※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

Questions [30%]

Please answer the following questions and justify your answer.

1. [18%] Distribution Requirement Planning (DRP): (a) Describe the three phases of DRP processing logic. (b) Show a TABLE comparison between DRP and material requirement planning (MRP). (c) Show a TABLE comparison between DRP and reorder point (ROP). (d) What is bullwhip effect in supply chain? Give a figure for illustration. (e) What is the cause of bullwhip effect (at least three points)? (f) Any suggestion to improve the bullwhip effect?

2. [12%] Advanced Planning and Scheduling (APS): (a) What is the hierarchical processing logic of conventional production planning (i.e. the framework of production planning and control)? (b) What are the drawbacks of conventional production planning (at least three points)? (c) In APS, what is the difference between material-oriented planning and capacity-oriented planning? (d) Show a TABLE comparison between traditional production planning and APS.

Numerical Problem and Analysis [70%]

Please answer the following numerical questions and show all your work in detail.

3. [24%] Economic Production Quantity (EPQ)

The NCKU Company produces glass windows. The glass window can be produced at a rate of 1,000 pounds per day. Demand for the window is 240 pounds per day. The fixed cost of setting up for a production run of the window is $45,000, and the variable cost of production is $100 per window. The holding cost (including storage and handling) per window per year is 10 percent of the variable cost. Assume that there are 250 working days in a year.

   (a) [4%] What is the optimal EPQ size of the production run for this particular compound?

   (b) [4%] What is the maximal inventory level?

   (c) [8%] In one cycle, what proportion of each production cycle consists of uptime (i.e. production and consumption simultaneously) and what proportion consists of downtime (i.e. only demand consumption)?

   (d) [8%] What is the "average" annual cost of holding and setup per window? If the window sells for $200 per item, what is the annual profit the NCKU company is realizing from this item?

4. [18%] Transportation Problem

The NCKU Company has three plants producing NCKU raincoat that are to be shipped to four distribution centers (DCs). Plants 1, 2, and 3 produce 19, 23, and 18 raincoats per month, respectively. Each distribution center needs to receive 15 raincoats per month. The distance from

each plant to the respective distributing centers is as follows:

Plant	Distance (miles)			
	DC1	DC2	DC3	DC4
1	40	24	56	44
2	36	32	48	24
3	28	16	52	32

The cost of transportation is $1 per mile. How much should be shipped from each plant to each of the distribution centers to minimize the total transportation cost?

(a) **[8%]** Give a linear programming (LP) formulation of this transportation problem.

(b) **[10%]** Construct the appropriate parameter table and obtain an optimal solution by the northwest-corner method and the transportation simplex tableau algorithm.

5. **[20%]** Job Shop Scheduling Problem

NCKU factory implements a small-volume large-variety production. In the shop floor, there exists a 3-machine job shop scheduling problem. 3 machines are A, B, and C. There are 4 jobs.

Job	Processing time				
	Operation1	Operation2	Operation3	Operation4	Due date
1	6(A)	4(B)	7(C)	3(B)	25
2	7(A)	6(C)			15
3	8(C)	5(A)	4(B)	6(A)	21
4	6(C)	3(B)	8(A)		18

(a) **[10%]** Use the dispatching rule earliest due date (EDD) to sequence the "jobs". (i) Give a Gantt Chart for illustration. (ii) What is the completion time of all jobs and how many number of tardy jobs (over due date)?

(b) **[10%]** Use the dispatching rule minimum slack time (MST), which keep updating the current time and considers the remaining operating process, to decide the "job-operation" sequence. (i) Give a Gantt Chart for illustration. (ii) What is the completion time of all jobs and how many number of tardy jobs (over due date)?

6. **[8%]** Quality Assurance

NCKU automatic machinery is used to fill and seal 15-oz cans of a certain liquid product. The process standard deviation is 0.3 oz. to ensure that every can meets or exceeds this 15-oz minimum, the company has set a target value for the process of 16 oz. (Hint: you may use the attached normal curve table.)

(a) **[4%]** At this process average of 16 oz, what percent of the can will has less than 15.5 oz of product? Assume contained weights are normally distributed.

(b) **[4%]** If the quality control division samples these cans in subgroups of five, what will 3-sigma control limits be for the $\bar{X}$-chart?
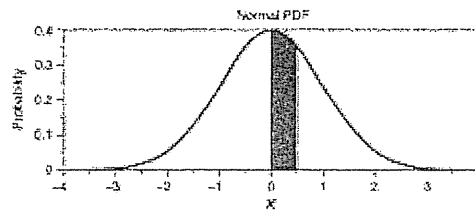
Area under the Normal Curve from 0 to X

