National Exams May 2013

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.

Question 1:

a) What common components of demand do we wish to take into account in a forecasting system for operations?

b) What is the general structure of adaptive forecasting systems?

c) How is economic forecasting different from regression analysis?

Question 2:

Job orders are received at a work center with the characteristics indicated by the data in Table 2. In what sequence should the orders be processed at the work center if the priority dispatch decision rule is:

a. FCFS (first come-first served)?

b. SOT (shortest operation time)?

c. SS (static slack, i.e., due date less time of arrival at work center)?

d. FISFS (due date system, first in system-first served)?

e. SS/RO (static slack/remaining number of operations)?

Compute priorities for each rule and list the sequence in which orders would be processed. Which decision rule do you prefer? Why?

Table 2 Order and Processing Data for Six Jobs

Order Number	Due Date	Date and Time Received at Center	Operation Time, Hours	Remaining Operations
1	May 1	Apr. 18, 9 a.m.	6	3
2	Apr. 20	Apr. 21, 10 a.m.	3	1
3	June 1	Apr. 19, 5 p.m.	7	2
4	June 15	Apr. 21, 3 p.m.	9	4
5	May 15	Apr. 20, 5 p.m.	4	5
6	May 20	Apr. 21, 5 p.m.	8	7

Question 3:

a) What are the categories of forecasting techniques? Generally, how do they differ from each other?

b) Monthly demand (in thousands) for component parts is as follows:

First Year		Second Year	
Month	**Demand**	**Month**	**Demand**
1	10	1	12
2	8	2	11
3	7	3	11
4	4	4	8
5	5	5	10
6	9	6	17
7	12	7	22
8	19	8	27
9	25	9	32
10	29	10	33
11	19	11	21
12	15	12	19

a. Plot these observations.
b. Estimate the best methods of forecasting future demands.

Question 4:

The transportation and processing costs for the three final candidate locations for a manufacturing plan are roughly equal. The critical qualitative factors have received the following weights and evaluation scores on a 5-point scale (5 = excellent) from the site selection committee. Select the best site on the basis of the weighted scores.

Factor	Weight	Location		
		A	B	C
Labor supply	0.20	5	4	4
Labor relations	0.30	3	4	5
Supporting services	0.25	5	3	3
Waste disposal	0.15	4	4	4
Community attitude	0.10	5	4	3

Question 5:

An electronics firm has just won a contract to manufacture two products (A and B) for the government. The firm has three departments – design, manufacture, and test. The design department has finished its work, and now it is up to manufacturing to actually start production.

The contract stipulates that 1,000 A's and 2,000 B's must be made over the next 30 working days. It is management's objective to produce the product on straight time (i.e., an eight-hour work day). Other data about the case are as follows:

Standard time per unit A	20 hours
Standard time per unit B	5 hours
Set-up time per unit A	3 hours
Set-up time per unit B	2 hours
Number of batches	1 for A and 1 for B
Standard set-up time per batch A	16 hours
Standard set-up time per batch B	10 hours
Organizational efficiency including operator productivity	80%

a) How many workers are required to complete the project on time?

b) Halfway through the project, the government asks if you can add another 300 A's to the contract. Assume that you can react instantaneously by pulling workers off other projects. (This will entail a separate batch of A.) For this remaining 15 days, how many additional workers are required?

Question 6:

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

- 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.)
- 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, X and R charts are started based on 25 subgroups of four items each. For these 25 subgroups, $\Sigma X = 500$ 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?