

國立清華大學命題紙

98 學年度工業工程與工程管理學系 乙 組碩士班入學考試

科目 生產管理 科目代碼 1502 共 5 頁第 1 頁 \*請在【答案卷卡】內作答

1. (20%) Multiple choice questions:(單或多重選擇題，全答對該小題才給四分)
- (1) Which of the following strategies has the shortest delivery lead time and the least customer input? (a) engineer-to-order (b) make-to-order (c) assemble-to-order (d) configure-to-order (e) make-to-stock.
  - (2) Which are the major elements of the Lean Production? (a)Automation (b)Autonomation (c)JIT (d) pull system (e) Kaizen.
  - (3) What are the major inputs of MRP? (a) MPS (b) forecast data (c) BOM (d) inventory record (e) capacity.
  - (4) Which of the following are inputs to the production plan? (a) strategic business plan (b)financial plan (c) market plan (d) engineering plan (e) none of above.
  - (5) Which of the following statements are right? (a) an hour lost at a bottleneck is an hour lost for the total system; (b)time saved at a non-bottleneck is a mirage; (c) the capacity of a system depends on the capacity of the bottleneck; (d) capacity and priority should be considered simultaneously, not sequentially; (e) a buffer should be established after each bottleneck.

2. (20%)Tsing-Hua(TH) company was updating the MPS(Master Production Schedule) record for one of its products.

(a). Complete the following MPS time-phased record (on-hand = 20; MPS lot size = 50) and explain the meaning of data you put in ATP.(10%)

Week		1	2	3	4	5	6	7	8
Forecast		20	20	20	30	30	30	30	30
Orders		5	3	2					
Projected Available	20	50	30	10	30	50	20	40	10
MPS		50			50	50		50	
ATP(Available To Promise)									

(b).The following events occurred during week 1.

- (1) Actual demand during week 1 was 24 units.
- (2) Marketing forecasted that 40 units would be needed for week 9.
- (3) An order for 10 in week 2 was accepted.
- (4) An order for 20 in week 4 was accepted.
- (5) An order for 6 in week 3 was accepted.
- (6) An order for 10 in week 6 was accepted.
- (7) The MPS in week 1 was produced as planned.

Please update the record below after rolling through time.(10%)

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Week	2	3	4	5	6	7	8	9
Forecast								
Orders								
Projected Available								
MPS								
ATP(Available To Promise)								

3. (20%) The basic idea behind job scheduling is to develop a rule for arranging the queue in front of each workstation that will maintain due date integrity while keeping machine utilization high and manufacturing times low. Many rules have been proposed for doing this such as SPT, EDD, and least slack. Job information is given in the table, answer the following questions. (5 points each)

Job	Arrival time at workstation 1	Process time at workstation 1	Due date
1	0 min	25 min	90 min
2	0 min	12 min	85 min
3	0 min	5 min	10 min
4	10 min	2 min	25 min

- Assume we use SPT rule to schedule job 1, 2, and 3. What is the job sequence and what is the starting time of each job?
- We add job 4 to the pool. What is the job sequence and what is the starting time of each job if we use SPT rule?
- We add job 4 to the pool. What is the job sequence and what is the starting time of each job if we use EDD rule?
- We add job 4 to the pool. The slack for a job is its due date minus the remaining process time minus the current time. Under the least slack rule, the highest priority is the job with the lowest slack value. What is the job sequence and what is the starting time of each job if we use least slack rule?

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4. (20%) Consider the situation facing TH Appliance, a store that sell a particular model of plasma TV. Because space is limited and because manufacturer makes frequent deliveries of other appliances, TH finds it practical to order replacement TVs each time one is sold. In fact, it has a system that places purchase orders automatically whenever a sale is made. But because the manufacturer is relatively slow to fill replenishment orders, the store must carry some stock in order to meet customer demands promptly. To develop models we make the following assumptions:

- (1) Products can be analyzed individually.
- (2) Demands occur one at a time.
- (3) Unfilled demand is backordered.
- (4) Replenishment lead time are fixed and known.
- (5) Replenishments are ordered one at a time.