X	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.00000	0.00399	0.00798	0.01197	0.01595	0.01994	0.02392	0.02790	0.03188	0.03586
0.1	0.03983	0.04380	0.04776	0.05172	0.05567	0.05962	0.06356	0.06749	0.07142	0.07535
0.2	0.07926	0.08317	0.08706	0.09095	0.09483	0.09871	0.10257	0.10642	0.11026	0.11409
0.3	0.11791	0.12172	0.12552	0.12930	0.13307	0.13683	0.14058	0.14431	0.14803	0.15173
0.4	0.15542	0.15910	0.16276	0.16640	0.17003	0.17364	0.17724	0.18082	0.18439	0.18793
0.5	0.19146	0.19497	0.19847	0.20194	0.20540	0.20884	0.21226	0.21566	0.21904	0.22240
0.6	0.22575	0.22907	0.23237	0.23565	0.23891	0.24215	0.24537	0.24857	0.25175	0.25490
0.7	0.25804	0.26115	0.26424	0.26730	0.27035	0.27337	0.27637	0.27935	0.28230	0.28524
0.8	0.28814	0.29103	0.29389	0.29673	0.29955	0.30234	0.30511	0.30785	0.31057	0.31327
0.9	0.31594	0.31859	0.32121	0.32381	0.32639	0.32894	0.33147	0.33398	0.33646	0.33891
1.0	0.34134	0.34375	0.34614	0.34849	0.35083	0.35314	0.35543	0.35769	0.35993	0.36214
1.1	0.36433	0.36650	0.36864	0.37076	0.37286	0.37493	0.37698	0.37900	0.38100	0.38298
1.2	0.38493	0.38686	0.38877	0.39065	0.39251	0.39435	0.39617	0.39796	0.39973	0.40147
1.3	0.40320	0.40490	0.40658	0.40824	0.40988	0.41149	0.41308	0.41466	0.41621	0.41774
1.4	0.41924	0.42073	0.42220	0.42364	0.42507	0.42647	0.42785	0.42922	0.43056	0.43189
1.5	0.43319	0.43448	0.43574	0.43699	0.43822	0.43943	0.44062	0.44179	0.44295	0.44408
1.6	0.44520	0.44630	0.44738	0.44845	0.44950	0.45053	0.45154	0.45254	0.45352	0.45449
1.7	0.45543	0.45637	0.45728	0.45818	0.45907	0.45994	0.46080	0.46164	0.46246	0.46327
1.8	0.46407	0.46485	0.46562	0.46638	0.46712	0.46784	0.46856	0.46926	0.46995	0.47062
1.9	0.47128	0.47193	0.47257	0.47320	0.47381	0.47441	0.47500	0.47558	0.47615	0.47670
2.0	0.47725	0.47778	0.47831	0.47882	0.47932	0.47982	0.48030	0.48077	0.48124	0.48169
2.1	0.48214	0.48257	0.48300	0.48341	0.48382	0.48422	0.48461	0.48500	0.48537	0.48574
2.2	0.48610	0.48645	0.48679	0.48713	0.48745	0.48778	0.48809	0.48840	0.48870	0.48899
2.3	0.48928	0.48956	0.48983	0.49010	0.49036	0.49061	0.49086	0.49111	0.49134	0.49158
2.4	0.49180	0.49202	0.49224	0.49245	0.49266	0.49286	0.49305	0.49324	0.49343	0.49361
2.5	0.49379	0.49396	0.49413	0.49430	0.49446	0.49461	0.49477	0.49492	0.49506	0.49520
2.6	0.49534	0.49547	0.49560	0.49573	0.49585	0.49598	0.49609	0.49621	0.49632	0.49643
2.7	0.49653	0.49664	0.49674	0.49683	0.49693	0.49702	0.49711	0.49720	0.49728	0.49736
2.8	0.49744	0.49752	0.49760	0.49767	0.49774	0.49781	0.49788	0.49795	0.49801	0.49807
2.9	0.49813	0.49819	0.49825	0.49831	0.49836	0.49841	0.49846	0.49851	0.49856	0.49861
3.0	0.49865	0.49869	0.49874	0.49878	0.49882	0.49886	0.49889	0.49893	0.49896	0.49900
3.1	0.49903	0.49906	0.49910	0.49913	0.49916	0.49918	0.49921	0.49924	0.49926	0.49929
3.2	0.49931	0.49934	0.49936	0.49938	0.49940	0.49942	0.49944	0.49946	0.49948	0.49950
3.3	0.49952	0.49953	0.49955	0.49957	0.49958	0.49960	0.49961	0.49962	0.49964	0.49965
3.4	0.49966	0.49968	0.49969	0.49970	0.49971	0.49972	0.49973	0.49974	0.49975	0.49976
3.5	0.49977	0.49978	0.49978	0.49979	0.49980	0.49981	0.49981	0.49982	0.49983	0.49983
3.6	0.49984	0.49985	0.49985	0.49986	0.49986	0.49987	0.49987	0.49988	0.49988	0.49989
3.7	0.49989	0.49990	0.49990	0.49990	0.49991	0.49991	0.49992	0.49992	0.49992	0.49992
3.8	0.49993	0.49993	0.49993	0.49994	0.49994	0.49994	0.49994	0.49995	0.49995	0.49995
3.9	0.49995	0.49995	0.49996	0.49996	0.49996	0.49996	0.49996	0.49996	0.49997	0.49997
4.0	0.49997	0.49997	0.49997	0.49997	0.49997	0.49997	0.49998	0.49998	0.49998	0.49998