Reading Assignment

- The preamble and Sections 4.1 and 4.2 from Chapter 4 of your textbook. Section 4.2 corresponds to the material on preemptive non-destructive outages discussed in class.
- The slides on the G/G/m-based modeling of Asynchronous Transfer Lines and its applications that are posted at the course website (http://www2.isye.gatech.edu/~spyros/courses/IE4803/Fall-15/course_materials.html); this is item #2 in the “course materials” list in the above website.
- Your notes from the class lectures.
- Also, batching related issues are covered in your book in Chapter 7. The material that was presented in class on batching was not taken from this chapter, but it relates to the preamble and Sections 7.1, 7.1.1, 7.1.2, 7.3 and 7.3.1 of Chapter 7 (of course, it is also covered in the set of the posted slides mentioned above).

Problem set:

A. Solve problems 4.3, 4.4, 4.7 and 7.4 at the end of Chapters 4 and 7 of your textbook.

Remark:

For Problem 4.7, you have to develop a Markov-chain model that also accounts for the machine failures. The rest of the analysis is similar to the M/M/1/c model that have discussed earlier.

For Problem 7.4, instead of doing parts (c) and (d), try to find an optimized batch size that minimizes the expected total cycle time for a part going through the considered station.

B. Solve the following two problems:

1. Consider a G/G/1 station operated at 95% of its effective processing capacity. The station is fed with parts at a deterministically paced rate of one part per 10 minutes and the average waiting time experienced by a part before it enters the server is equal to 45 minutes. Use the above information in order to compute the part departure rate from this station and the coefficient of variation of the part inter-departure times.

2. Consider a production line consisting of two single-machine stations. The operational characteristics of these two stations are as follows:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Station 1</th>
<th>Station 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_s$</td>
<td>11min</td>
<td>11min</td>
</tr>
<tr>
<td>$c_s$</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>MTTF</td>
<td>7hrs</td>
<td>5hrs</td>
</tr>
<tr>
<td>MTTR</td>
<td>1.5hrs</td>
<td>0.5hrs</td>
</tr>
<tr>
<td>$c_r$</td>
<td>0.75</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Also, at each station, the (operational) time between two consecutive failures is exponentially distributed.
Answer the following questions:

i. Which station is the effective bottleneck of the line? Consider that the bottleneck is defined as the station that has the highest effective utilization.

ii. Can the line sustain a production rate of 35 parts over an eight-hour shift?

iii. Suppose that parts are released to the line in a deterministic manner, with constant inter-release times, and the resulting mean cycle time at Station 1, CT₁, is equal to 2 hours and 7.815 minutes. What is the length of the inter-release intervals?

iv. What is the average WIP waiting for processing at Station 1 under the assumptions of item (iii) above?

v. Provide estimates for the mean and the variance of the part inter-arrival times at Station 2, under the assumptions stated in item (iii) above.

C. **Extra Credit (15%)**

Read Sections 7.1.1, 7.1.2 and 7.1.3 of your textbook and solve Problem 7.1.