UNIVERSITY OF SWAZILAND

FACULTY OF COMMERCE

DEPARTMENT OF BUSINESS ADMINISTRATION

FINAL EXAMINATION PAPER

MAY 2007
(FULL TIME / IDE STUDENTS).

TITLE PAPER : **PRODUCTION/OPERATIONS MANAGEMENT**

COURSE TITLE : **BA 513**

TIME ALLOWED : **THREE (3) HOURS**

INSTRUCTIONS :

(1) **TOTAL NUMBER OF QUESTIONS IN THIS PAPER IS SIX (6)**

(2) **THE PAPER CONSISTS OF SECTION A AND SECTION B.**

(3) **ANSWER ANY TWO (2) QUESTIONS FROM EACH SECTION.**

(4) **THE MARKS AWARDED FOR A QUESTION /PART OF A QUESTION ARE INDICATED AT THE END OF EACH QUESTION / PART OF QUESTION.**

(5) **WHERE APPLICABLE, ALL WORKINGS / CALCULATIONS MUST BE CLEARLY SHOWN.**

NOTE: MAXIMUM MARKS WILL BE AWARDED FOR GOOD QUALITY LAYOUT, ACCURACY, AND PRESENTATION OF WORK.

THIS PAPER MUST NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR.

GOOD LUCK!!!

SECTION A (ANSWER ANY TWO QUESTIONS).

Q1. A company uses a particular chemical for its products. The chemical is being stored in special refrigerated units which are provided by the supplier at a nominal rental of E40 per month. The demand for the chemical is reasonably constant from month to month and averages about 1000 litres per month. The company currently rents one storage unit which has a capacity of 1000 litres, so that replenishment takes place every month when stock falls to zero. The process of stock replenishment involves cleaning and sterilizing the unit each time at a cost of E50.
As a result of an expansion of the company's product range, the demand for this chemical is expected to increase to 2500 litres per month and the company Operation Manager has been asked to recommend an appropriate purchasing and storage policy. Additional storage units could be obtained but this would involve a further rental cost of E40 per month for each additional unit. However, there would be some economies in the cleaning and sterilizing costs as these would only increase by E25 for each additional unit involved.

Required:
(a). Show that the present policy of ordering 1000 litres every month is the most economical ordering policy in the current demand situation with just one storage unit. What is the total annual cost associated with the storing of this chemical? (7marks).

(b). Given the projected increase in demand, advise the company on whether an additional storage unit should be rented if the objective is to minimize the storage costs involved. (9marks).

(c). Show that demand has to increase to 7200 litres per month before it becomes economical to rent a second storage unit. (9marks).

Q2. (a) A manager must decide which type of machine to buy, A, B, and C. Machine costs are:

Machine A costs E40,000.
Machine B costs E30,000.
Machine C costs E80,000.

Product forecasts and processing times on the machines are as follows

Product	*Annual Demand*	*Processing time per unit (minutes)* A	B	C
1	16,000	3	4	2
2	12,000	4	4	3
3	6,000	5	6	4
4	30,000	2	2	1

(i). Assume that only purchasing costs are being considered. Which machine would have the lowest total cost, and how many of that machine would be needed? Machines operate 10 hours a day, 250 days a year. (7marks).

(ii). Consider this additional information: The machines differ in terms of hourly operating costs. Machines **A** have an hourly operating cost of E10 each, **B** machines have an hourly operating cost of E11 each, **C** machines have an hourly operating cost of E12 each. Which alternative would be selected, and how many machines, in order to minimize total cost while satisfying capacity processing requirements? (6marks).

(b). A company manufactures a product using two machine cells. Each cell has a design capacity of 250 units per day and an effective capacity of 230 units per day. At present, actual output averages 200 units per cell, but the manager estimates that productivity improvements soon will increase output to 225 units per day. Annual demand is currently 50,000 units. It is forecasted that within two years, annual demand will triple. How many cells should the company plan to produce to satisfy predicted demand under these conditions? Assume 240 workdays per year. (4marks).

(c). In a job shop, effective capacity is only 50% of design capacity, and the actual output is 80% of effective output. What design capacity would be needed to achieve an output of eight (8) jobs per week? (8marks).

Q3. End item P is composed of three subassemblies: *K, L,* and *W. K* is assembled using 3 Gs and 4 Hs; *L* is made of 2 Ms and 2 Ns; and *W* is made of 3 Zs. On-hand inventories are 20 Ls, 40 Gs, and 200 Hs. Scheduled receipts are 10 Ks at the start of week 3, 30 Ks at the start of week 6, and 200 Ws at the start of week 3.
100 Ps will be shipped at the start of week 6, and another 100 at the start of week 7. Lead times are two weeks for subassemblies and one week for components G, H, and M. Final assembly of P requires one week. Consider an extra 10% scrap allowance in each planned order of G. The minimum order size for H is 200 units. Develop each of the following:

(a). A product structure tree. (5marks).

