National Technical Examinations May 2015
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.
1.	5	5	5	5
2.	5	5	5	5
3.	10	10		
4.	20			
5.	10	10		
6.	8	4	8	
7.	20			

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1. A number of innovators have changed the direction of production management in the last 250 years. **Briefly** discuss the significance of the following ideas.
   a. Little's law;
   b. 5S;
   c. Division of labour;
   d. TPM.

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)	3000
Operating days (per week)	7
Holidays – stores are closed (per year)	0
Holding cost (cost/$/year)	15%
Ordering cost	$100
Number of items in a box	10000
Minimum order allowed	1 box
Cost of item (per box of 10000)	$10

   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 18% per year, but 1% per year 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 a tablet computer (both old and new models combined) for a recent eight-month period at an electronics retailer. One of the data values is missing (the sales report was misplaced).

Month	Sales
February	450
March	300
May	740
June	1000
July	950
August	1000
September	800

   a. Develop a sales forecast for October. Justify your answer.
   b. 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 12 months, and has the following information.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Forecast Demand	150	150	160	180	100	140	150	80	140	160	200	150

Costs (per unit)

Regular time	$100
Overtime	$150
Subcontract	$200
Inventory (per month)	$20
Back-order (per month)	$25
Hiring cost (per worker)	$1000
Firing cost (per worker)	$2000

There are 7 workers, each making 12 chairs per month. The maximum production of chairs during overtime is 25 per month. Subcontracting can handle a maximum of 50 chairs per month. Assume that the beginning inventory is 100, the ending inventory is zero, and backorders are not allowed at month 12.

   a. If we would like to have no backorders or inventory at the end of month 5, prepare an aggregate plan for the first 5 months.

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, and briefly explain why they will work.

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 15 days duration, because of an accident investigation ongoing at the subcontractor responsible for the activity. Determine the effect on the project's finish date, and discuss strategies you could use to complete the project.

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 completed such that you minimize the lateness of the worst job.

   a. Create a mathematical programming model to schedule the jobs.

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