

## National Exams May 2012

### 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.
  - a) What are the three basic controllable variables of a production planning problem? What are the four major costs?
  - b) Distinguish between pure and mixed strategies in production planning.
  - c) How does Search Decision Rule method work?
  - d) What are the general conditions for which preventive maintenance is appropriate?
  
2.
  - a) What benefits may result from planning a system for materials handling?
  - b) Should materials handling labour cost be a direct cost or an indirect one? Give reasons.
  - c) List the reasons for considering plant layout at the same time materials handling requirements are determined.
  - d) To what extent does low material handling cost depend upon efficient materials handling systems?

3. Construct the  $\bar{X}$  and R charts for the following data.

Measurement	Time	9 am	1 pm	9 am	11 am	2 am	9 am	3 pm	7 am	9 pm	10 pm
	Sample	1	2	3	4	5	6	7	8	9	10
1		10.0	10.01	10.01	10.01	10.02	10.01	10.01	10.01	10.0	10.02
2		9.99	10.04	10.0	10.02	10.04	9.99	10.01	10.03	10.01	9.98
3		10.0	10.0	9.99	10.03	10.0	10.0	10.0	10.05	10.01	10.0
4		9.97	10.02	10.02	10.01	10.02	10.01	10.01	10.02	9.99	10.02
5		10.01	10.01	10.01	10.01	10.03	10.01	10.03	10.01	10.01	10.01

Note: Factors for computing control line charts are:

Number of observations in sample, n	Chart for averages			Chart for standard deviations							Chart for ranges						
	Factors for control limits			Factors for central line		Factors for control limits				Factors for central line		Factors for control limits					
	A	A <sub>1</sub>	A <sub>2</sub>	c <sub>s</sub>	1/c <sub>s</sub>	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>	d <sub>1</sub>	1/d <sub>1</sub>	d <sub>2</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	
2	2.121	3.760	1.880	0.5642	1.7725	0	1.843	0	3.267	1.128	0.8865	0.853	0	3.686	0	3.267	
3	1.732	2.394	1.023	0.7236	1.3820	0	1.858	0	2.568	1.693	0.5907	0.888	0	4.858	0	2.575	
4	1.500	1.880	0.729	0.7979	1.2533	0	1.808	0	2.266	2.059	0.4857	0.880	0	4.698	0	2.262	
5	1.342	1.696	0.577	0.8407	1.1894	0	1.756	0	2.089	2.326	0.4299	0.864	0	4.918	0	2.115	
6	1.225	1.410	0.483	0.8686	1.1512	0.026	1.711	0.030	1.970	2.534	0.3946	0.848	0	5.078	0	2.004	
7	1.134	1.277	0.419	0.8882	1.1259	0.106	1.672	0.118	1.882	2.704	0.3698	0.833	0.205	5.203	0.076	1.924	
8	1.061	1.175	0.373	0.9027	1.1078	0.167	1.638	0.185	1.815	2.847	0.3512	0.820	0.387	5.367	0.136	1.864	
9	1.000	1.094	0.337	0.9189	1.0942	0.219	1.609	0.239	1.761	2.970	0.3367	0.808	0.546	5.594	0.184	1.816	

4. One ball bearing was measured by one inspector 13 times with each of two vernier micrometers. The results are shown below:

<i>Measurement Number</i>	<i>Model A</i>	<i>Model B</i>
1	0.6557	0.6559
2	0.6556	0.6559
3	0.6556	0.6559
4	0.6555	0.6559
5	0.6556	0.6559
6	0.6557	0.6559
7	0.6556	0.6559
8	0.6558	0.6559
9	0.6557	0.6559
10	0.6557	0.6559
11	0.6556	0.6559
12	0.6557	0.6560
13	0.6557	0.6560

Suppose the true diameter is 0.65600. Calculate measures of accuracy and precision for each micrometer. What restrictions must be placed on the applicability of the numbers you determined?

5. The Green Manufacturing Company has leased facilities to manufacture a new product. The following data have been formulated from cost and market studies:

Estimated annual sales	24,000 units
Estimated costs:	
Materials	\$96,000.
Direct labor	14,400.
Overhead	24,000.
Administrative expenses	28,000.

Selling expenses are expected to be 15% of sales. The required profit is \$1.02 per unit.

- What should the selling price be per unit?
- What is the breakeven point in dollars and units if overhead and administrative expenses are fixed but other costs are variable?

6. A manufacturing concern has four departments, and the flow between combinations of departments is as follows:

From	To			
	A	B	C	D
A		2		2
B	2		4	
C		3		1
D	2		1	

- a) Using the operation sequence analysis technique, how should the departments be arranged?
- b) Now suppose that the area requirements are as follows:  
 Department A – 3600 sq. ft.  
 Department B – 2400 sq. ft.  
 Department C – 2400 sq. ft.  
 Department D – 1600 sq. ft.  
 Sketch the block diagram based on your answer in part a.
- c) Now assume that the four departments are located in two separate buildings that are 100 feet apart. The two buildings have floor areas of  $60 \times 100 = 6000$  square feet, housing departments A and C, and  $40 \times 100 = 4000$  square feet, housing departments B and D, respectively. What should be the space allocation to the four departments if the material handling costs are as follows:

From	To			
	A	B	C	D
A		1	1	2
B	1		1	2
C	1	1		2
D	2	2	2	