

Name: _____

Recitation Section: L _____

Student Number: _____

1. Check that your exam includes all 8 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 55 minutes. Point values are listed for each problem to assist you in best using your time.

_____	Problem 1.	(14 points possible)
_____	Problem 2.	(10 points possible)
_____	Problem 3.	(16 points possible)
_____	Problem 4.	(20 points possible)
_____	Problem 5.	(20 points possible)
_____	Problem 6.	(20 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. (14 points)

(a) (6) State two reasons why perceived risk may be different from actual risk.

(b) (4) Are most government standards written in the form of design standards or performance standards? State a reason.

Design or Performance (circle one)

Reason _____

(c) (4) State a principal factor that contributed to the collapse of the Hyatt walkway.

Factor _____

Problem 2. (10 points)

Assume that an engineer has determined the benefits of a project to be 6.0 (arbitrary units), and the cost to be 3.0 (same units). If a small additional item of magnitude .3 exists, and it could be classified as either a disbenefit or as an additional cost, which classification would result in a lower benefit-cost ratio? **Justify** your result.

Lower ratio classification: _____

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

Reason _____

Name: _____

Student #: _____

Problem 3. (16 points)

A manufacturing design for resistors is characterized by the following values:

- Lower specification Limit = 24 Kilohms
- Upper specification Limit = 40 Kilohms
- Target mean = 32 Kilohms
- Actual mean = 30 Kilohms
- Standard Deviation = 4 Kilohms

Assume 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 in order to receive full credit.

Cp: _____

Cpk: _____

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

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

Which one of the three descriptions would be most likely used to describe the above process? Circle the letter of the correct response below.

- (a) The design is tolerant
- (b) The design is intolerant
- (c) The design and the manufacturing process agree at the 3 sigma points

Name: _____

Student #: _____

Problem 4. (20 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 500 hours. The process is characterized by a per unit failure rate of $4 \times 10^{-3} \text{ hr}^{-1}$. How many devices fail between 200 hours and 400 hours of their life? **a b c d**
(a) 2019 (c) 4493
(b) 2474 (d) 7526
- B. A manufacturing process has an average defect rate of 1.8 defects per unit. What is probability that a particular unit will have more than one defect? **a b c d**
(a) 16.5 % (c) 46.3 %
(b) 29.8 % (d) 53.7 %
- 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 tests will have to be performed? **a b c d**
(a) 301 (c) 1,699
(b) 1,398 (d) 2,200
- D. A manufacturing line produce microprocessors whose average maximum operating clock speed is 120 MHz. Assuming a normal distribution of maximum operating speeds and a standard deviation of 20MHz, approximately what percentage of microprocessors will operate correctly at 90 MHz? **a b c d**
(a) less than 6 % (c) 34 %
(b) 7 % (d) 93 %
- E. A system composed of two parallel subsystems of reliability .4 and .6 respectively, has a system reliability of **a b c d**
(a) .24 (c) .76
(b) .48 (d) 1.4
- F. Which one of the following characteristics or sets of characteristics listed below is not discussed in the Stancell Leadership module as an effective leadership practice? **a b c d**
(a) aggressiveness in a new situation
(b) teamwork in diverse groups
(c) integrity and self-awareness
(d) risk taking and vision.
- G. According to the leadership module, the starting point in developing leadership skills is **a b c d**
(a) to graduate from college with good grades
(b) to develop a sound set of personal principles
(c) to play a team sport
(d) to develop a system of time-management

Name: _____

Student #: _____

- H.** The matrix method, as discussed in the guest lecture by Mr. Drapeau, is a method **a b c d**
- (a) to organize available engineering talent into teams
 - (b) to develop a risk management model for the company's projects
 - (c) to organize an effective oral presentation
 - (d) to select a vendor as a supplier
- I.** In the video on engineering disasters the point was made that most disasters are related to a **a b c d**
- (a) rare combination of unexpected events
 - (b) clearly defined ethical lapse
 - (c) fundamental lack of knowledge of engineering or scientific principles
 - (d) management communication failure
- J.** Two machines are involved in producing a part for a printed circuit board. **a b c d e**
For a batch of 10000 boards, 6000 of the boards have the part made by machine A, and 4000 have the part made by machine B. Machine A has a defect rate of 1 %, and machine B has a defect rate of 5%. If a board is randomly selected after the part has been inserted, and it is determined that the part is defective, what may one conclude?
- (a) The probability that machine A made the part is 60%, and the probability that Machine B made the part is greater than 40%
 - (b) The probability that machine A made the part is 60%, and the probability that Machine B made the part is 40%
 - (c) The probability that machine A made the part is greater than 60%, and the probability that Machine B made the part is less than 40%
 - (d) The probability that machine A made the part is less than 60%, and the probability that Machine B made the part is greater than 40%
 - (e) The probability that machine A made the part is greater than 60%, and the probability that Machine B made the part is 40%

Name: _____

Student #: _____

Problem 5. (20 points)

Following are 10 statements. For each of the following statements, circle the appropriate response in the right-hand column. This problem is scored by # of points=2 (number correctly circled) – 1 (number incorrectly circled). In other words, incorrect guesses hurt worse than no guesses.

- | | | |
|---|-------------|--------------|
| (a) If one becomes a licensed professional engineer by passing the Principles and Practice Exam in the electrical discipline, one must pass another exam in the mechanical discipline before one can legally perform mechanical work as a PE. | TRUE | FALSE |
| (b) Under the doctrine of strict liability, negligence does not have to be proved before a corporation is legally liable. | TRUE | FALSE |
| (c) A definition of the term “ukase” is a regulatory ruling with the force of law. | TRUE | FALSE |
| (d) Assuming that the initial payment of a series of 10 annual payments is \$100, then a geometric series of payment increasing 8% a year has necessarily a higher present value than an arithmetic series increasing \$8 per year for any non-zero, positive interest rate | TRUE | FALSE |
| (e) For the afternoon portion of the Fundamentals of Engineering Exam, one must take a discipline specific exam | TRUE | FALSE |
| (f) If a company has complied with ISO 9000:2000 standards, it means that a majority of customers have indicated that they are satisfied with the product | TRUE | FALSE |
| (g) The useful lifetime region of the “bathtub” model of device reliability is typically characterized by a decreasing per-unit failure rate. | TRUE | FALSE |
| (h) The roof-top portion of the QFD diagram describes the trade-off between the consumer desires and the engineering requirements. | TRUE | FALSE |
| (i) It is possible to include intangible factors in a numerical benefit-cost analysis. | TRUE | FALSE |
| (j) A system composed of two subsystems in parallel is always more reliable than a system composed of the same two subsystems in series, assuming that for each subsystem, $0 < R < 1$. | TRUE | FALSE |

Scoring: _____ correct answers x 2pts = _____
 minus number of incorrect answers – _____

Score:

Name: _____

Student #: _____

Problem 6. (20 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 \$3600 with probability =.8, **OR**

A present lump-sum payment of \$4800 with probability =.2

Alternative #2 generates revenue of:

6 annual payments with probability =1:
\$600 the first three years,
\$800 the last three years
(each payment occurs at the end of the year)

Alternative #3 generates revenue of:

6 annual payments of \$650, the first payment occurring immediately,
with probability =1

Alternative #1 expected revenue (present value) = _____

Alternative #2 expected revenue (present value) = _____

Alternative #3 expected revenue (present value) = _____

Choose alternative # _____