis

Skill: Recall

Category: Qualitative

3) In engineering economics, sensitivity analysis

A) addresses risk in engineering projects.

B) addresses inflation in a country.

C) involves random variables with their probabilities.

D) assesses the effect of uncertainty on a decision.

Answer: D

Diff: 3 Type: MC

Topic: 1.6. Uncertainty and sensitivity analysis

Skill: Recall

Category: Qualitative

4) With sensitivity analysis, usually only one parameter is varied at a time

A) because the appropriate tools are not available to vary parameters simultaneously.

B) because this best emulates "real world" scenarios.

C) so as to simplify the procedure.

D) so that the effect of each can be observed independently of all other parameters.

Answer: D

Diff: 2 Type: MC

Topic: 1.6. Uncertainty and sensitivity analysis

Skill: Recall

Category: Qualitative

5) Most of the economic values we use in our evaluation of engineering projects are

A) precise and very descriptive.

B) approximate.

C) based on robust statistical estimation.

D) derived from natural experiments.

Answer: B

Diff: 2 Type: MC

Topic: 1.6. Uncertainty and sensitivity analysis

Skill: Recall

Category: Qualitative

6) If you decide to buy a home, list basic economic and non-economic factors you have to take into account and rank them.

Answer: You need to know the price of a home, current mortgage rate, potential duration of the mortgage and your own current and expected income. Those are fundamental economic factors. Non-economic factors may include: location, environmental quality, and safety and noise level.

Diff: 2 Type: ES

Topic: 1.6. Uncertainty and sensitivity analysis

Skill: Applied

Category: Qualitative

7) Sensitivity Analysis has sometimes been referred to as "what if" analysis. Explain why.

Answer: Sensitivity Analysis begins with a base situation, which is developed using the most likely values for each input. We then vary the variable of interest by specified percentage points above and below the most likely value, while holding the other variables steady and observing the output. Sensitivity analysis is providing information on the "what if I vary this input"? What will be the effect on the output?

For instance, "what if" our annual sales were only 2 million units instead of 2.5 million units? What effect would that have on overall earnings?

Diff: 3 Type: ES

Topic: 1.6. Uncertainty and sensitivity analysis

Skill: Applied

Category: Qualitative