

- 3 Please prepare Gantt chart and bring optimize solution : 15
 J = Jobs
 M = MachineNo
 [] = Figure in brackets is unit of time

J1	M1[5]	M3 [2]	M4 [5]	M2 [4]
J2	M2 [4]	M4 [4]	M3 [5]	M1 [5]

- 4 (a) What is theory of constraint ? Who was the inventor ? 15
 (b) Please explain major assumptions of theory of constraint.
 (c) Please write down steps for implementing steps of theory of constraint.

- 5 Case study : 10

John Walker was the operations manager for twelve state-operated liquor stores in the city of Richland. He was concerned about the utilization of cashier personnel and availability of cashier personnel to perform shelf restocking on Friday of each week.

In the past each store's superintendent had scheduled the cashier personnel needed for customer service and shelf restocking based on judgement and experience. Recently, the efforts at each store to plan ahead for manpower availability to work on shelf restocking had not succeeded as well due to the new, inexperienced supervision at many of the stores.

Weekly orders from the regional alcoholic beverage warehouse were received at each store between noon and 2.00 pm on Friday. Shelf restocking began as soon as the truck pulled away in order to have the "goods" ready for the Saturday crowds.

John had a directive in effect at each store stating that all available cashier time – over that which was needed for adequate customer service – should be devoted to shelf restocking.

However, John discovered that most of the shelf restocking was being done on overtime hours after the stores closed on Friday evenings. The inexperienced supervisors found it easier not to have to bother with close scheduling of personnel between the service counter and shelf-restocking area. The supervisor simply kept the cashiers over and the cashiers were happy to receive the overtime pay.

In an effort to help each store supervisor to provide adequate coverage for customer service and to know when to utilize the “extra personnel” for shelf restocking, John undertook a second study. This time he chose the city’s largest store – Central and 12th Street. He wanted to determine how much manpower the superintendent could place on the shelf-restocking activity on Friday afternoons between 2.00 PM and 8.00 PM.

The following information was gathered from the Central and 12th Street store.

- (1) The store can expect a total of 60 cashier man-hours to be available on Fridays between 2.00 pm and 8.00 p.m.
- (2) It has been determined that, on the average, it takes 1.5 minutes to complete a service transaction at this store.
- (3) There are sufficient data available so that a reasonably reliable statistical comparison can be made between the Friday studied and Fridays in other weeks.
- (4) The table below shows, column by column, the 12 half-hour periods making up the 2.00 - 8.00 pm period in which shelf re-stocking is accomplished, the number of arrivals expected during each period, and the utilization desired for each period :

Time Period	Arrivals per Half Hour	Desired Utilization Rate
2.00 - 2.30	60	0.40
2.30 - 3.00	70	0.45
3.00 - 3.30	80	0.50
3.30 - 4.00	100	0.60
4.00 - 4.30	55	0.37
4.30 - 5.00	47	0.33
5.00 - 5.30	55	0.37
5.30 - 6.00	85	0.53
6.00 - 6.30	100	0.60
6.30 - 7.00	98	0.59
7.00 - 7.30	50	0.35
7.30 - 8.00	34	0.30

A quick check of the overtime records from the Central and 12th Street store indicated that approximately 12 man-hours were needed to handle the shelf restocking. John needed to apply his information to several questions.

- (1) Will the superintendent have the required 12 hours on Friday, or should he have to use overtime ?
- (2) If a customer arrives between 6.00 and 6.30.
 - (a) What are the chances he will have to wait ?
 - (b) What percentage of the time can each cashier expect to be idle ?
 - (c) What is the expected waiting time ?