# **IE 251** Midterm Examination Nov. 10, 2016

(Duration: 90 minutes. One page of ***hand-written*** notes is allowed.)

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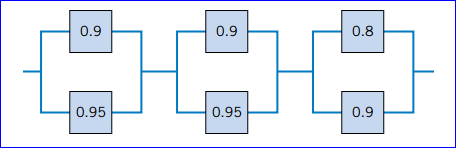
**1.** An inspector working for a manufacturing company has a 99% chance of correctly identifying defective items and a 0.5% chance of incorrectly classifying a good item as defective. The company has evidence that its line produces 0.9% of nonconforming items.

(a) What is the probability that an item selected for inspection is classified as defective?

A: Item is defective  
B: Item is classified defective

(b) If an item selected at random is classified as nondefective, what is the probability that it is indeed good?

**2.** The following circuit operates if and only if there is a path of functional devices from left to right. The probability each device functions is as shown. What is the probability that the circuit operates?



Let A be at least one of the devices on the left are functional, let B be at least one of the devices in the middle be functional, and let C be at least one of the devices on the right are functional. The probability that the circuit operates can be calculated as:

**3.** A memory chip consists of 5,000,000 transistors. From past production data it is known that one transistor in every 1,000,000 is defective.

a) What is the probability that a chip contains no defective transistors? (Hint: Use Poisson approximation)

b) A chip is functional if it has zero or one defective transistors. What is the probability that a chip is functional?

c) There are 300 chips on a single wafer, what is the expected value and standard deviation of the functional chips on a wafer?

**4.** Suppose that X is a random variable with the following probability mass function:



a) Determine *c* so that this is a valid pmf

b) Determine the cumulative distribution function of X

c) Sketch the graph of the pdf and the cdf

**5.** The number of customers arriving at a certain automobile service facility is assumed to follow a Poisson distribution with rate λ = 2 per hour.

a) What is the probability that exactly 3 customers will arrive within the next two hours?

b) If X denotes the number of customers in 10 hours, what is E(X) and V(X)?

c) If 3 customers have arrived between 10:00 and 11:00, what is the probability that no customers arrive between 11:00 and 12:00?