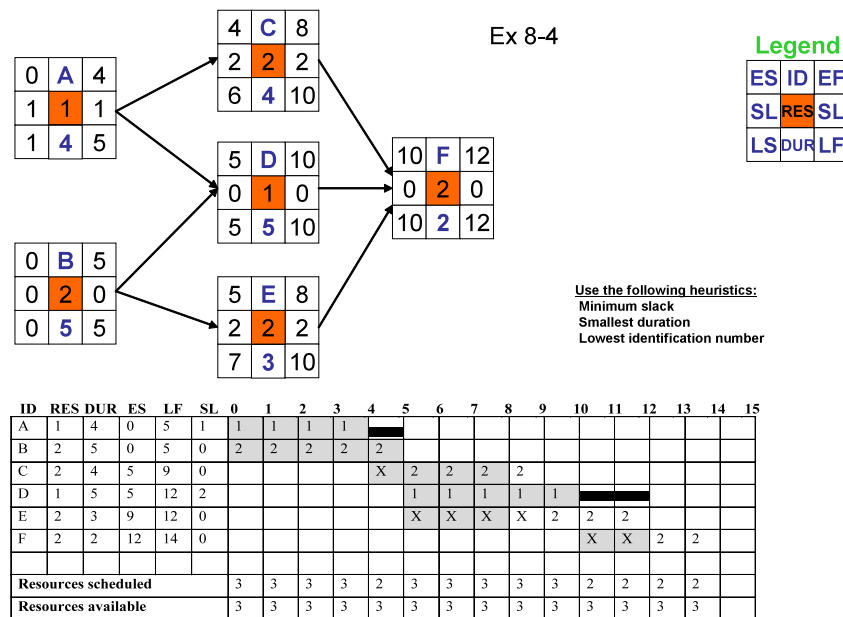**4. You have prepared the following schedule for a project in which the key resource is a tractor. There are three tractors available to the project. Activities A and D require one tractor to complete while Activities B, C, E and F require two tractors.**

Develop a resource-constrained schedule in the loading chart that follows. Use the parallel method and heuristics given. Be sure to update each period as the computer would do. Record the early start (ES), late finish (FL) and slack (SL) for the new schedule.
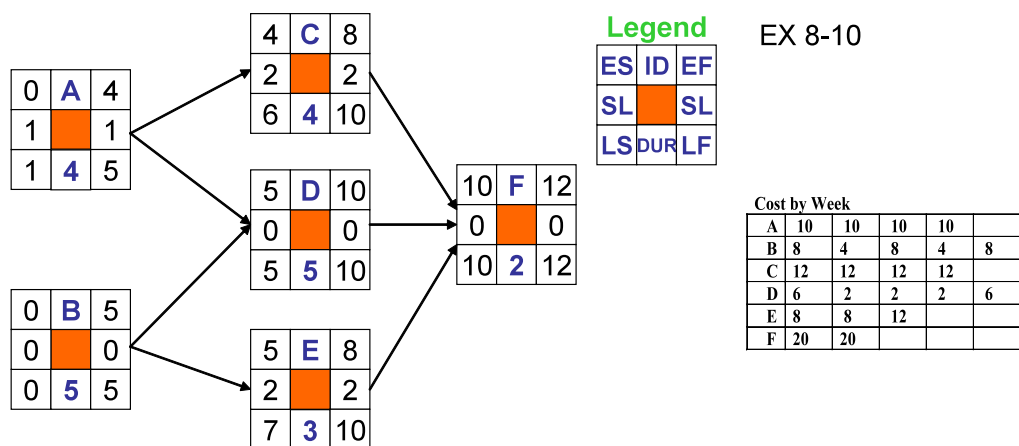

Ex 8-4

Legend

Use the following heuristics:
- Minimum slack
- Smallest duration
- Lowest identification number

ID	RES	DUR	ES	LF	SL	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	1	4	0	5	1	1	1	1	1	■											
B	2	5	0	5	0	2	2	2	2	2											
C	2	4	5	9	0					X	2	2	2	2							
D	1	5	5	12	2						1	1	1	1	1	■	■				
E	2	3	9	12	0						X	X	X	X	2	2	2				
F	2	2	12	14	0											X	X	2	2		
Resources scheduled						3	3	3	3	2	3	3	3	3	3	2	2	2	2		
Resources available						3	3	3	3	3	3	3	3	3	3	3	3	3	3		

Log of parallel method of scheduling: Exercise 4

PERIOD	ACTIVITY	CHANGES
0–1	B	Schedule Activity B (first by minimum slack rule)
	A	Schedule Activity A
1–2	–	No changes
2–3	–	No changes
3–4	–	No changes
4–5	C	Delay ES of Activity C to 5. Reduce slack to 1
5–6	D	Schedule Activity D (minimum slack rule)
	C	Schedule Activity C
	E	Delay ES of Activity E to 6. Reduce slack to 1
6–7	E	Delay ES of Activity E to 7. Reduce slack to 0
7–8	E	Delay ES of Activity E to 8. Reduce slack to –1
	F	Delay ES of Activity F to 11. Reduce slack to –1
8–9	E	Delay ES of Activity E to 9. Reduce slack to –2
	F	Delay ES of Activity F to 12. Reduce slack to –2
9–10	E	Schedule Activity E
10–11	–	No changes
11–12	–	No changes
12–13	F	Schedule Activity F