(b). A master schedule for ***P***. (2marks).

(c). A material requirements plan for ***K, G,*** and ***H*** using lot-for-lot ordering. (18marks).

SECTION B (ANSWER ANY TWO QUESTIONS).

Q4. A production line has three machines A, B, and C, with reliabilities of 99%, 96%, and 93% respectively. The machines are arranged so that if one breaks down, the others must shut down. Engineers are weighting two alternative designs for increasing the line's reliability. Plan 1 involves adding an identical backup line, and plan 2 involves providing a backup for each machine. In either case, three machines (A, B, and C) would be used with reliabilities equal to the original three.

(a). Which plan will provide the higher reliability? (8marks).

(b). Assume that the single switch used in plan 1 is 98% reliable, while reliabilities of the machines remain the same. Recalculate the reliability of plan 1. Compare the reliability of this plan with the reliability of the plan 1 calculated in solving the original problem. How much did reliability of plan 1 decrease as a result of a 98% reliable switch? (9marks).

(c). Assume that the three switches used in plan 2 are all 98% reliable, while reliabilities of the machines remain the same. Recalculate the reliability of plan 2. Compare the reliability of this plan with the reliability of the plan 2 calculated in solving the original problem. How much did reliability of plan 2 decrease? (9marks).

Q5 (a). A production process consists of a three-step operation. The scrap rate is 10% for the first step and 6% for the other two steps.

(i). If the desired daily output is 450 units, how many units must be started to allow for loss due to scap? (5marks).

(ii). If the scrap rate for each step could be cut in half, how many units would this save in terms of the scrap allowance? (5marks).

(iii). If the scrap represents a cost of E10 per unit, how much is it costing the company per day for the original scrap rate? (5marks).

(b). An appliance manufacturer wants to contract with a repair shop to handle authorized repairs in Matsapha. The company has set an acceptance range of repair time of 50 minutes to 90 minutes. Two firms have submitted bids for the work. In test trials, one firm has a mean repair time of 74 minutes with a standard deviation of 4.0 minutes and the other firm has a mean repair time of 72 minutes with a standard deviation of 5.1 minutes. Which firm would you choose? Why? (10marks).

Q6 (a). A worker-machine operation was found to involve 3.3 minutes of machine time per cycle in the course of 40 cycles of stopwatch study. The worker's time averaged 1.9 minutes per cycle, and the worker was given a rating of 120% (machine rating is 100%). Midway through the study, the worker took a 10-minute rest break. Assuming an allowance factor of 12% of work time, determine the standard time for this job. (4marks).

(b). The labour cost to produce a certain item is E8.50 per hour. Job setup costs E50 and material costs are E20 per unit. The item can be purchased for E88.50 per unit. The learning rate is 90%. Overhead is charged at a rate of 50% of labour, materials, and setup costs.

(i). Determine the unit cost for 20 units, given that the first unit took 5 hours to complete. (7marks).

(ii). What is the minimum production quantity necessary to make production cost less than purchase cost? (7marks).

(c). Estimate the number of repetitions each of the workers listed in the following table will require to reach a time of 7 hours per unit. Time is in hours.

Trainee	T_1	T_2
Khumalo	11.0	9.9
Gamedze	10.5	8.4
Vilane	12.0	10.2

(7marks).

