SYSTEM PHYSICS EXERCISE

Exercise 1

The production system of WASHING Spa, a manufacturer of household appliances, has 3 production stations decoupled by stocks, whose main characteristics are highlighted in the table below:

	Station 1	Station 2	Station 3
Cycle time	22 sec	25 sec	24 sec
Set-up	10 min	5 min	5 min
Availability	80%	100%	90%

The daily demand is equal to 2000 units. The facility is open 220 days per year, three shifts per day of seven hours each. The quality control at the end of the line intercepts defective units, which are equal to 5% of the processed ones. Defective units are scrapped (discarded).

1. What is the daily production capacity of Washing Spa when producing a single product?
2. How much would the daily production capacity of Washing Spa be, in case the company decides to organize its production system in a coupled serial system configuration?
3. Now consider the multi product situation. Assuming that batch size is 60 and that every time a new batch is starting a set-up is necessary in all the phases, is the production serial system decoupled by stocks able to meet customer demand?
4. In case the company wanted to produce each day all 15 versions of the finished product of the range, organizing the system as a serial coupled system, how much should the maximum setup time be?

Exercise 2

MTCF Spa is a leader in the production of wrist watches.
The company has a daily demand of 3,000 watches. 100% quality control at the end of the line intercepts the 20% of the watches that are not compliant. In each stage there is one operator that is specialized and full-time dedicated.
The production process consists of three production stages, decoupled by a fair amount of stocks. The company works on two shifts per day, for 200 days a year. Each shift is 8 hours with two 15 min breaks. The daily demand of the customer is extremely constant in volume, and, if not satisfied, overtime production is required, because the company does not want to lose demand.
At the paint stage, the watch hands are painted. Each watch has two hands those are assembled on the dial, in the next production stage. The assembly and case closing stage puts together the painted hands and ensures sealing of the watchcase. At the band mounting stage, the operator puts together the watchcase and the band. The table below shows the quantitative data of the production process.

Process	Cycle Time (sec.)	Changeover (min.)	Uptime (%)
Painting of 1 hand	5	0	90%
Assembly and case closing	9	0	80%
Band mounting	10	0	85%

1) With the production parameters in the table, is the company able to avoid the use of overtime if a single product type is produced?
2) Assume now that the set-up time at the hands painting stage and at the case closing stage are not null.
   In particular, at the painting stage it is possible to paint the hands with 4 different colors. In each watch, the hands are same colored. The color change at this stage takes 15 minutes. At the case assembly and closing stage, each pair of watch-hands is mounted whit each of the 3 different cases. The set-up time at the case assembly and closing stage when switching from one case type to another one is 5 minutes. What is the minimum batch size to meet customer demand without using overtime?
3) In the case MTCF changes to a coupled serial production system, how would the answer to points 1?
4) If the customer allows 2 days for delivery. The daily demand of the customer is constant in volume. Every day all models are ordered (4 hands colors x 3 case types = 12 different product variants). The company delivers to the customer once a day, at the end of the day.
   With the coupled serial system configuration, is the company able to work on a Make-to-Order basis and deliver in two days to the customer the product type he had requested without overtime? (That is, has it enough flexibility to work on make to order with a delivery time of less than or equal to 2 days?). If not, how much overtime is necessary? Which are stage/stages involved?
5) Assuming that MTCF has a COUPLED production system, the same setup time and range explained in the question 2, but the availability of each stage is 90%. With this configuration is the overtime necessary to meet daily customer demand? What is the minimum batch size not to use overtime?