

Name: _____

Recitation Section: L _____

Student Number: _____

1. Check that your exam includes all 7 pages (cover, 6 problems, and one 2-sided formula sheet).
2. Read all instructions and problems carefully. Points will be deducted for failure to follow instructions.
3. Complete the information requested in the spaces above.
4. PRINT your name and student number in the spaces at the top of all remaining pages of this exam.
5. **Show ALL of your work on these pages.** 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. The instructions for a specific question may limit the amount of space allowed for an answer.
6. You are permitted one sheet (8 1/2 x 11, double-sided) of **handwritten** notes. Use of any other notes, books, or other resources is prohibited.
7. Calculators are permitted; however, you are not allowed to use the calculator memory to store notes, etc.
8. This exam lasts for 65 minutes. Point values are listed for each problem to assist you in best using your time.

_____	Problem 1.	(20 points possible)
_____	Problem 2.	(10 points possible)
_____	Problem 3.	(15 points possible)
_____	Problem 4.	(18 points possible)
_____	Problem 5.	(20 points possible)
_____	Problem 6.	(17 points possible)
_____	TOTAL.	(100 points possible)

Manufacturing-Related Formulas

$$C_p = (USL - LSL) / (6 \sigma) \quad C_{pk} = C_p (1 - k)$$

$$k = | \text{Actual Mean} - \text{Target Mean} | / ((USL - LSL) / 2)$$

$$\text{First-time yield, FTY} = e^{-dpu} \quad \text{Prob} \{ k \text{ defects} \} = (dpu)^k / k! e^{-dpu}$$

Name: _____

Student #: _____

Problem 1. (20 points)

- (a) (6) State one disadvantage of performing a single long simulation and one disadvantage of performing many very short simulations of a system, instead of several intermediate length simulations.

Disadvantage of single long _____

Disadvantage of many short _____

- (b) (4) State one reason why recycling might not be economically feasible

Reason _____

- (c) (6) State two additional factors, besides hitting the iceberg, that contributed to the large loss of life in the sinking of the Titanic.

Reason #1 _____

Reason #2 _____

- (d) (4) What is the difference in meaning of the following two sentences?

#1: The car, which was travelling 60 miles per hour, is red.

#2: The car that was travelling 60 miles per hour is red

Difference: _____

Name: _____

Student #: _____

Problem 2. (10 points)

Assume that an engineer has determined the benefit-cost ratio of a project to be 2.0. If a small additional item exists that could be classified as either a disbenefit or as an additional cost, which classification would result in a higher benefit-cost ratio? **Justify** your result.

Higher ratio classification: _____

Why is the benefit-cost ratio usually used instead of the benefit-cost difference?

Reason _____

Problem 3. (15 points)

A manufacturing process is characterized by the following values:

$C_p = 3.0$ $C_{pk} = 2.4$ Target mean = 800 Actual mean = 860

Assume design specifications are symmetric around the target mean and that the characteristics of the manufactured item are distributed according to a normal (Gaussian) distribution. Compute the values specified below. You must show your calculations in the space below (or on the back of *this* page) in order to receive full credit.

Lower specification limit: _____

Upper specification limit: _____

Standard deviation: _____

Defects below LSL
(in terms of tail-end Z function): _____

Defects above USL
(in terms of tail-end Z function): _____

Name: _____

Student #: _____

Problem 4. (18 points)

For each of the following questions, circle the letter in the right-hand column that corresponds to the best answer.

- A. 10,000 devices are being tested for 300 hours. The process is characterized by a per unit failure rate of $4 \times 10^{-3} \text{ hr}^{-1}$. How many devices do not survive past 300 hours of their life? **a b c d**
(a) 1026 (c) 4493
(b) 3012 (d) 6988
- B. A manufacturing process has an average defect rate of 1.8 defects per unit. What is probability that a particular unit will have less than than 2 defects? **a b c d**
(a) 29.8 % (c) 53.7 %
(b) 46.3 % (d) 83.5 %
- C. A manufacturing process step, involving inspection with perfect repair and 100% coverage, has a first-time yield (FTY) of 30.1%. While producing 1000 good units, approximately how many total inspections will have to be performed? **a b c d**
(a) 301 (c) 1,699
(b) 1,398 (d) 6,990
- D. A manufacturing line produce microprocessors whose average maximum operating clock speed is 150 MHz. Assuming a normal distribution of maximum operating speeds and a standard deviation of 30MHz, approximately what percentage of microprocessors will operate correctly at 120 MHz? **a b c d**
(a) less than 5 % (c) 34 %
(b) 16 % (d) 84 %
- E. A system composed of two parallel subsystems of reliability .6 and .8 respectively, has a system reliability of **a b c d**
(a) .34 (c) .92
(b) .48 (d) 1.4
- F. A semiconductor manufacturing company owns the assets listed below. Select the one that is not a form of intellectual property. **a b c d**
(a) copyright on a textbook on integrated circuits
(b) specially purchased oven for making the masks
(c) patent on the integrated circuit manufacturing process
(d) trademark of the company logo.

Name: _____

Student #: _____

Problem 6. (17 points)

A company is making a decision on which of three possible alternatives to design and build. A decision theory model for the projected revenue is to be used (dollar amounts are in millions). All systems cost the same. An interest rate of 6% is appropriate. Using an equivalent **present value** viewpoint, determine the present value of expected revenue of each alternative and determine which alternative should be chosen. State your justification and result.

Alternative #1 generates revenue of:

A present lump-sum payment of \$400 with probability =.8, **OR**

A present lump-sum payment of \$600 with probability =.2

Alternative #2 generates revenue of:

5 annual payments of \$100, the first payment occurring immediately, with probability =1

Alternative #3 generates revenue of:

5 annual payments of \$105, the first payment occurring at the end of the first year, with probability =1

Alternative #1 expected revenue (present value) = _____

Alternative #2 expected revenue (present value) = _____

Alternative #3 expected revenue (present value) = _____

Choose alternative # _____