Name: _____ Recitation Section: **L**

Student Number: _____

1. Verify that you have all 7 pages (cover, 5 problems, formula sheet) of the exam. This exam was distributed in multiple sections; when you finish, be sure to turn in all pages (except the formula sheet) for grading.
2. Read all instructions and problems carefully. Points will be deducted for failure to follow instructions.
3. PRINT your name and student number in the spaces at the top of ALL pages of this exam. Enter your recitation section in the indicated space above on this cover page.
4. The pages in this exam may be separated for grading; therefore, if you need extra space for a particular problem, write on the back of the page for that problem.
5. **Show ALL of your work on these pages.** Numeric answers without supporting calculations may be discounted. The instructions for a specific question may limit the amount of space allowed for an answer. For all multiple-choice questions, select the closest, or most appropriate, answer.
6. You are permitted one sheet (8 1/2 x 11, double-sided) of original **handwritten** notes; photocopies, reductions, etc. are prohibited. Use of any other notes, books, or other resources is prohibited.
7. Calculators are permitted solely for the purpose of performing numerical computations. You are not allowed to use the calculator memory to store notes, etc.
8. This exam lasts for 70 minutes. Point values are listed for each problem to assist you in best using your time.

_____	Problem 1.	(30 points possible)
_____	Problem 2.	(25 points possible)
_____	Problem 3.	(20 points possible)
_____	Problem 4.	(15 points possible)
_____	Problem 5	(10 points possible)
_____	**TOTAL**.	(100 points possible)

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Problem 1. (30 points)

(2 points each) Match each of the following terms with the best definition or explanation from the list on the lower section of this page. Write the letter corresponding to the **best** choice on the line in front of each term. Note that not all definitions/explanations will be used and that response "U" may occur multiple times.

____ Quality Function Deployment	____ utilitarian	____ recycling
____ decomposition	____ amortize	____ arithmetic gradient
____ non-recurring cost	____ interest	____ modularity
____ duty-based	____ partitioning	____ simulation
____ cash flow diagram	____ virtue-based	____ inflation

A. Average change in cost of products and/or services over a period of time.

B. A multi-level description in which an item at one level of abstraction is composed of multiple items at the next lower level.

C. A matrix-based method for relating requirements and engineering choices between adjacent hierarchical levels of a design.

D. Dividing an item at one level of abstraction into multiple items at a lower level.

E. A cost that occurs repeatedly for each unit or each time interval.

F. A grouping of components to reduce interactions among items and increase self-containment and potential re-use.

G. An ethical system that emphasizes results, with the objective of providing the most benefit for the greatest number of people.

H. Putting a device or modular part of device into service again once its original use is completed.

I. An ethical system that emphasizes the achievement of a set of common values, such as generosity or honesty.

J. A time-value-of-money sequence that changes by a fixed percentage from one time interval to the next.

K. Extracting, separating, and/or reprocessing material so that it can be used to produce a new product.

L. A charge for the use of money over time, commonly expressed as an annual percentage rate.

M. A fixed expense independent of the number of units produced or length of time.

N. A time-value-of-money sequence with a constant value in each time interval.

O. An ethical system that focuses on the obligation of those making a decision to satisfy their responsibilities.

P. To spread a value over multiple units or an extended length of time.

Q. A time-value-of-money sequence that changes by a fixed amount from one time interval to the next.

R. A graphical representation of income and expenses grouped by time intervals.

S. An ethical system that emphasizes those who will be affected by a decision, with the objective of not violating people's rights.

T. Dividing a single item at a particular level of abstraction into a set of items, typically at that same level of abstraction.

U. None of the above.

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Problem 2. (25 points)

For each of the following computations, (a) list the conversion factor(s) to be used, specifying the parameter values, and (b) compute the result, showing your work in the space provided. Write your answers on the blank lines on the right edge of this page; correct answers in other locations may not receive full credit. An example is provided.

EXAMPLE:

If you invest \$100 in a bank account today, at an interest rate of 6.5%, how much will you have after five years?

(a) **(F/P, 6.5%, 5)**

(b) **\$ 137.01**

$$\mathbf{100\ (F/P,\ 6.5\%,\ 5)\ =\ 100\ (1 + 0.065)^{5}\ =\ 100 * 1.3701\ =\ 137.01}$$

A. (5 points) What fixed amount should you set aside for each of the next 8 years, assuming an interest rate of 7.5%, in order to accumulate \$90,000 at the end of the 8-year period?

(a) _____

(b) _____

B. (5 points) You currently spend \$35 per month buying gasoline for your car. Assuming the price of gasoline increases by 7% each year and an interest rate of 5%, what is the present value of your gasoline purchases for the next 6 years?

(a) _____

(b) _____

C. (5 points) A new house costs \$280,000 today. Assuming an annual interest rate of 3.5%, what would have been an equivalent value 20 years ago?

(a) _____

(b) _____

D. (10 points) Your company purchases a machine with a present cost of \$750,000. The machine is expected to have a useful lifetime of 12 years and a salvage value of \$50,000. Assuming an interest rate of 6%, what is the annualized cost of this machine over its useful life?

NOTE: This problem may require the use of more than one conversion factor. List all factors used.

