EX2 – Sterilisation Centre

The two surgery blocks (S.B.) of the hospital "A.O. Curiamo Tutti" don't have a cleaning instruments zone. The surgery instruments kits are directly sent to the sterilization center, once used by different specialized departments.

To improve the service level offered to "A.O Curiamo Tutti", Eng. Smith is in charge of studying the sterilization system during the rush hours when all the 12 operating theatres of the hospital work simultaneously.

The specialized departments are as follows:

- Orthopedics
- General Surgery
- Gynecology
- Ophthalmology

The sterilization center is located on the same floor of S.B. At the sterilization center entrance, a nurse receives all the surgery instruments kits. She is in charge of recognizing and categorizing all the instruments kits, and of sending them to the right dedicated area.

In each area (in particular, there are 4 areas dedicated to the specialized departments: Orthopaedics, General Surgery, Gynaecology, and Ophthalmology) there are specialized nurses that are in charge of the cleaning phase. The instrument kits are allocated to each nurse according to the single queue configuration.

Once the cleaning phase ended, the instrument kits are sent to 2 specialized operators that are in charge of preparing the material before putting that onto the sterilizations machines. The two operators work in

parallel, according to the multiple queue configuration.

Eng. Smith collected the following data:

- During rush hours, two different types of surgery kits arrive, some classified as "*urgent*" and some others as "*not urgent*". The arrival rate of the urgent kit is 5 kits/hour, and they have pre-emptive priority on the non-urgent kits. In particular, non-urgent kits have an arrival rate of 10 kits/hour. The nurse can recognize and categorize one kit every 2 minutes. Only in this stage, there is a distinction between urgent kits and non-urgent kits; after this stage, they are characterized by the same priority.
- The 30% of the whole amount of kit in entrance go to the Orthopaedics cleaning area, the 20% of the whole amount of kit in entrance go to the General Surgery cleaning area, the 30% of the whole amount of kit in entrance go to the Gynaecology cleaning area, the 20% of the whole amount of kit in entrance go to the Ophthalmology cleaning area.
- The instrument kits that arrive at the Ophthalmology cleaning area are categorized as "*normal*"(40% on the total amount in the entrance at the Ophthalmology cleaning area) or "special" (60% on the total amount in the entrance at the Ophthalmology cleaning area). The special ones have a non-pre-emptive priority over the normal ones.

Another data, collected by Eng. Smith, is that 15% of the instruments kit cleaned in the Orthopaedics cleaning area, once cleaned in this area, are sent to the General Surgery cleaning area, where will be cleaned another time.

The service rate and the number of operators involved in the flow are depicted in the following table:

Operators	**Service time/operator**
Orthopedics (3 nurses)	2 kits every 30 minutes
General Surgery (2 nurses)	1 kit every 20 minutes
Gynecology (2 nurses)	1 kit every 12 minutes
Ophthalmology (1 nurse)	1 kit every 12 minutes
Categorization (1 nurse)	5 kits every 10 minutes
Preparing phase (2 Operators)	2 kits every 10 minutes

Service rates and arrival rates are distributed according to a negative exponential. Queues are managed with a FCFS rule.

You are required to:

a) Map the system in a detailed and precise way, putting all the important parameters.

b) Calculate the average time between an instruments kit entering the sterilization center, until it is ready to be put into the sterilization machines.

c) Identify which kind of improvements you would like to propose to improve the whole system. (examples: decreasing cost without increasing queues, reducing queues without increasing resources, etc.). You are required to motivate each proposed improvement.