Here are the notations we use:

L	Replenishment lead time
X	Demand during replenishment lead time
P(x)	$P(X=x)$ , probability demand during replenishment lead time equals x
G(x)	$P(X \leq x)$ , probability demand during replenishment lead time is less than or equal to x
$\Theta$	$E[X]$ , mean demand during lead time
$\sigma$	Standard deviation of demand during lead time
H	Cost to carry one unit of inventory for one year
B	Cost to carry one unit of backorder for one year
r	Reorder points, which represents inventory level that triggers a replenishment order
R	Based stock level
S(R)	Fill rate as a function of R
B(R)	Average number of outstanding backorder as a function of R
I(R)	Average on-hand inventory level as a function of R

Answer the following questions: (5 points each)

(a) Choose the right answer and explain your choice. What is the based stock level?

- A.  $R = r + 1$
- B.  $R = r - 1$
- C.  $R = r - \Theta$
- D.  $R = r + \Theta$

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(b) Choose the right answer and explain your choice. What is the safety stock level ?

- A.  $R = r + 1$
- B.  $R = r - 1$
- C.  $R = r - \Theta$
- D.  $R = r + \Theta$

(c) Explain why  $S(R) = G(r)$

(d) What is  $I(R)$  in terms of the notations above?

5. (20%)The TH Garden sells garden tools to distributors and also directly to hardware stores and home improvement discount chains. The TH Garden's four most popular small garden tools are a trowel, a hoe, a rake, and a shovel. Each of these tools is made from durable steel and has a wooden handle. The TH Garden prides itself on its high quality tools.

The manufacturing process encompasses two stages. The first stage includes two operations – stamping out the metal tool heads and drilling screw holes in them. The completed tool heads then flow to the second stage. The second stage includes an assembly operation, in which the handles are attached to the tool heads, a finishing step, and finally packaging. The processing times per tool for each operation are provided in the following table:

Operations	Tool (Hours/Unit)				Total Hours Available Per Month
	Trowel	Hoe	Rake	Shovel	
Stamping	$a_{11}$	$a_{12}$	$a_{13}$	$a_{14}$	$A_1$
Drilling	$a_{21}$	$a_{22}$	$a_{23}$	$a_{24}$	$A_2$
Assembly	$a_{31}$	$a_{32}$	$a_{33}$	$a_{34}$	$A_3$
Finishing	$a_{41}$	$a_{42}$	$a_{43}$	$a_{44}$	$A_4$
Packaging	$a_{51}$	$a_{52}$	$a_{53}$	$a_{54}$	$A_5$

The steel the company uses is ordered from an iron and steel works in Japan. The company has B square feet of sheet steel available each month. The metal required for each tool and the monthly contracted production volume per tool are provided in the following table.

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	Sheet Metal (ft <sup>2</sup> )	Monthly Contracted Sales
Trowel	b <sub>1</sub>	D <sub>1</sub>
Hoe	b <sub>2</sub>	D <sub>2</sub>
Rake	b <sub>3</sub>	D <sub>3</sub>
Shovel	b <sub>4</sub>	D <sub>4</sub>

The reason the company has prospered are its ability to meet customer demand on time and its high quality. As a result, the TH Garden will produce on an overtime basis in order to meet its sales requirements, and it also has a longstanding arrangement with a local tool and die company to manufacture its tool heads. The TH Garden feels comfortable subcontracting the first stage operations, since it is easier to detect defects prior to assembly and finishing. For the same reason, the company will not subcontract for the entire tool, since defects would be particularly hard to detect after the tool is finished and packaged. However, the company does have E hours of overtime available each month for each operation in both stages. The regular production and overtime costs per tool for both stages are provided in the following table.

	Stage 1		Stage 2	
	Regular Cost	Overtime Cost	Regular Cost	Overtime Cost
Trowel	c <sub>11</sub>	c <sub>12</sub>	c <sub>13</sub>	c <sub>14</sub>
Hoe	c <sub>21</sub>	c <sub>22</sub>	c <sub>23</sub>	c <sub>24</sub>
Rake	c <sub>31</sub>	c <sub>32</sub>	c <sub>33</sub>	c <sub>34</sub>
Shovel	c <sub>41</sub>	c <sub>42</sub>	c <sub>43</sub>	c <sub>44</sub>

The cost of subcontracting in stage 1 adds 20% to the regular production cost.

The TH Garden wants to establish a production schedule for regular and overtime production in each stage and for the number of tool heads subcontracted, at minimum cost. Clearly define your decision variables and answer the following question.

- What is the total cost to produce Trowel? (5 points)
- What are the constraints for metal availability? (5 points)
- Write down the complete formulation including decision variables, objective function, and constraints. (10 points)