(a) _____

_____

_____

(b) _____

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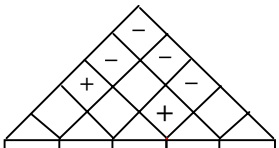
Problem 3. (20 points)

A portion of the QFD diagram from the example discussed in class is shown to the right. Answer the following questions **based on this QFD diagram**.



	– Energy required to close door	+ Check force on 10° slope	– Energy required to open door	+ Door seal resistance	– Acoustic transmission of window
Easy to close from outside	+			–	
Easy to open from outside			+	+	
Stays open on a hill		+			
Doesn't kick back		+	+	–	
No road noise				+	+

NOTE: For parts B and C, you must select the correct response AND provide an appropriate explanation to receive full credit.

A. (3 points) Which of the following statements is **NOT** true?

(a) Reducing acoustic transmission of the window makes it harder to achieve most of the other engineering characteristics.
(b) Improving the ability of the door to stay open on a hill will also tend to reduce kick back.
(c) For the listed engineering characteristics, all changes that make it easier to close the door also make it easier to open the door.
(d) None of the above

B. (5 points) Which one of the listed customer desires is likely to be most difficult to achieve?

(a) Easy to close from outside
(b) Easy to open from outside
(c) Stays open on a hill
(d) Doesn't kick back
(e) No road noise

Briefly explain:

C. (5 points) Which one of the listed engineering characteristics is likely to have the greatest effect on customer satisfaction with this product?

(a) Energy required to close door
(b) Check force on 10° slope
(c) Energy required to open door
(d) Door seal resistance
(e) Acoustic transmission of window

Briefly explain:

D. (7 points) On the QFD diagram, the "+" in front of "Door seal resistance" indicates that it is generally desirable to maximize this characteristic. Briefly explain in the space below, based on the diagram entries, why it might be more appropriate to list this engineering characteristic without a "+" or "-" indicator. Would making this change affect any of the other entries in either the matrix or roof sections of the QFD diagram?

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Problem 4. (15 points)

Legibly write your answer to each question on the lines provided. Your answer for each part is limited to the space provided. ***DO NOT*** *write (or continue) your answers on the back of this page or anywhere else on this exam. Your answers will be graded on both appropriateness/correctness and on quality/clarity.*

A. (4 points) List at least two significant advantages of partitioning and/or decomposing a complex problem early in the design process. Briefly explain one significant disadvantage or limitation that may result from early partitioning/decomposition of a design problem.

Advantages:

Disadvantage/Limitation:

B. (5 points) List at least two significant advantages of increasing the modularity of a design. List one potentially significant disadvantage of increasing the modularity of a design. Provide one example of how increased modularity is commonly achieved in electrical/computer engineering design.

Advantages:

Disadvantage:

Example:

C. (6 points) Disposal, recycling, and re-use were all identified as options for what happens to a product at the end of its useful lifetime. List one significant benefit (in addition to environmental benefits) for recycling and for re-use. List, and briefly explain, at least two factors that make it more difficult to design a engineering product so that it can be recycled or re-used.

Recycling benefit:

Re-use benefit:

Factors:

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Problem 5. (10 points)

Legibly write your answer to each question on the lines provided. There are many good answers to these questions, so you will be graded heavily on your ability to explain and justify your choices. Your answer for each part is limited to the space provided on the lines. ***DO NOT*** *write (or continue) answers in the margins, on the back of this page, or anywhere else on this exam. Your answers will be graded on both appropriateness/correctness and on quality/clarity; for maximum credit, your answers should be clear, concise, and organized.*

Consider the following excerpt from a recent editorial column (Carlin Romano, "New Orleans and the Probability Blues," *The Chronicle of Higher Education*, September 23, 2005, p. B13):

> [Lee Clarke, a Rutgers University sociologist and expert on disasters] divides people into probabilists and possibilists. Much modern scientific and governmental policy about disasters, he claims, emerges from probabilistic thinking -- "What's the likelihood that the nuclear plant will melt down?" -- while possibilistic, or worst-case, thinking asks "What happens if the nuclear plant has a really bad day?" … Because probabilistic thinking "tends to favor those who benefit from dangerous systems" -- i.e., corporations and governments bent on risky things -- "probabilism tends to protect the powerful. More important, it often results in the nonpowerful being placed in danger." Business leaders worry that laymen's possibilistic irrationalities "get translated into overregulation of industry." Professional possibilistic types in the corner of the nonpowerful are largely restricted to environmentalists and antinuclear activists. The important truth, Clarke insists, is that chance "is often against us." As a colleague he quotes says, "things that have never happened before happen all the time." Society needs to be protected from the possible, not just the probable. Too often, Clarke argues, "probabilism" protects the powerful to such an extent that "reasonable" simply "means probability."

A. (5 points) In the textbook and class discussion, four ethical models were presented: utilitarian, duty-based, rights-based, and virtue-based. Briefly explain how one or more of these models might produce choices similar to those resulting from the probabilist and possibilist approaches.

B. (10 points) What would be the likely engineering consequences (positive and negative) of adopting a possibilist ethical model in making product design decisions? Choose one specific example of an electrical/computer engineering design that directly affects health, safety, and/or public welfare and describe how the design choices would most likely be different using probabilist versus possibilist approaches.