**Chapter 19: Detailed Scheduling**

**Practice Problems**

**MULTIPLE CHOICE**

LeMark Shipyards produces coastal gunboats for several navies. Data for last year’s four quarters are given below. The actual backlog before Q1 was 9.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Q1 | Q2 | Q3 | Q4 |
| Planned Input | 26 | 29 | 25 | 30 |
| Actual Input | 25 | 30 | 28 | 28 |
| Planned Output | 31 | 31 | 31 | 25 |
| Actual Output | 28 | 29 | 33 | 30 |

1. What was the cumulative deviation in Quarter 2 for the Inputs?

|  |  |
| --- | --- |
| a. | -2 |
| b. | -1 |
| c. | 0 |
| d. | +2 |

ANS: C PTS: 1 DIF: Easy

2. What was the cumulative deviation in Quarter 4 for the Inputs?

|  |  |
| --- | --- |
| a. | -2 |
| b. | -1 |
| c. | 0 |
| d. | +1 |

ANS: D PTS: 1 DIF: Easy

3. What was the cumulative deviation in Quarter 2 for the Outputs?

|  |  |
| --- | --- |
| a. | -5 |
| b. | -3 |
| c. | -2 |
| d. | -1 |

ANS: A PTS: 1 DIF: Easy

4. What was the cumulative deviation in Quarter 4 for the Outputs?

|  |  |
| --- | --- |
| a. | -2 |
| b. | 0 |
| c. | +2 |
| d. | +5 |

ANS: C PTS: 1 DIF: Easy

5. What was the actual backlog in Quarter 2?

|  |  |
| --- | --- |
| a. | 0 |
| b. | 7 |
| c. | 13 |
| d. | 18 |

ANS: B PTS: 1 DIF: Medium

6. What was the actual backlog in Quarter 4?

|  |  |
| --- | --- |
| a. | 0 |
| b. | 2 |
| c. | 4 |
| d. | 6 |

ANS: A PTS: 1 DIF: Medium

7. Nanotech Composites produces components for the nuclear power industry, among others. Some of their key components are three parts of a pump. Each of the three parts must pass through two work centers. Each work center has three machines. The machines in each work center are similar but not identical. Therefore, each of the three machines takes a different amount of time to process each of the three products. Below, you will find the processing time for each product on the three machines in Work Center 1.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Machine 1 | Machine 2 | Machine 3 |
| Product 1 | 8 | 16 | 12 |
| Product 2 | 12 | 10 | 9 |
| Product 3 | 10 | 13 | 11 |

What would be the optimal assignment of product to machine in Work Center 1?

|  |  |
| --- | --- |
| a. | Product 1 - Machine 1; Product 2 - Machine 2; Product 3 - Machine 3 |
| b. | Product 1 - Machine 2; Product 2 - Machine 3; Product 3 - Machine 1 |
| c. | Product 1 - Machine 3; Product 2 - Machine 1; Product 3 - Machine 2 |
| d. | Product 1 - Machine 1; Product 2 - Machine 3; Product 3 - Machine 2 |

ANS: A PTS: 1 DIF: Medium

8. Nanotech Composites produces components for the nuclear power industry, among others. Some of their key components are three parts of a pump. Each of the three pumps must pass through two work centers. Each work center has three machines. The machines in each work center are similar but not identical. Therefore, each of the three machines takes a different amount of time to process each of the three products. Below you will find the processing time for each product on the three machines in Work Center 2.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Machine 4 | Machine 5 | Machine 6 |
| Product 1 | 5 | 9 | 11 |
| Product 2 | 6 | 7 | 12 |
| Product 3 | 8 | 6 | 7 |

What would be the optimal assignment of product to machine in Work Center 2?

|  |  |
| --- | --- |
| a. | Product 1 - Machine 4; Product 2 - Machine 5; Product 3 - Machine 6 |
| b. | Product 1 - Machine 5; Product 2 - Machine 6; Product 3 - Machine 4 |
| c. | Product 1 - Machine 6; Product 2 - Machine 4; Product 3 - Machine 5 |
| d. | Product 1 - Machine 4; Product 2 - Machine 6; Product 3 - Machine 5 |

ANS: A PTS: 1 DIF: Medium

9. Luxory Lawn produces hand-crafted lawn decorations. After reviewing the work of their key artists (those who paint the decorations), they found that each artist takes a different amount of time to paint their largest selling lawn decorations. The times for each artist on each item are given below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Gnome | Elf | Dragon | Deer |
| Ed | 26 | 24 | 37 | 48 |
| Liz | 37 | 18 | 46 | 52 |
| Bob | 41 | 16 | 40 | 35 |
| June | 29 | 23 | 39 | 39 |

