Name:___________________

I.D.: _________________

Exam Simulation (1)

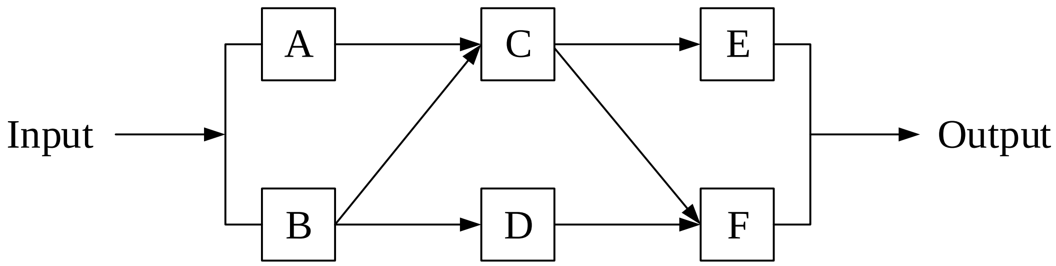
(15/06/2020)

Note:

1. Make sure to write your name and I.D. Number
2. The exam consists of 2 problems
3. Exam time is 40 minutes (20 minutes for Mobility Engineerig)

Good Luck!

Problem 1. (20 minutes) [both courses Mobility Engineering and Reliability Engineering]
(**15 points**)
Consider the following structure of a simple system where input signal is processing via any path and is output.



Each component has a constant failure rate $\boldsymbol{\lambda = 2 \cdot 10^{-5}}$ h^{-1}.
Please answer the following questions:

1. Build the Fault Tree corresponding to the top event: 'no connection between Input and Output'. **(6)**
2. Find the minimal cut sets **(6)**
3. Estimate the reliability of system at t=1000h **(3)**

Problem 2. [Only for Reliability Engineering]
(**15 points**)
In order to estimate a product's reliability, 10 independent life experiments are made. The lives of these 10 products are: 997h, 945h, 1039h, 1001h, 998h, 1022h, 999h, 959h, 1027h, 992h.

1. If the life of the product obeys the exponential distribution, please compute an estimate of the product failure rate by:

   a) The method of moments **(5)**

   b) The maximum likelihood **(5)**

2. Compute the reliability of the product at 500h and at 1000h; **(5)**

3. Compute the product hazard rate and MTTF;

Exam Simulation (2)

(15/06/2020)

Note:

4. Make sure to write your name and I.D. Number
5. The exam consists of 2 problems
6. Exam time is 40 minutes (20 minutes for Mobility Engineerig)

Good Luck!

Problem 1. (20 minutes) [both courses Mobility Engineering and Reliability Engineering]
(**15 points**)
Consider a hot standby system. The main component passes through "safe" and "failed with a failure rate $\lambda=10^{-3}h^{-1}$, whereas the standby component fails with rate $\lambda_S=10^{-4}h^{-1}$.

1. Analytically compute the reliability of the system at t=1000h. **(9)**
2. Analytically compute the system MTTF. **(6)**

Problem 2. (20 minutes) [Only for Reliability, Risk and Safety]
(**15 points**)
The number of defective rivets, D, on an airplane wing can be assumed to have a Poisson distribution with parameter λ, i.e.,

f(d│λ)=P(D=d│λ)=(λ^d e^(-λ))/d!   d=0,1,2

A random sample of n=5 wings is observed and (d_1,d_2,d_3,d_4,d_5)=(1 ,4 , 3 ,5,6) defective rivets are found.

•Find the method-of-moments estimate (λ_mom)̂ **(6)**

•What is (λ_MLE)̂, the maximum likelihood estimate of λ? **(7)**

•Compare (λ_mom)̂ with (λ_MLE)̂. **(2)**

Name:____________________

I.D.: ___________________

Exam Simulation (3)

(15/06/2020)

Note:

7. Make sure to write your name and I.D. Number
8. The exam consists of 2 problems
9. Exam time is 40 minutes (20 minutes for Mobility Engineerig)

Good Luck!

Problem 1. (20 minutes) [both courses Mobility Engineering and Reliability Engineering]
(**15 points**)
Consider a hot standby system. The main component passes through "safe" and "failed with a failure rate $\lambda=10^{-3}h^{-1}$, whereas the standby component fails with rate $\lambda_S=10^{-4}h^{-1}$.
Consider a repair rate $\mu=10^{-2}h^{-1}$ (only one repair worker) and compute the system steady-state availability based on the Markov quantification and the system MTTF.

- Draw the markov diagram **(4)**
- Define the Transition Matrix A **(3)**
- Compute the MTTF **(8)**

Problem 2. (20 minutes) [Only for Reliability, Risk and Safety]
(**15 points**)
A system consists of seven components. The logic of the system is indicated in the diagram of the Figure below. The components have an identical failure rate of $\lambda = 10^{-4}h^{-1}$

Questions:
2A) Find the minimal cut sets of the system (**6**)
2B) Calculate the reliability R(t) of the system for a mission time of 1000 hours (**9**)