National Technical Examinations May 2009
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. Answer any five questions. 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.	2	2	2	2	2
2.	5	5			
3.	6	4			
4.	10				
5.	2	8			
6.	4	3	3		
7.	4	3	3		
8.	10				

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1. Briefly define and discuss the significance of the following ideas.
   a. Mass production
   b. Lean production
   c. Mass customization
   d. Interchangeable parts
   e. Division of labour

2. A produce distributor uses 1000 non-returnable wooden crates a month, which it purchases at a cost of $10 each. There is an annual holding cost of 25% of the price per crate. The ordering cost is $50 per order, and orders are currently placed once per month.
   a. Determine the optimal operating policy, and show why this policy is best.
   b. The company has the option of buying reusable plastic crates. These crates cost $25 each. Assume that all crates are shipped and returned within a month, with the exception of 5% broken or lost crates per month. Broken crates have no salvage value. If a crate is not lost or broken, assume that it has a life of 5 years. Considering only economic factors, and ignoring the time value of money, are reusable crates justified? Are there other factors to be considered?

3. The table below shows the actual demand for a particular brand of automobiles for the last 10 months.

Month	Demand
1	770
2	789
3	794
4	780
5	768
6	772
7	730
8	690
9	535
10	549

   a. Forecast the demand for month 11 by at least three different methods.
   b. Calculate performance metrics for your forecasting methods, and discuss which of the methods inspires the most confidence.

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**
Forecast Demand	150	150	160	180	110	140

Costs (per unit)

Regular time	$100
Overtime	$150
Subcontract	$200
Inventory (per month)	$25
Back-order (per month)	$100
Hiring cost (per worker)	$1500
Firing cost (per worker)	$2500

There are 7 workers, each making 35 chairs per month. The maximum production of chairs during overtime is 15 per month. Subcontracting can handle a maximum of 12 chairs per month. Assume that the beginning and ending inventories are zero, and backorders are not allowed at month 6.

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. A new, high-powered cordless drill is composed of three sub-assemblies: K, L and W. K is assembled using 3 Gs and 4 Hs; L is made of 2 Ms and 2 Ns; and W is made of 3 Zs. On-hand inventories are 40 Gs and 200 Hs. Scheduled receipts are 10 Ks at the start of week 3 and 30 Ks at the start of week 6. One hundred drills must be shipped at the start of week 6, and another 100 at the start of week 7. Manufacturing lead times average about two weeks for subassemblies, and purchasing lead times are one week for components. Final assembly of the drill requires one week for 150 units. There is a 10% scrap rate for Ks. The minimum order size for H is 200 units. Other than component H, use lot-for-lot ordering.
   a. Draw a product structure tree.
   b. Develop a material requirements plan for K, G and H.

6. In certain situations, CONWIP and Kanban control systems can have identical results.
   a. Give an example where CONWIP and Kanban will produce identical behavior in a manufacturing system.
   b. Describe the ideal environment for implementing a Kanban system.
   c. Describe the ideal environment for implementing a CONWIP system.

7. The following table shows the data for a small construction project. Timely completion is very important.

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

   a. Draw the project diagram and determine the list of activities which should be monitored most closely to maintain timely completion.
   b. Calculate the slack on each activity.
   c. Just as the project is about to begin, you are informed that activity B will now have 25 days duration, because of equipment failure at the subcontractor responsible for the activity. Discuss at least two different strategies you could use to complete the project as close to on-time as possible.

8. A small manufacturer of circuit boards must process a number of jobs through their facility. Three surface-mount machines with similar capability are available (Machines A, B and C). Each job is in a batch, but the batches cannot be split between machines. An initial allocation of jobs to machines is given below. All times are in seconds. The jobs must be complete in 4 hours.

   Develop a schedule with a makespan of around 4 hours. What are the makespan and tardiness of your schedule?

		SM Machine time		
Job number	Batch size	Machine A	Machine B	Machine C
B2401	72	3,134		
B7982	126	4,410		
B6188	45		6,030	
B1186	110	3,850		
B9450	240			3,840
B4053	32		4,288	
B1848	32		4,288	
B6294	32		4,288	
B9981	192			1,792
B1969	64		1,197	
B3317	64		1,197	
B8202	32		2,944	
B4888	64		1,024	
B7298	64		1,024	
	Total time:	11,394	26,280	5,632