λ/μ	M	L_q	P_0	λ/μ	M	L_q	P_0	λ/μ	M	L_q	P_0
3.8	5	1.519	.017	4.6	5	9.289	.004	5.3	8	0.422	.005
	6	0.412	.021		6	1.487	.008		9	0.155	.005
	7	0.129	.022		7	0.453	.009		10	0.057	.005
	8	0.041	.022		8	0.156	.010		11	0.021	.005
	9	0.013	.022		9	0.054	.010		12	0.007	.005
3.9	4	36.859	.002		10	0.018	.010	5.4	6	6.661	.002
	5	1.830	.015	4.7	5	13.382	.003		7	1.444	.004
	6	0.485	.019		6	1.752	.007		8	0.483	.004
	7	0.153	.020		7	0.525	.008		9	0.178	.004
	8	0.050	.020		8	0.181	.008		10	0.066	.004
	9	0.016	.020		9	0.064	.009		11	0.024	.005
4.0	5	2.216	.013		10	0.022	.009		12	0.009	.005
	6	0.570	.017	4.8	5	21.641	.002	5.5	6	8.590	.002
	7	0.180	.018		6	2.071	.006		7	1.674	.003
	8	0.059	.018		7	0.607	.008		8	0.553	.004
	9	0.019	.018		8	0.209	.008		9	0.204	.004
4.1	5	2.703	.011		9	0.074	.008		10	0.077	.004
	6	0.668	.015		10	0.026	.008		11	0.028	.004
	7	0.212	.016	4.9	5	46.566	.001		12	0.010	.004
	8	0.070	.016		6	2.459	.005	5.6	6	11.519	.001
	9	0.023	.017		7	0.702	.007		7	1.944	.003
4.2	5	3.327	.009		8	0.242	.007		8	0.631	.003
	6	0.784	.013		9	0.087	.007		9	0.233	.004
	7	0.248	.014		10	0.031	.007		10	0.088	.004
	8	0.083	.015		11	0.011	.077		11	0.033	.004
	9	0.027	.015	5.0	6	2.938	.005		12	0.012	.004
	10	0.009	.015		7	0.810	.006	5.7	6	16.446	.001
4.3	5	4.149	.008		8	0.279	.006		7	2.264	.002
	6	0.919	.012		9	0.101	.007		8	0.721	.003
	7	0.289	.130		10	0.036	.007		9	0.266	.003
	8	0.097	.013		11	0.013	.007		10	0.102	.003
	9	0.033	014	5.1	6	3.536	.004		11	0.038	.003
	10	0.011	.014		7	0.936	.005		12	0.014	.003
4.4	5	5.268	.006		8	0.321	.006	5.8	6	26.373	.001
	6	1.078	.010		9	0.117	.006		7	2.648	.002
	7	0.337	.012		10	0.042	.006		8	0.823	.003
	8	0.114	.012		11	0.015	.006		9	0.303	.003
	9	0.039	.012	5.2	6	4.301	.003		10	0.116	.003
	10	0.013	.012		7	1.081	.005		11	0.044	.003
4.5	5	6.862	.005		8	0.368	.005		12	0.017	.003
	6	1.265	.009		9	0.135	.005	5.9	6	56.300	.000
	7	0.391	.010		10	0.049	.005		7	3.113	.002
	8	0.133	.011		11	0.017	.006		8	0.939	.002
	9	0.046	.011	5.3	6	5.303	.003		9	0.345	.003
	10	0.015	.011		7	1.249	.004		10	0.133	.003

TABLE 7S.1
Learning curve coefficients

	70%		75%		80%		85%		90%	
Unit Number	Unit Time	Total Time	Unit Time	Total Time	Unit Time	Total Time	Unit Time	Total Time	Unit Time	Total Time
1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	.700	1.700	.750	1.750	.800	1.800	.850	1.850	.900	1.900
3	.568	2.268	.634	2.384	.702	2.502	.773	2.623	.846	2.746
4	.490	2.758	.562	2.946	.640	3.142	.723	3.345	.810	3.556
5	.437	3.195	.513	3.459	.596	3.738	.686	4.031	.783	4.339
6	.398	3.593	.475	3.934	.562	4.299	.657	4.688	.762	5.101
7	.367	3.960	.446	4.380	.534	4.834	.634	5.322	.744	5.845
8	.343	4.303	.422	4.802	.512	5.346	.614	5.936	.729	6.574
9	.323	4.626	.402	5.204	.493	5.839	.597	6.533	.716	7.290
10	.306	4.932	.385	5.589	.477	6.315	.583	7.116	.705	7.994
11	.291	5.223	.370	5.958	.462	6.777	.570	7.686	.695	8.689
12	.278	5.501	.357	6.315	.449	7.227	.558	8.244	.685	9.374
13	.267	5.769	.345	6.660	.438	7.665	.548	8.792	.677	10.052
14	.257	6.026	.334	6.994	.428	8.092	.539	9.331	.670	10.721
15	.248	6.274	.325	7.319	.418	8.511	.530	9.861	.663	11.384
16	.240	6.514	.316	7.635	.410	8.920	.522	10.383	.656	12.040
17	.233	6.747	.309	7.944	.402	9.322	.515	10.898	.650	12.690
18	.226	6.973	.301	8.245	.394	9.716	.508	11.405	.644	13.334
19	.220	7.192	.295	8.540	.388	10.104	.501	11.907	.639	13.974
20	.214	7.407	.288	8.828	.381	10.485	.495	12.402	.634	14.608
21	.209	7.615	.283	9.111	.375	10.860	.490	12.892	.630	15.237
22	.204	7.819	.277	9.388	.370	11.230	.484	13.376	.625	15.862
23	.199	8.018	.272	9.660	.364	11.594	.479	13.856	.621	16.483
24	.195	8.213	.267	9.928	.359	11.954	.475	14.331	.617	17.100
25	.191	8.404	.263	10.191	.355	12.309	.470	14.801	.613	17.713
26	.187	8.591	.259	10.449	.350	12.659	.466	15.267	.609	18.323
27	.183	8.774	.255	10.704	.346	13.005	.462	15.728	.606	18.929
28	.180	8.954	.251	10.955	.342	13.347	.458	16.186	.603	19.531
29	.177	9.131	.247	11.202	.338	13.685	.454	16.640	.599	20.131
30	.174	9.305	.244	11.446	.335	14.020	.450	17.091	.596	20.727