Name:

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Final Exam
ENRE447 Spring 2017 SAMPLE

Question	1	2	3	4	5	Total Points	Grade
Earned Points							
Maximum Points	25	30	20	15	15	100+5	

Duration: 120 minutes Time will be displayed at front of classroom.

Electronics, book, & notes policy: Open book, notes, computer; **closed internet.** You may use a calculator and selected computer programs: Excel (including RARE), Matlab, Python, R, Word, Powerpoint, Calculators, PDF viewers, text editors, etc. You may not use any other specialized mathematical or engineering software. No use of the internet or any communications devices. Place all of your devices onto airplane mode & silent. SmartWatch or equivalent must be removed and placed in backpack.

General guidelines:
- All answers must be hand-written in the exam packet. No computer print-outs or file uploads will be accepted. If you need additional paper, ask the exam proctor. Submit all additional paper.
- Turn in this exam packet with your exam. Put your first initial and last name on each page.
- Circle or highlight your answers. Show enough work to demonstrate that you understand how to solve the problem. Cross out anything you do not want graded.
- Make sure your answers have both a left hand side and a right hand side.
- Notation: Use A to denote the event that system A fails, $\bar{A}$ for the event that system A operates successfully. Define any other notation if necessary.
- **Off campus:** if you attach any additional pages, please ensure that your proctor puts them in order and numbers the pages. Make sure you have a clock or timer visible from your desk.

Please sign the honor pledge below indicating that you have not given or received any unauthorized help on this exam:

I pledge on my honor that I have not given or received any unauthorized assistance on this examination.

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PROBLEM 1: [25 points]

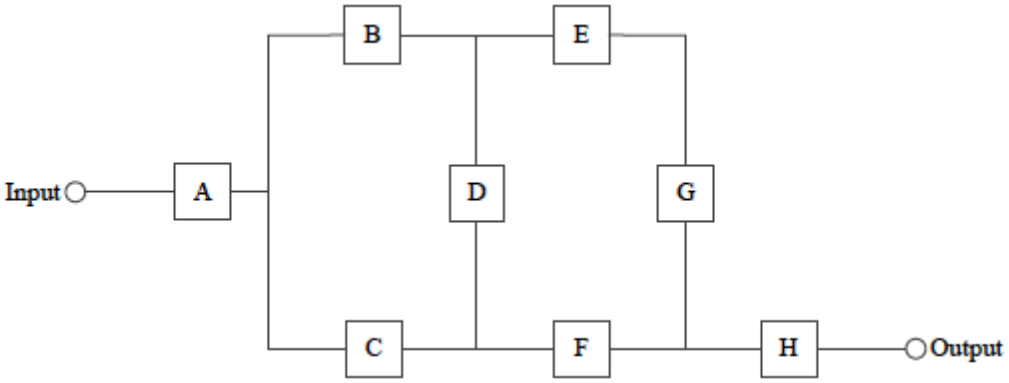
Data on minutes-to-failure for an insulating fluid were obtained for 11 reliability tests. After 100 min, there were 7 failures at the following times (in minutes): 7.74, 15.05, 20.46, 24.02, 28.66, 41.40, and 47.30. The other four units did not fail.

a. Make a Weibull probability plot and estimate the parameters of this distribution.
b. Would you suggest using an exponential distribution to model these data? Why?
c. Assuming an exponential distribution, obtain the maximum likelihood point estimate and approximate one-sided 95% confidence interval for the failure rate.

PROBLEM 2: [30 points]

For the reliability diagram below all blocks are operate in one-way direction (toward the output) except block "D" that can operate in two-way direction:

a. Find the reliability of the system as a function of the reliability of each component directly from the reliability block diagram.
b. Draw a fault tree representing the diagram with the top event: "No Flow in the Output".
c. Derive the minimal cut sets of the fault tree in part b (above) using Boolean Logic Substitution method.
d. **5 points extra credit:** Compare the reliability using the reliability equation found in part a with the reliability found from the cut sets in part c. Assume failure probability of all blocks A through H in this mission are equal to 0.1. Use rare event approximation for part c.



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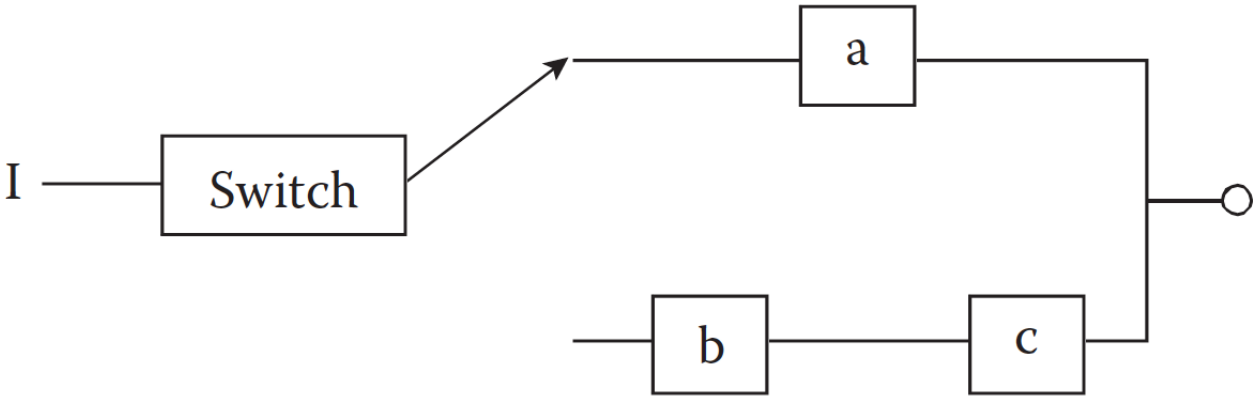
PROBLEM 3: [20 points]

For the standby system shown below, assume that components a, b, and c are identical with a constant failure rate of 1×10^{-3} (per hour) and no (zero) standby failure rate. The probability that the switch fails to operate if component "a" fails is 5×10^{-2}. Calculate the reliability of this system at t = 200 h. (Note that either "a" or "b and c" is required for system operation.)



PROBLEM 4: [15 points]

Hazard rate of a component is $h(t)=e^{-0.5t}$, where t is time measured in months.

a. Derive reliability function, R(t), and time-to-failure distribution, f(t).
b. Do you consider this a reliable component? Why?

PROBLEM 5: [15 points]

Suppose that 0.1% of a certain brand of new cell phone manufactured is defective when purchased. What is the probability that a company that decides to purchase 100 of such phones for its employees will find more than one defective phone?

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