National Exams May 2010

07-Mec-B4, Integrated Manufacturing Systems

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 an OPEN BOOK EXAM.
   Any non-communicating calculator is permitted.
3. Any five questions constitute a complete paper. Only the first five (5) questions as they appear in your answer book will be marked.
4. Each question is of equal value.
5. Some questions require an answer in essay format. Clarity and organization of the answer are important.

1. Develop an inventory control system for a new product just starting production when the following information is given:

   a) Production economic lot size is 1000 units.

   b) Production rate (supplied daily to inventory) is 50 units per day.

   c) Usage rate is 20 units per day.

   d) Production start-up takes 10±5 days after an order is placed.

   e) Annual cost of storing 1 unit is $5.00.

   f) Production cost of product is $15.00.

   g) 240 production and sales days per year.

2. a) Previous experience shows that the mean time between failures of a radar set is 240 hours. Assuming a constant failure rate, what is the chance of running the set for 24 hours without failure?

   b) The following reliability requirements have been set on the subsystems of a communication system:

Subsystem	Reliability (for a 4-hour Period)
Receiver	0.970
Control System	0.989
Power Supply	0.995
Antenna	0.996

What is the expected reliability of the overall system if the above requirements are met?

3. a) Discuss a manufacturing situation in which centralized inspection would be particularly desirable.

   b) In what ways may the use of data processing equipment and computers be of value in the quality control program?

   c) In what way can statistical quality control aid in promoting the understanding and appreciation of quality control?

4. a) Discuss in greater detail why the volume to be produced has little effect on the design and operation of a system of production planning and control.

   b) Assume you are organizing a small plant for the manufacture of flashlights. How many of the different types of orders would you use? Explain your use of each type.

   c) Compare the advantages of centralized dispatching with those of decentralized dispatching.

5. a) Given a nonlinear price function of

$$P = 21{,}000n^{-1/2} \text{ dollars per unit}$$

where $V = \$1000$ per unit and $FC = \$100{,}000$ per period, determine:

(a) The breakeven point.
(b) The production level for maximum profit.

b) Operating expenses and revenue for a manufacturing plant are closely approximated by the following relationships:

$$R = 100n - 0.001n^2$$

$$TC = 0.005n^2 + 4n + 200{,}000 \quad \text{(both in dollars)}$$

(a) What is the output for maximum profit?
(b) What is the output at the breakeven point?
(c) What is the output for minimum average cost?

6. a) Control charts are maintained on the weight of an item. After a base period of 30 samples of size 3, $\Sigma \overline{X} = 12930$ g and $\Sigma R = 123$ g.

i) Compute the control limits and estimate the standard deviation of the item weights. (Assume that base period observations indicate the process to be in control.)

ii) If the process average of the weights shifts to 433 g, how long will it take to detect the shift using the control limits in part (a)?

b) Production is started to produce a newly designed component. To monitor the length, $\overline{X}$ and R charts are started based on 25 subgroups of four items each. For these 25 subgroups, $\Sigma \overline{X} = 500$ cm and $\Sigma R = 153.2$ cm. Determine the 3σ control limits. What is the probability that a shift of 2 cm in the process average would be detected on the first subgroup observed after the shift?