What would be the optimal (least cumulative time) assignment of artist to decoration?

|  |  |
| --- | --- |
| a. | Ed - Gnome; Liz - Elf; Bob - Dragon; June - Deer |
| b. | Ed - Elf; Liz - Dragon; Bob - Gnome; June - Deer |
| c. | Ed - Gnome; Liz - Elf; Bob - Deer; June - Dragon |
| d. | Ed - Deer; Liz - Dragon; Bob - Gnome; June - Elf |

ANS: C PTS: 1 DIF: Hard

10. Lars and Cee Law Firm uses interns to process four different types of legal documents. After gathering data, they discovered that the interns process the types of documents at different rates. These rates for the interns are listed below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Legal 1 | Legal 2 | Legal 3 | Legal 4 |
| Vin | 100 | 70 | 95 | 85 |
| Matt | 60 | 50 | 85 | 70 |
| Mark | 85 | 65 | 75 | 60 |
| Lonnie | 90 | 70 | 80 | 75 |

What would be the optimal (least cumulative time) assignment of intern to the type of legal document?

|  |  |
| --- | --- |
| a. | Vin - Legal 1; Matt - Legal 2; Mark - Legal 3; Lonnie - Legal 4 |
| b. | Vin - Legal 2; Matt - Legal 3; Mark - Legal 4; Lonnie - Legal 1 |
| c. | Vin - Legal 3; Matt - Legal 4; Mark - Legal 1; Lonnie - Legal 2 |
| d. | Vin - Legal 2; Matt - Legal 1; Mark - Legal 4; Lonnie - Legal 3 |

ANS: D PTS: 1 DIF: Hard

Luther Baines is trying to schedule his work center’s upcoming activities. They have to process five jobs—A, B, C, D, and E—which came in the respective order. The process times for the jobs (in days) and the due dates are provided in the table below.

|  |  |  |
| --- | --- | --- |
| Job | Process Time | Due Date |
| A | 3 | 7 |
| B | 12 | 26 |
| C | 10 | 14 |
| D | 8 | 31 |
| E | 14 | 40 |

11. Using the first come, first served (FCFS) rule, what would be the schedule?

|  |  |
| --- | --- |
| a. | A - B - C - D - E |
| b. | B - C - E - A - D |
| c. | C - E - D - B - A |
| d. | D - B - C - D - A |

ANS: A PTS: 1 DIF: Easy

12. Using the first come, first served (FCFS) rule, what would be the average flow time?

|  |  |
| --- | --- |
| a. | 20.0 |
| b. | 21.4 |
| c. | 24.6 |
| d. | 33.2 |

ANS: C PTS: 1 DIF: Medium

13. Using the first come, first served (FCFS) rule, what would be the average tardiness?

|  |  |
| --- | --- |
| a. | 0.0 |
| b. | 2.5 |
| c. | 3.3 |
| d. | 4.0 |

ANS: D PTS: 1 DIF: Medium

14. Using the first come, first served (FCFS) rule, what would be the average number of jobs in the system?

|  |  |
| --- | --- |
| a. | 2.40 |
| b. | 2.62 |
| c. | 3.95 |
| d. | 4.24 |

ANS: B PTS: 1 DIF: Medium

15. Using the shortest processing time (SPT) rule, what would be the schedule?

|  |  |
| --- | --- |
| a. | A - B - C - D - E |
| b. | A - D - C - B - E |
| c. | E - B - C - D - A |
| d. | D - C - A - B - E |

ANS: B PTS: 1 DIF: Easy

16. Using the shortest processing time (SPT) rule, what would be the average flow time?

|  |  |
| --- | --- |
| a. | 10 |
| b. | 19 |
| c. | 23 |
| d. | 33 |

ANS: C PTS: 1 DIF: Medium

17. Using the shortest processing time (SPT) rule, what would be the average tardiness?

|  |  |
| --- | --- |
| a. | 0.8 |
| b. | 2.2 |
| c. | 3.8 |
| d. | 4.2 |

ANS: D PTS: 1 DIF: Medium

18. Using the shortest processing time (SPT) rule, what would be the average number of jobs in the system?

|  |  |
| --- | --- |
| a. | 1.90 |
| b. | 2.20 |
| c. | 2.45 |
| d. | 3.15 |

ANS: C PTS: 1 DIF: Medium

19. Using the earliest due date (EDD) rule, what would be the schedule?

|  |  |
| --- | --- |
| a. | A - B - C - D - E |
| b. | A - C - B - D - E |
| c. | B - D - E - A - C |
| d. | D - B - C - A - E |

