Department of Mechanical Engineering
Birla Institute of Technology and Science, Pilani, Pilani campus

MSE G512: Manufacturing Planning and Control

Comprehensive Examination (7/05/2022)

Time: 180 min; Max. Marks: 70

Note to Students:

1. Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
2. All parts of a question should be answered consecutively.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.
4. There is no partial or step marking for theoretical/conceptual/multiple choice questions.
5. **Answer the MCQs in the question paper itself.**

Name:…… ID……

Q1. Mark the correct answer:

(i) The probability that the inventory available during lead time will meet demand is referred to as the **[2]**

a. Expected lead time demand
b. Safety stock
c. Stockout risk
d. Service level

(ii) A restaurant currently uses 62,500 boxes of napkins each year at a constant daily rate. If the cost to order napkins is $200.00 per order and the annual carrying cost for one box of napkins is $1.00, then the optimal order quantity (EOQ) for napkins would be **[2]**

a. 62,500 boxes
b. 10,000 boxes
c. 5,000 boxes
d. 2,500 boxes

(iii) A company is developing a linear programming model for its aggregate production plan. If I_t = units in inventory at the end of period t, P_t = units produced in period t, and D_t = demand in period t, then the company's demand constraint to ensure that demand is met in quarter 3 would be **[2]**

a. $D_3 = I_2 – I_3 + P_3$
b. $D_3 = I_3 + P_3$
c. $D_3 = I_3 – I_2 + P_3$
d. $D_3 = I_2 – I_3 + P_2$

(iv) Given the information below, the number of available-to-promise units in period 2 would be **[2]**

Period						
On Hand = 100	1	2	3	4	5	6
Forecast	200	250	200	300	200	200
Customer Orders	150	125	100	250	150	250
Master Production Schedule	400		400		400	
Available-to-Promise						

a. 400
b. 350
c. 225
d. 125

(v) Four products (1, 2, 3, and 4) must be processed on one of four machines (A, B, C, and D). The times required in minutes for each product on each machine are shown below. **[2]**

	Machine			
Product	A	B	C	D
1	10	9	16	12
2	8	14	17	5
3	19	20	11	7
4	8	18	5	10

If management wishes to assign products to machines so that the total time to complete all the products is minimized, then Product 4 would be assigned to

a. Machine A
b. Machine B
c. Machine C
d. Machine D

(vi) A product has a normally distributed usage with an average daily demand of 250 units and a daily standard deviation of 50 units. The lead time for the product is 6 days. If the company wants a 95% service level for this product then its reorder point must be **[2]**

a. 202 units
b. 452 units
c. 1500 units
d. 1702 units

(vii) The following information relates to a company's aggregate production planning activities: **[2]**

Quarter	Demand Forecast
1	75,000
2	100,000
3	75,000
4	125,000

Beginning Workforce = 35 workers
Production per Employee = 1,250 units per quarter
Hiring Cost = $500 per worker
Firing Cost = $1,000 per worker
Inventory Carrying Cost = $20 per unit per quarter

If a chase demand strategy is used then the total firing cost for the plan would be

a. $10,000
b. $15,000
c. $20,000
d. $25,000

(viii) A workstation must produce 200 units an hour. It takes 45 minutes to receive the necessary material for production from the previous workstation. Output is moved between workstations in containers holding 30 units. If the process uses a safety factor of 20%, then the number of kanbans that should be circulating between this workstation and the previous workstation is **[2]**

a. 4
b. 5
c. 6
d. 360

(ix) If the work remaining is greater than the time remaining, the critical ratio (CR) will be **[2]**

a. equal to 1.0
b. equal to 0.0
c. greater than 1.0
d. less than 1.0

(x) The following set of jobs must be processed serially through a two-step system. The times at each process are in hours. If Johnson's Rule is used to sequence the jobs then Job A would complete processing on operation 2 at **[2]**

Job	Process 1	Process 2
A	12	9
B	8	11
C	7	6
D	10	14
E	5	8

a. hour 21
b. hour 35
c. hour 38
d. hour 47

Q2. An executive conference center has the physical ability to handle 1,100 participants. However, conference management personnel believe that only 1,000 participants can be handled effectively for most events. The last event, although forecasted to have 1,000 participants, resulted in the attendance of only 950 participants. What are the utilization and efficiency of the conference facility? **[5]**

Q3. How does MRP differ from traditional inventory control systems explain with suitable example? **[5]**

Q4. Make a graphical representation showing the inter-relationships of all the activities involved in "Manufacturing Planning and Control". **[5]**

Q5. A PERT network has total 9 activities, if the variance of each activity on the critical path is also 9, what will be the standard deviation of the critical path? What is the significance of standard deviation, explain with the help of a suitable example? **[5]**

Q6. A company's management has determined the activities required to complete the project, the precedence relationships of the activities, and activity time estimates as follows: **[10]**

Activity	**Activity predecessor**	**Time estimates (in weeks)**		
		a	**m**	**b**
a	-	5	8	17
b	-	3	12	15
c	a	4	7	10
d	a	5	8	23
e	b, c	1	1	1
f	b, c	1	4	13
g	d, e	3	6	9
h	d, e	1	2.5	7
i	h	1	1	1
j	f, g	2	2	2
k	g, i	5	8	11

(i) Draw a labelled PERT network diagram and determine the earliest and latest activity times and the expected completion time.
(ii) Calculate the standard deviation, and the probability of the project completion in 30 and 40 weeks.

Q7. The demand for a product is shown in table given below. A holding cost of $0.50 per unit per day, a setup cost of $100 per setup, a lead time of one day and 70 units on hand. Determine when a work order should be released for the item and the size of the order using the L4L, EOQ, and POQ lot sizing techniques. Which technique produces the lowest total cost? **[10]**

Period	1	2	3	4	5	6	7	8	9	10
Gross Req.	50	30	25	35	40	50	35	45	70	75

Q8. Six jobs are required to assign to six different machining centres. Approximated time required to machine the corresponding machining centre is given in the matrix. Determine how the jobs should be assigned to different machining centres so that overall performance is maximized. Find out the total machining time from your solution **[10]**

Jobs	Machining centers					
	Center-1	Center-2	Center-3	Center-4	Center-5	Center-6
Job-1	18	17	14	19	19	18
Job-2	17	15	12	14	20	17
Job-3	15	15	13	17	20	18
Job-4	19	16	18	18	18	20
Job-5	18	15	12	17	19	17
Job-6	16	16	16	18	20	17