

Name: _____

Recitation Section: L _____

Student Number: _____

1. Check that your exam includes all 9 pages (cover, 5 problems, one 2-sided formula sheet, and one interest table).
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** (no photocopies or reductions) notes. Use of any other notes, books, or other resources is prohibited. **No cellular telephones** are permitted.
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.	(17 points possible)
_____	Problem 2.	(30 points possible)
_____	Problem 3.	(18 points possible)
_____	Problem 4.	(20 points possible)
_____	Problem 5.	(15 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. (17 points)

(a) (6) State two reasons why perceived risk may be viewed as less than actual risk.

(b) (5) State a reason why some countries might choose not to implement public policies normally associated with the achievement of a sustainable society?

Reason _____

(c) (6) State two general classes of intellectual property

Name: _____

Student #: _____

Problem 2. (30 points)

- (a) (12) The first payment in an arithmetic gradient series of 8 payments is \$1,200, and the last payment is \$3,300, and the interest rate appropriate to the calculation is 8%. Determine the amount of the gradient increase of each payment over the previous payment and the present value of the entire series. Show all calculations.

Gradient between payments _____

Present value of series _____

- (b) (12) The last payment in a geometrical gradient series of 8 payments is \$1,800. Each payment increases by 4% over the preceding payment, and the interest rate appropriate to the calculation is 8%. Determine the amount of the first payment and the present value of the entire series. Show all calculations.

First payment _____

Present value of series _____

- (c) (6) We wish to convert an annual series of 8 payments of \$2000, the first occurring a year from the present, to an equivalent annual series of 9 equal annual payments, the first payment occurring immediately. Determine the amount of each payment. The interest rate appropriate to the calculation is 8%. Show all calculations.

Each payment _____

Problem 3. (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 600 hours. The process is characterized by two sub-systems with parallel reliabilities of 0.2 and 0.4 at 200 hours. Determine the number of these devices that have failed before 200 hours of their life? **a b c d**
(a) 1500 (c) 4800
(b) 3200 (d) 5200
- B. A group of 3,000 devices is characterized by two sub-systems with series reliabilities characterized by per unit failure rates of $2 \times 10^{-3} \text{ hr}^{-1}$ and $4 \times 10^{-3} \text{ hr}^{-1}$. How many of these devices have survived past 200 hours of their life? **a b c d**
(a) 358 (c) 1806
(b) 904 (d) 2096
- C. A manufacturing process has an average defect rate of 1.6 defects per unit. What is the probability that a particular unit will have greater than one defect? **a b c d**
(a) 20.2 % (c) 47.5 %
(b) 32.3 % (d) 52.5 %
- D. A manufacturing process step, involving testing with perfect repair and 100% coverage, has a first-time yield (FTY) of 30.1%. While producing 2,000 good units, approximately how many total tests will have to be performed? **a b c d**
(a) 2,602 (c) 4,401
(b) 3,398 (d) 5,646
- E. Two resistors are wired in series connection to form an equivalent resistance $R = R_1 + R_2$. R_1 has a value of 2 Kilohms, with a tolerance of 2.0%, and R_2 has a value of 3 Kilohms, with a tolerance of 3.0%. The tolerance in the specification represents absolute upper and lower values. Which one of the following statements is correct? **a b c d**
(a) The equivalent resistance is equal to 5 Kilohms with a tolerance of 2.0%.
(b) The equivalent resistance is equal to 5 Kilohms with a tolerance of 2.6%
(c) The equivalent resistance is equal to 5 Kilohms with a tolerance of 3.2%.
(d) The equivalent resistance is equal to 5 Kilohms with a tolerance of 5.0%.
- F. While performing a benefit-cost analysis of a proposed new bridge, an engineer must determine whether to treat periodic anti-rust coating costs as a deferred cost or as a disbenefit. This determination is representative of: **a b c d**
(a) quantification of an intangible item
(b) quantification of a tangible item
(c) classification of a intangible item
(d) classification of an tangible item.

Problem 4. (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) The failure of the walkways in the Hyatt Regency hotel was primarily the result of errors in the original design specifications. | TRUE | FALSE |
| (b) Under the doctrine of strict liability, it is typically easier to satisfy the requirements that would result in a corporation being held legally liable for harm resulting from a product than it was under the previous standard of negligence. | TRUE | FALSE |
| (c) Most government standards for products are stated in the form of performance standards, as opposed to design standards. | TRUE | FALSE |
| (d) A potential advantage of building a prototype compared to performing a simulation is that it is easier to discover unforeseen interactions among the system components. | TRUE | FALSE |
| (e) For the afternoon portion of the Fundamentals of Engineering Exam, one may choose to take an other/general examination option. | 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) If the reliability of a device can be characterized by a two parallel reliabilities with two constant per unit failure rates, then its overall per unit failure rate is constant with time. | TRUE | FALSE |
| (h) The morning portion of the Fundamentals of Engineering Exam does not include questions on ethics or on engineering economy. | TRUE | FALSE |
| (i) The Baldrige Award is given for outstanding technical design of a new product. | TRUE | FALSE |
| (j) The fundamental canons of the ABET Code of ethics is quite similar to the NCEES Model Rules of Professional Conduct, because both emphasize public safety and welfare. | TRUE | FALSE |

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

Score:

Name: _____

Student #: _____

Problem 5. (15 points)

A manufacturing process that involves the insertion of a soldered part into a printed circuit board is characterized by the following values:

$$C_p = 1.40$$

$$C_{pk} = 1.12$$

$$\text{Target mean} = 570$$

$$\text{Actual mean} = 540$$

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, assuming 20,000 units. You must show your calculations in the space below in order to receive full credit.

Lower specification limit: _____

Upper specification limit: _____

Standard deviation: _____

Number of defective units
below LSL: _____

Number of defective units
above USL: _____