ANS: B PTS: 1 DIF: Easy

20. Using the earliest due date (EDD) rule, what would be the average flow time?

|  |  |
| --- | --- |
| a. | 19.8 |
| b. | 24.2 |
| c. | 28.7 |
| d. | 31.2 |

ANS: B PTS: 1 DIF: Medium

21. Using the earliest due date (EDD) rule, what would be the average tardiness?

|  |  |
| --- | --- |
| a. | 1.8 |
| b. | 2.2 |
| c. | 2.6 |
| d. | 3.1 |

ANS: A PTS: 1 DIF: Medium

22. Using the earliest due date (EDD) rule, what would be the average number of jobs in the system?

|  |  |
| --- | --- |
| a. | 1.34 |
| b. | 2.57 |
| c. | 3.02 |
| d. | 3.86 |

ANS: B PTS: 1 DIF: Hard

23. Using the longest processing time (LPT) rule, what would be the schedule?

|  |  |
| --- | --- |
| a. | A - B - C - D - E |
| b. | C - B - A - E - D |
| c. | D - A - B - C - E |
| d. | E - B - C - D - A |

ANS: D PTS: 1 DIF: Medium

24. Using the longest processing time (LPT) rule, what would be the average flow time?

|  |  |
| --- | --- |
| a. | 28.6 |
| b. | 30.2 |
| c. | 33.4 |
| d. | 35.2 |

ANS: C PTS: 1 DIF: Medium

25. Using the longest processing time (LPT) rule, what would be the average tardiness?

|  |  |
| --- | --- |
| a. | 4.5 |
| b. | 7.8 |
| c. | 10.3 |
| d. | 15.0 |

ANS: D PTS: 1 DIF: Medium

26. Using the longest processing time (LPT) rule, what would be the average number of jobs in the system?

|  |  |
| --- | --- |
| a. | 2.85 |
| b. | 3.21 |
| c. | 3.55 |
| d. | 3.82 |

ANS: C PTS: 1 DIF: Medium

27. Using the critical ratio (CR) rule, what would be the schedule?

|  |  |
| --- | --- |
| a. | A - C - B - D - E |
| b. | A - D - C - B - E |
| c. | E - B - C - D - A |
| d. | C - B - A - E - D |

ANS: D PTS: 1 DIF: Hard

28. Using the critical ratio (CR) rule, what would be the average flow time?

|  |  |
| --- | --- |
| a. | 28.6 |
| b. | 30.2 |
| c. | 33.4 |
| d. | 35.2 |

ANS: A PTS: 1 DIF: Hard

29. Using the critical ratio (CR) rule, what would be the average tardiness?

|  |  |
| --- | --- |
| a. | 5.6 |
| b. | 6.2 |
| c. | 6.8 |
| d. | 8.6 |

ANS: C PTS: 1 DIF: Hard

30. Using the critical ratio (CR) rule, what would be the average number of jobs in the system?

|  |  |
| --- | --- |
| a. | 2.58 |
| b. | 3.04 |
| c. | 3.84 |
| d. | 3.96 |

ANS: B PTS: 1 DIF: Hard

31. Nanotech Composites produces components for the ship building industry, among others. Some of their key components are five parts of a jet pump for ship propulsion. Each of the five parts must pass through two work centers. Each work center has five 3-D printer machines. The machines in each work center are similar but not identical. Therefore, each of the five 3-D printers take a different amount of time to process each of the five products. Below, you will find the processing time (in days) for each product on the five machines in Work Center 1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Job | Machine 1 | Machine 2 | Machine 3 | Machine 4 | Machine 5 |
| A | 17 | 26 | 15 | 22 | 20 |
| B | 31 | 34 | 28 | 24 | 30 |
| C | 7 | 11 | 13 | 8 | 14 |
| D | 16 | 20 | 18 | 23 | 19 |
| E | 22 | 20 | 28 | 30 | 24 |

What would be the optimal allocation of jobs to machines in Work Center 1?

|  |  |
| --- | --- |
| a. | A - M1; B - M2; C - M3; D - M4; E - M5 |
| b. | A - M2; B - M4; C - M5; D - M3; E - M1 |
| c. | A - M2; B - M1; C - M4; D - M5; E - M3 |
| d. | A - M3; B - M4; C - M1; D - M5; E - M2 |

