Advance Computer Networks Part II Final Exam

Note: Please answer any 5 questions out of the 7 showed below.

1. (20%) Please answer the following questions regarding Poisson processes.
   a. Let $X(t)$ and $Y(t)$ be two independent Poisson processes. Let $W(t) = X(t) + Y(t)$. Show that $W(t)$ is a Poisson process.
   b. Suppose that each arrival in a Poisson process, independently, is of one of two types: Type 1 with probability p and Type 2 with probability $q = 1 - p$ (this is sometimes referred to as splitting a Poisson process). Show that Type 1 arrivals and Type 2 arrivals form separate and independent Poisson processes.
2. (20%) Please explain how to evenly decompose the given delay threshold T and the given overdue probability P considered in an end-to-end percentile-type delay requirement to k hops, so that when the allocated requirement to each hop is satisfied then the end-to-end delay requirement is guaranteed to be satisfied. Please propose as may methods as possible.
3. (20%) Consider a large institute, where the rate of outgoing calls is m calls per second and the call arrival process is assumed to be Poisson. Assume also that the call holding time can be characterized by an exponentially distributed random variable with mean t seconds. Please propose a method to calculate the minimum number of outgoing lines (channels) required, denoted by n, so that the call blocking probability (the probability that an outgoing call finds that all the outgoing lines are occupied) should be no greater than p%. What is the system utilization, defined as the average number of channels in use divided by n? After the system is in service, if at any time the call blocking probability exceeds p%, what measures can you take to correct this performance exception?
4. (20%) Give your own definition on “cloud computing”. In your opinion, what planning and capacity/performance management issues should be especially concerned in the contest of “cloud computing”?
5. (20%) Please explain how admission control and policing (flow enforcement) can be jointly applied in a high-speed network to assure QoS requirements.
6. (20%) Consider two concatenated links, of which the two delays, considered as random variables, are positively correlated. If the two variances of delay are added up to estimate the end-to-end delay variance, will overestimation or underestimation be resulted in? Please show your proof.

7. (20%) Consider a 3×3 grid network (in total 9 nodes and 12 undirected links). Please answer the following questions.
   a. Calculate the number of elementary paths (paths without cycles) from the upper left corner to the lower right corner.
   b. If for each link, the mutually independent reliability is 0.99, i.e. each link is of 99% probability to be up and running, please calculate the reliability from the upper left corner to the lower right corner, which is defined as the probability that there exists at least one available path to connect the upper left corner and the lower right corner.