

National Technical Examinations May 2013

98-Ind-A4, Production Management

3 hours duration

**Notes:**

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit, with the answer paper, a clear statement of any assumptions made.
2. This is a Closed Book exam. Candidates may use one of two calculators, the Casio or Sharp approved models.
3. Five questions constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.
4. All questions are equally weighted.
5. Write your answers in point-form whenever possible.

**Marking Scheme**

	a.	b.	c.	d.	e.
1.	5	5	5	5	
2.	5	5	5	5	
3.	10	10			
4.	20				
5.	10	10			
6.	8	6	6		
7.	10	4	6		

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1. Briefly discuss the significance of the following ideas.
  - a. Little's law;
  - b. 5S;
  - c. Interchangeable parts;
  - d. TQM.
  
2. The MacBig fast-food Company stocks custom-printed wrappers that are used for their sandwiches. The wrappers are needed throughout the 52-week year; the stores never close. Assume that wrappers are used at a constant daily rate. All wrapper inventory is held at MacBig's head office, and shipped to each store as needed. The Operations Manager collected the following data.

Item	Wrapper
Number of MacBig stores to be supplied	500
Average daily demand (wrappers per store)	12000
Operating days (per week)	7
Holidays – stores are closed (per year)	0
Holding cost (cost/\$/year)	10%
Ordering cost	\$100
Number of items in a box	10000
Minimum order allowed	1 box
Cost of item (per box of 10000)	\$100

- a. Develop an inventory control system for the wrappers.
- b. An alternative is for each store to keep its own inventory. Calculate the cost of this alternative and indicate your recommended course of action.
- c. If you knew each store's individual demand, what would you do differently?
- d. If MacBig experiences head-office warehouse shrinkage of 5% per month, but 1% per month shrinkage at the stores, will the inventory decision be different? [Note: "shrinkage" is loss from theft, damage and misplacement of products.]

3. The following table shows the actual sales of iPad® tablets (both old and new models combined) for the last eight months at an electronics retailer.

Month	Sales
September	450
October	300
November	473
December	740
January	45
February	10
March	1023
April	800

- Develop a sales forecast for May. Justify your answer.
  - Discuss the forecast, and suggest ways in which the forecast can be improved.
4. A manufacturer produces a variety of office chairs. The manager is preparing an aggregate production plan for the next six months, and has the following information.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Forecast Demand	151	150	163	181	112	143	152	85	147	164	211	149

**Costs (per unit)**

Regular time	\$115
Overtime	\$163
Subcontract	\$204
Inventory (per month)	\$26
Back-order (per month)	\$103
Hiring cost (per worker)	\$1523
Firing cost (per worker)	\$2512

There are 7 workers, each making 36 chairs per month. The maximum production of chairs during overtime is 15 per month. Subcontracting can handle a maximum of 16 chairs per month. Assume that the beginning inventory is 143, the ending inventory is zero, and backorders are not allowed at month 12.

Write the **mathematical formulation** that can be solved to produce the minimum-cost aggregate plan for this case. *Note that only the model is required, not the solution.*

5. Some scholars claim that variability is the main cause of inefficiency in a production system.
  - a. Give an example of how variability can affect the cost of production, and suggest a way to reduce this variability.
  - b. Suggest a set of principles for reducing variability.
  
6. The following table shows the data for a construction project. Late completion has a \$5000/day penalty.

Activity	Precedes	Duration (days)
A	B, C, D	15
B	E	12
C	E, G	6
D	H	5
E	F	3
F	I	8
G	F, J	8
H	J	9
I	END	7
J	END	14

- a. Draw the project diagram and determine the critical path.
- b. Find the earliest and latest start time of each activity.
- c. Just as the project is about to begin, you are informed that activity D will now have 35 days duration, because of a strike at the subcontractor responsible for the activity. Determine the effect on the project's finish date, and discuss at least two different strategies you could use to complete the project as close to on-time as possible.

7. A small manufacturer of circuit boards must process a number of jobs through their facility. Three surface-mount machines with similar capabilities are available (Machines A, B and C). Each job is in a batch. An initial allocation of jobs to machines is given below. All times are in seconds. Your manager has asked that the jobs be complete within 4 hours, otherwise customers may be lost.
- Develop a schedule with a makespan as close to 4 hours as possible.
  - What is the average tardiness of your schedule?
  - Is it possible to reduce the makespan below 4 hours? If so, explain how you would attempt this. If not, explain why.

Job number	Batch size	SM:Machine:time		
		Machine A	Machine B	Machine C
B2401	72	3100		
B7982	126	4400		
B6183	45		6000	
B1184	110	3800		
B9455	240			3800
B4056	32		4300	
B1847	32		4300	
B6298	32		4300	
B9989	192			1800
B1910	64		1200	
B3311	64		1200	
B8212	32		2900	
B4813	64		1000	
B7214	64		1000	
Total time:		11300	26200	5600