ANS: D PTS: 1 DIF: Hard

32. Nanotech Composites produces components for the ship building industry, among others. Some of their key components are five parts of a jet pump for ship propulsion. Each of the five parts must pass through two work centers. Each work center has five 3-D printer machines. The machines in each work center are similar but not identical. Therefore, each of the five 3-D printers take a different amount of time to process each of the three products. Below, you will find the processing time (in days) for each product on the five machines in Work Center 2.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Job | Machine 6 | Machine 7 | Machine 8 | Machine 9 | Machine 10 |
| A | 31 | 28 | 25 | 22 | 29 |
| B | 16 | 19 | 28 | 25 | 23 |
| C | 36 | 29 | 33 | 31 | 38 |
| D | 29 | 31 | 23 | 25 | 19 |
| E | 27 | 26 | 22 | 28 | 31 |

What would be the optimal allocation of jobs to machines in Work Center 2?

|  |  |
| --- | --- |
| a. | A - M9; B - M7; C - M6; D - M8; E - M10 |
| b. | A - M6; B - M7; C - M8; D - M9; E - M10 |
| c. | A - M9; B - M6; C - M7; D - M10; E - M8 |
| d. | A - M9; B - M6; C - M7; D - M8; E - M10 |

ANS: C PTS: 1 DIF: Hard

Marveltine Manufacturers produces a broad number of industrial products to order. Recently, they received orders for five products. These products must pass through two work centers. The process times for both work centers for the five jobs are given below.

|  |  |  |
| --- | --- | --- |
| Job | Process Time 1 | Process Time 2 |
| A | 15 | 22 |
| B | 24 | 16 |
| C | 7 | 29 |
| D | 19 | 19 |
| E | 20 | 22 |

33. What would be an optimal schedule for these jobs?

|  |  |
| --- | --- |
| a. | B - A - C - E - D |
| b. | C - B - D - A - C |
| c. | C - A - E - D - B |
| d. | C - B - A - D - E |

ANS: C PTS: 1 DIF: Medium

34. What would be the total time for these five jobs to pass through both work centers given the schedule identified in the previous question?

|  |  |
| --- | --- |
| a. | 96 |
| b. | 105 |
| c. | 115 |
| d. | 132 |

ANS: C PTS: 1 DIF: Medium

35. What would be the total idle time for the schedule identified?

|  |  |
| --- | --- |
| a. | 16 |
| b. | 19 |
| c. | 21 |
| d. | 25 |

ANS: C PTS: 1 DIF: Hard

Philo Manufacturing and Forgings has received orders for seven jobs. Each of the seven jobs must pass through two work centers. The times for processing at each work center for all seven jobs, along with their due dates, are provided below.

|  |  |  |  |
| --- | --- | --- | --- |
| Job | Process Time 1 | Process Time 2 | Due Date |
| A | 9 | 16 | 20 |
| B | 7 | 12 | 26 |
| C | 18 | 19 | 50 |
| D | 12 | 18 | 62 |
| E | 10 | 6 | 78 |
| F | 15 | 14 | 92 |
| G | 6 | 11 | 33 |

36. What would be an optimal schedule for the assignment of these seven jobs through the two work centers?

|  |  |
| --- | --- |
| a. | B - A - G - F - C - E - D |
| b. | A - C - B - G - E - D - F |
| c. | B - E - F - C - D - A - B |
| d. | G - B - A - D - C - F - E |

ANS: D PTS: 1 DIF: Hard

37. What would be the total time for these seven jobs to pass through both work centers given the schedule identified in the previous question?

|  |  |
| --- | --- |
| a. | 96 |
| b. | 102 |
| c. | 112 |
| d. | 124 |

ANS: B PTS: 1 DIF: Medium

38. What would be the total idle time for the schedule identified?

|  |  |
| --- | --- |
| a. | 16 |
| b. | 18 |
| c. | 22 |
| d. | 67 |

ANS: D PTS: 1 DIF: Hard

39. What would be the average tardiness for the schedule identified?

|  |  |
| --- | --- |
| a. | 10.0 |
| b. | 10.4 |
| c. | 11.1 |
| d. | 12.7 |

ANS: D PTS: 1 DIF: Medium

Lars and Cee Law Firm uses interns to process different types of legal documents. The company is working on a major case. A tremendous number of documents need to be reviewed and then sorted. The documents have been grouped into five categories. The law team has estimated the time to review the documents (Process Time 1) and the time to sort (Process Time 2). They have also estimated the due dates for these categories (see below).

