1. (8 points) Read the article “Broken links: The disruption to manufacturers worldwide from Japan’s disasters will force a rethink of how they manage production” The Economist. March, 2011. (http://www.economist.com/node/18486015). Answer briefly (a paragraph) the following questions:
   a. (2 points) Just-in-time (JIT) concept has spread down the global manufacturing to keep inventories down. Discuss the shortcomings that JIT global manufacturers experienced after disasters like Japan’s earthquake and tsunami or Iceland's volcano eruption.
   b. (2 points) In this article, JIT shortcomings are discussed in a natural disaster setting. Discuss other situations when similar shortcomings may arise.
   c. (4 points) Does this mean that JIT does not work or it is “too risky” to implement? What can be done to reduce the JIT associated risks (at least two recommendations)? Discuss the potential trade-offs of your recommendations.

2. (4 points) Recall the Penville game you played in the class.
   a. (1 point) Explain why there was more WIP inventory in the “push” system compared to the “pull” system where we used Kanbans.
   b. (1 point) In the “team” system there were only 3 players, but their overall production was close to that of the “pull” system which had 5 players. Explain why this is the case.
   c. (1 point) Which of the three systems you would expect to perform worse in terms of catching defects in the production line?
   d. (1 point) Suppose that the workers at the workstations need to take frequent (and sometimes long) breaks. Which of these systems would be affected more, in terms of the impact on the throughput?

3. (15 points) A manufacturing company needs to plan the order releases for component Z. Component Z’s gross requirements for weeks 2 to 6 are given in the table below. The component’s lead time is 1 week. The cost per order is $50 and the holding cost is $2/unit/period.

<table>
<thead>
<tr>
<th>Week</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>30</td>
</tr>
</tbody>
</table>

Compute the planned order releases using the given algorithm.

a. (4 points) Silver –Meal heuristic
b. (4 points) Least Unit Cost
c. (4 points) Part Period balancing
d. (3 points) Assume that the company can order up to 25 units of component Z per week due to space limitations. Can there be a feasible order release plan considering
this constraint? If so, give one feasible plan. Can you further improve this feasible plan to reduce the total setup and holding costs?

4. **(8 points)** The demands for an assembly for weeks 1-5 are: 40, 30, 25, 35, and 20. The setup cost is $100 and the holding cost is $4/unit/period. There can be at most one setup per week of this assembly. Assume there is enough capacity to produce any number of assemblies per week. Find the optimal production schedule and its cost (holding and setup costs). If there are more than one optimal schedule, state all of them. You can use either a shortest path or a dynamic programming approach.