

※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 [44%]

Please answer the following questions briefly and justify your answer.

1. [12%] Facility layout: The term facility layout refers to the arrangement of these physical facilities and manufacturing resource in a production system. In general, there are four principle types of plant layout as: (a) product-flow layout; (b) process layout; (c) group layout; and (d) fixed position layout. Explain briefly each of these layout types, advantages and limitations. What's the manufacturing environment which these types of layout designs best suit for?
2. [16%] Theory of Constraint (TOC): (a) What's the five-step procedure in TOC? (b) What's Drum-Buffer-Rope (DBR)? Give an example to describe DBR. (c) How to define and identify bottleneck? (d) What's the relationship between bottleneck and Little's law?
3. [16%] Scheduling problem: (a) Draw the graph to illustrate the difference between flow-shop scheduling and job-shop scheduling. (b) What is parallel machine? What's the difference between identical machine, uniform machine, and unrelated machine? (c) What's the difference between scheduling, sequencing, and dispatching? (d) Why is the scheduling problem a NP-hard problem? What's NP-hard and give an example to describe it.

Numerical Problem and Analysis [56%]

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

4. [10%] Master Production Schedule

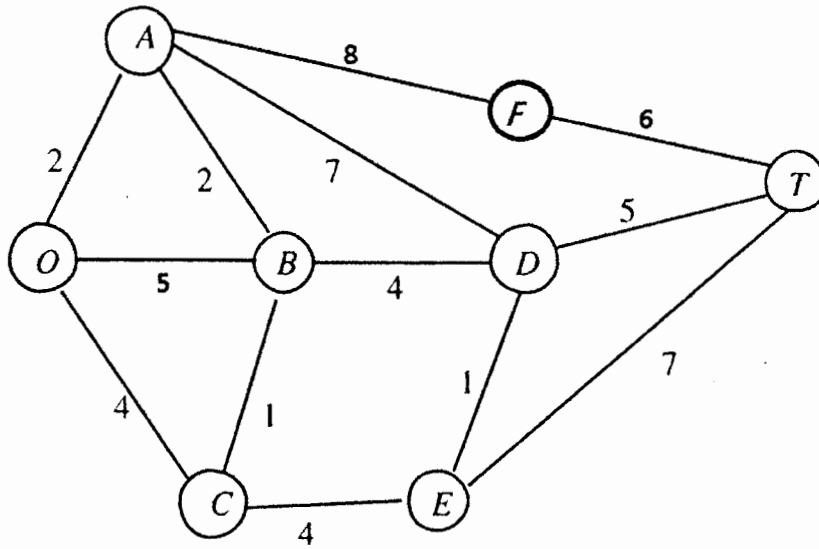
NCKU company builds up a master production schedule (MPS) for one specific item. Customer order is the order received before production. ATP is the quantity available to promise. If there exists inventory, then no production is allowed; otherwise, the production batch size 25 is scheduled in MPS when inventory is lower than zero. If the initial inventory is 5 and no safety stock is considered, complete the following table with Expected inventory, MPS, and ATP.

	Week1	Week2	Week3	Week4	Week5	Week6
Demand forecast	10	10	13	10	10	13
Customer order	12	9	5	3	0	0

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5. [10%] Shortest-Path Problem

Please find the shortest-path from the origin (node O) to the destination (node T) in following figure. The value on the arc represents the distance.



6. [26%] Forecast Problem

NCKU company sells T-shirts to students. Suppose that the demand history of T-shirts for the past eight quarters is given as following table.

Quarter	Demand (1000 units)	Quarter	Demand (1000 units)
1	5	5	7
2	15	6	18
3	21	7	25
4	12	8	17

- (a) [10%] Compute seasonal decomposition using four-quarter moving averages and find the “deseasonalized” series.
- (b) [5%] Use linear regression method to find the fitted line by ordinary least squares (OLS)
- (c) [5%] Describe the five underlying assumptions applied to linear regression model.
- (d) [6%] What's the difference if replacing the objective function $\sum_{i=1}^6 (y_i - \hat{y}_i)^2$ by $\sum_{i=1}^6 |y_i - \hat{y}_i|$ in regression analysis? Does the regression line remain the same or change? If the same, please justify your answer. If change, how does it change?

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7. [10%] Operations Scheduling Problem

NCKU company produces a customized mug. There are two operations in manufacturing process. Operation A- the cup is laminated with a plastic resin called polyethylene. Operation B- stamp NCKU logo on mug. Now, five jobs must pass through two operations given precedence constraint, i.e., job must be processed on Operation A before it can be processed by Operation B. The processing times of given jobs are shown as following table.

Job	Operation A	Operation B
1	7	6
2	4	5
3	8	7
4	5	6
5	8	9

(a) [5%] Determine a minimum makespan and job sequence using Johnson's rule.

(b) [5%] Draw a Gantt Chart.