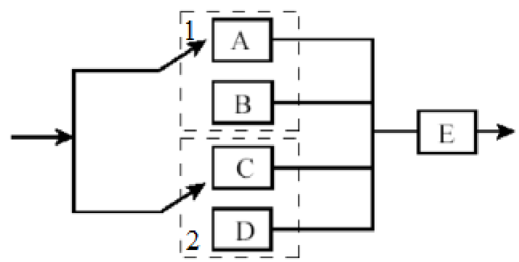
1. Lifetime of a car tyre is described as a random variable exponentially distributed ($[\lambda]$=1/10000km). In the car there is one spare tyre and it can be used for replacing any flat tyre. Quantify the probability that you can drive a distance T when the tyre failures are independent events and four working tyres are needed to drive a car.

2. (Modarres 3.23) Consider the system below. Two standby systems (A and B) and (C and D) are placed in parallel. The unit E is in series with the two standby subsystems. Assume time to failure of A, B, C, D and E are exponentially distributed and switching is perfectly reliable for the standby systems.

   (a) If $\lambda_A = \lambda_B = \lambda_C = \lambda_D = 10^{-3}$ per hour, determine the reliability of each standby subsystem (that is reliability (A and B) and reliability (C and D)) for 1000 hours.

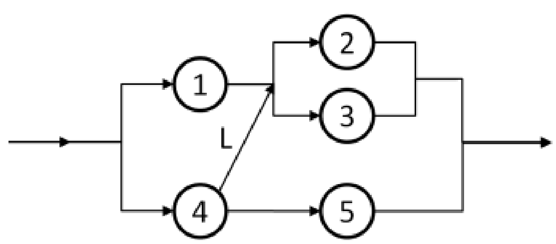
   (b) As a designer, if you are asked to select the unit E such that its contribution to the failure of the whole system is less than 10 % of the total system failure probability for a mission of $t = 1000$h, what should be the minimum acceptable failure rate for unit E?



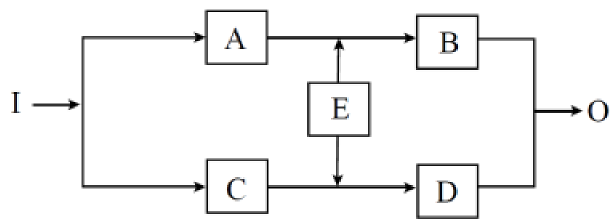
3. One possible metrics for reliability is Mean time to failure (MTTF). It can be defined by the system reliability function as follows:

$$\text{MTTF} = \int_0^\infty R(t)dt$$

   How much does the link L increase the system reliability in terms of MTTF for the following block diagram? Component failure times are exponentially distributed with parameter λ.



4. Define the mean availability of the system represented by the following block diagram.



All the components are identical: the failure frequency is $\lambda = 0.001$/h while $MTTR = 15$h. Mean availability is obtained by equation:

$$R = \frac{\text{MTTF}}{\text{MTTF+MTTR}}$$