

**National Technical Examinations Dec 2014
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. | 20 | | | | |
| 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. A number of innovators have changed the direction of production management in the last 250 years. For any three of the following, discuss the significance of a new idea introduced or popularized by that person.
 - i. Tatiici Ohno
 - ii. Henry Ford
 - iii. Joseph Juran
 - iv. Eli Whitney
 - v. John Little

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 | 600 |
| 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 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 a recent eight-month period at an electronics retailer.

| Month | Sales |
|-----------|-------|
| February | 450 |
| March | 300 |
| April | 400 |
| May | 740 |
| June | 500 |
| July | 100 |
| August | 1000 |
| September | 800 |

- Develop a sales forecast for October. 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 96 months, and has the following information.

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

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 24 chairs per month. The maximum production of chairs during overtime is 16 per month. Subcontracting can handle a maximum of 8 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.
- Give an example of how variability can affect the cost of production, and suggest a way to reduce this variability.
 - 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 |

- Draw the project diagram and determine the critical path.
- Find the earliest and latest start time of each activity.
- 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 3.5 hours, otherwise customers may be lost.
- Develop a schedule for the jobs.
 - If you cannot complete the jobs within 3.5 hours, explain how you would choose which jobs to complete late.
 - 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 |