National Exams December 2011

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. Consider a robot cell with machines B, C, and D. An input conveyor brings the part to the pick up point A and the output conveyor is represented by point E. Each part undergoes an operation on B, followed by C, and followed by D. The operation times on B, C, D are given by 9.1, 9.0, and 5.0 min., respectively. Also, the gripper pull-up time = 0.1 min, and gripper release time = 0.1 min. The robot move times in minutes are given by the table below. Compute the cycle time and the production rate for this system.

	To				
From	A	B	C	D	E
A	-	0.3	0.6	0.9	1.2
B	0.3	-	0.3	0.6	0.9
C	0.6	0.3	-	0.3	0.6
D	0.9	0.6	0.3	-	0.3
E	1.2	0.9	0.6	0.3	-

How will the cycle time and production rate change if there are two robots, with robot 1 handling all operations from A to C and robot 2 handling all operations from C to E?

2. a) A firm expects to decrease manufacturing costs from \$12.50 to \$11.80 per unit. If fixed costs are \$15,000 and the price of the item is \$20.00, what is the current break-even point? What would be the new break-even point? If the firm desires to maintain the same break-even point, what is the new selling price?

b) SRA Inc. currently has annual profits of \$150,000 on sales volume of \$1,000,000 and a fixed cost of \$250,000. They are considering purchasing a new system that would provide faster delivery. The equipment reduces variable cost of 20 percent but increases fixed cost by 10 percent. If sales volume is constant, by how much do profits change? If sales increase by 5 percent in the first year due to the more rapid deliveries, what would profits be?

3. 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.

4. The requirements for a motor drive unit to be assembled into a dictating machine follow the assembly schedule for the completed unit. The assembly schedule requires motor drive units with the timing shown in Table 1. Other data for the motor drive unit are: average requirements are $\bar{R} = 116.7$ units per week, c_p = $400 per lot, and c_H = $4 per unit per week. What is the inventory record and total incremental cost under each of the following lot size policies?

   a) Economic lot size
   b) Economic periodic reorder model
   c) Part-period total cost balancing

TABLE 1
Requirements Schedule for a Motor Drive Unit

Week number	1	2	3	4	5	6	7	8	9	10	11	12
Requirements, units	25	30	75	125	200	325	400	100	0	100	0	100

Total requirements for 12 weeks, 1390 units.

5. A time study was made of an existing job to develop new time standards. A worker was observed for a period of 45 minutes. During that period, 30 units were produced. The analyst rated the worker as performing at a 90 percent performance rate. Allowances in the firm for rest and personal time are 12 percent.
   a. What is the normal time for the task?
   b. What is the standard time for the task?
   c. If the worker produced 300 units in an eight-hour day, what would his/her day's pay be if the basic rate was $6.00 per hour and the premium payment system paid on a 100 percent basis?

6. a) What are some of the objectives of materials handling?

   b) What should an effective inventory control system accomplish? What vital areas should be considered in developing a comprehensive control system?

   c) List some factors which influence the selection of a forecasting model.

Factors for Computing Control Chart Line

Table of the Factors for Computing Control Chart Lines

Number of	*Chart for Averages*			*Chart for Standard Deviations*						*Chart for Ranges*						
Observations in	*Factors for Control Limits*			*Factors for Central Line*		*Factors for Control Limits*				*Factors for Central Line*		*Factors for Control Limits*				
Sample, n	A	A_1	A_2	c_2	$1/c_2$	B_1	B_2	B_3	B_4	d_2	$1/d_2$	d_3	D_1	D_2	D_3	D_4
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	4.358	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	2.282
5	1.342	1.596	0.577	0.8407	1.1894	0	1.756	0	2.059	2.326	0.4299	0.864	0	4.918	0	2.115
6	1.225	1.410	0.483	0.5686	1.1512	0.026	1.711	0.030	1.970	2.534	0.3945	0.848	0	5.078	0	2.004
7	1.134	1.277	0.419	0.8882	1.1259	0.105	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	0.829	0.387	5.307	0.136	1.864
9	1.000	1.094	0.337	0.9139	1.0942	0.219	1.609	0.239	1.761	2.970	0.3367	0.803	0.546	5.394	0.184	1.816
10	0.949	1.028	0.308	0.9227	1.0837	0.262	1.584	0.284	1.716	3.078	0.3249	0.797	0.687	5.469	0.223	1.777
11	0.905	0.973	0.285	0.9300	1.0753	0.299	1.561	0.321	1.679	3.173	0.3152	0.787	0.812	5.534	0.258	1.744
12	0.865	0.925	0.266	0.9359	1.0684	0.331	1.541	0.354	1.646	3.258	0.3069	0.778	0.924	5.592	0.284	1.716
13	0.832	0.884	0.249	0.9410	1.0627	0.359	1.523	0.382	1.618	3.336	0.2993	0.770	1.026	5.646	0.308	1.692
14	0.802	0.848	0.235	0.9153	1.0579	0.384	1.507	0.405	1.594	3.407	0.2935	0.762	1.121	5.693	0.329	1.671
15	0.775	0.816	0.223	0.9400	1.0537	0.406	1.492	0.428	1.572	3.472	0.2880	0.755	1.207	5.737	0.348	1.652
16	0.750	0.788	0.212	0.9523	1.0501	0.427	1.478	0.448	1.552	3.532	0.2831	0.749	1.285	5.779	0.364	1.636
17	0.728	0.762	0.203	0.9551	1.0170	0.445	1.465	0.466	1.534	3.588	0.2787	0.743	1.359	5.817	0.379	1.621
18	0.707	0.735	0.194	0.9576	1.0442	0.461	1.454	0.482	1.518	3.640	0.2747	0.739	1.426	5.854	0.392	1.608
19	0.688	0.717	0.187	0.9599	1.0413	0.477	1.443	0.497	1.503	3.689	0.2711	0.733	1.490	5.888	0.404	1.596
20	0.671	0.697	0.180	0.9619	1.0396	0.491	1.433	0.510	1.490	3.735	0.2677	0.723	1.548	5.922	0.414	1.586
21	0.655	0.679	0.173	0.9638	1.0376	0.504	1.424	0.523	1.477	3.778	0.2647	0.724	1.606	5.950	0.425	1.576
22	0.640	0.662	0.167	0.9655	1.0358	0.516	1.415	0.534	1.406	3.819	0.2618	0.720	1.659	5.979	0.434	1.566
23	0.626	0.647	0.162	0.9670	1.0342	0.527	1.407	0.545	1.455	3.858	0.2582	0.716	1.710	6.006	0.443	1.557
24	0.612	0.632	0.157	0.9684	1.0327	0.638	1.399	0/555	1.445	3.895	0.2567	0.712	1.759	6.031	0.452	1.548
25	0.600	0.619	0.153	0.9696	1.0313	0.548	1.392	0.565	1.436	3.931	0.2544	0.709	1.804	6.058	0.459	1.541
	3	3				*	†	*	†							
Over 25		$\sqrt{n}$	$\sqrt{n}$													

*$1-\frac{3}{\sqrt{2n}}$ †$1+\frac{3}{\sqrt{2n}}$