|  |  |  |  |
| --- | --- | --- | --- |
| Job | Process Time 1 | Process Time 2 | Due Date |
| A | 7 | 4 | 11 |
| B | 2 | 4 | 28 |
| C | 14 | 10 | 16 |
| D | 16 | 8 | 24 |
| E | 19 | 6 | 31 |

40. What would be an optimal schedule for the assignment of these five categories of documents through the two work centers?

|  |  |
| --- | --- |
| a. | A - E - D - C - B |
| b. | B - C - D - E - A |
| c. | C - D - B - A - E |
| d. | D - C - A - B - C |

ANS: B PTS: 1 DIF: Medium

41. What would be the total time for these five categories of documents to pass through both work centers given the schedule identified in the previous question?

|  |  |
| --- | --- |
| a. | 44 |
| b. | 58 |
| c. | 62 |
| d. | 81 |

ANS: C PTS: 1 DIF: Medium

42. What would be the total idle time for the schedule identified?

|  |  |
| --- | --- |
| a. | 6 |
| b. | 11 |
| c. | 24 |
| d. | 0 |

ANS: D PTS: 1 DIF: Hard

43. What would be the average tardiness for the schedule identified?

|  |  |
| --- | --- |
| a. | 16.7 |
| b. | 20.6 |
| c. | 24.2 |
| d. | 28.6 |

ANS: B PTS: 1 DIF: Medium

Nanotech Composites produces components for the construction industry, among others. Some of their key components are six parts of a hydraulic jacks for self-elevating cranes. Each of the six parts must pass through two work centers. Below you will find the processing time (in days) for each part for the two work centers and the due date of the six parts.

|  |  |  |  |
| --- | --- | --- | --- |
| Job | Process Time 1 | Process Time 2 | Due Date |
| A | 1 | 6 | 10 |
| B | 12 | 15 | 30 |
| C | 10 | 4 | 13 |
| D | 8 | 2 | 11 |
| E | 3 | 12 | 20 |
| F | 5 | 10 | 22 |

44. What would be an optimal schedule for the assignment of these six parts through the two work centers?

|  |  |
| --- | --- |
| a. | A - F - D - C - B - F |
| b. | A - E - F - B - C - D |
| c. | D - C - B - E - F - A |
| d. | C - D - B - A - E - F |

ANS: B PTS: 1 DIF: Medium

45. What would be the total time for these six parts to pass through both work centers given the schedule identified in the previous question?

|  |  |
| --- | --- |
| a. | 39 |
| b. | 50 |
| c. | 54 |
| d. | 52 |

ANS: B PTS: 1 DIF: Medium

46. What would be the total idle time for the schedule identified?

|  |  |
| --- | --- |
| a. | 0 |
| b. | 33 |
| c. | 42 |
| d. | 51 |

ANS: B PTS: 1 DIF: Hard

47. What would be the average tardiness for the schedule identified?

|  |  |
| --- | --- |
| a. | 11.3 |
| b. | 12.4 |
| c. | 16.5 |
| d. | 16.8 |

ANS: C PTS: 1 DIF: Hard

Marshall’s Shipyards produces high-speed pleasure craft. Their boats have carbon composite hulls that require a two-stage process. Currently, Marshall’s Shipyards have orders for five different types of boats. The process times for the five boats though each production process is given below, as are the due dates.

|  |  |  |  |
| --- | --- | --- | --- |
| Hull | Process Time 1 | Process Time 2 | Due Date |
| A | 10 | 12 | 41 |
| B | 14 | 26 | 58 |
| C | 8 | 19 | 16 |
| D | 29 | 9 | 34 |
| E | 10 | 32 | 71 |

48. What would be the total time for these five hulls to pass through both work centers for an optimal schedule.

|  |  |
| --- | --- |
| a. | A - C - E - D - B |
| b. | A - E - B - D - C |
| c. | B - D - E - C - A |
| d. | C - A - E - B - D |

ANS: D PTS: 1 DIF: Medium

49. What would be the total idle time for the schedule identified?

|  |  |
| --- | --- |
| a. | 38 |
| b. | 50 |
| c. | 65 |
| d. | 77 |

ANS: C PTS: 1 DIF: Medium

50. What would be the average tardiness for the schedule identified?

|  |  |
| --- | --- |
| a. | 20.6 |
| b. | 22.8 |
| c. | 24.4 |
| d. | 30.2 |

ANS: C PTS: 1 DIF: Hard