8. **Given the time-phased work package, complete the baseline budget form for the project.**

Time-phased budget ($ 000)

Week

Task	Budget	0	1	2	3	4	5	6	7	8	9	10
Activity 1	4	4										
Activity 2	6		1	3	2							
Activity 3	10		2	4	2	2						
Activity 4	8						2	3	3			
Activity 5	3									2	1	
Total	31	4	3	7	4	2	2	3	3	2	1	
Cumulative		4	7	14	18	20	22	25	28	30	31	

10. **Given the time-phased work packages and network, complete the baseline budget form for the project.**

Legend

ES	ID	EF
SL		SL
LS	DUR	LF

EX 8-10

Cost by Week

A	10	10	10	10	
B	8	4	8	4	8
C	12	12	12	12	
D	6	2	2	2	6
E	8	8	12		
F	20	20			

ID	Budget	0	1	2	3	4	5	6	7	8	9	10	11	12
A	40	10	10	10	10									
B	32	8	4	8	4	8								
C	48					12	12	12	12					
D	18						6	2	2	2	6			
E	28						8	8	12					
F	40											20	20	
Total	206	18	14	18	14	20	26	22	26	2	6	20	20	
Cumulative		18	32	50	64	84	110	132	158	160	166	186	206	

1. **Given the network plan that follows, compute the early, late and slack times. What is the project duration? Using any approach you wish (e.g. trial and error), develop a loading chart for resource, Electrical Engineers (EE), and resource, Mechanical Engineers (ME). Assume only one of each resource exists. Given your resource schedule, compute the early, late and slack times for your project. Which activities are now critical? What is the project duration now? Could something like this happen in real projects?**
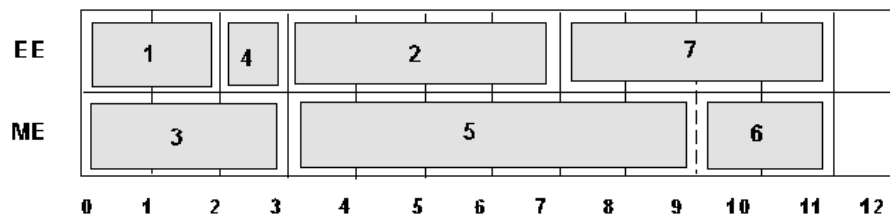
Instead of taking nine days the duration has been extended to 11 days and all activities are critical. Resource shortages are common in real projects and this problem demonstrates the impact resource constraints can have on project schedules.

Exercise 8-1

Use any approach you wish to develop a plan and resource schedule for the project below.

0	1	2
0	EE	0
0	2	2

→

2	4	3
0	EE	0
2	1	3

→

3	5	9
0	ME	0
3	6	9

0	2	4
3	EE	3
3	4	7

→

4	6	6
3	ME	3
7	2	9

0	3	3
2	ME	2
2	3	5

→

3	7	7
2	EE	2
5	4	9
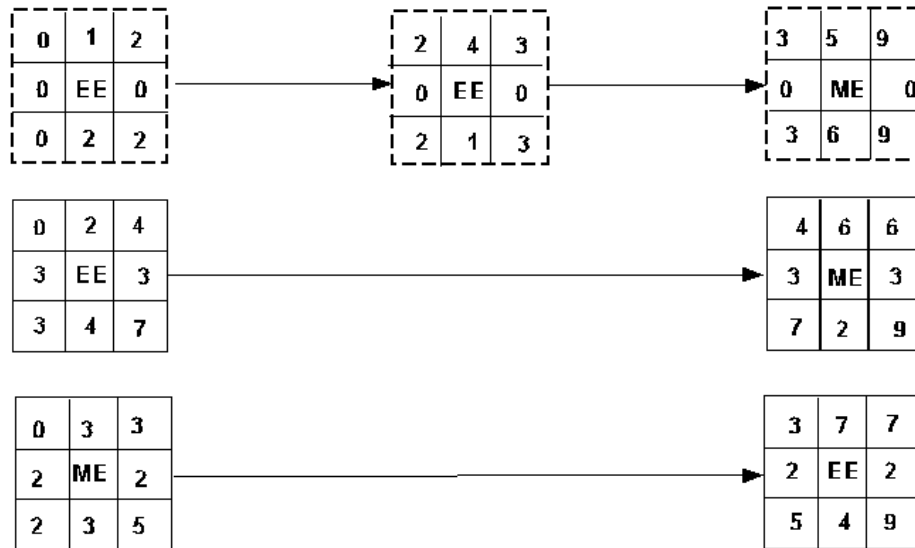
DEVELOP A LOADING SCHEDULE FOR EACH RESOURCE BELOW.

EE: 1, 4, 2, 7
ME: 3, 5, 6

Scale: 0 1 2 3 4 5 6 7 8 9 10 11 12

FILL IN THE TIMES BELOW FOR A RESOURCE ACTIVITY SCHEDULE

	ES	LS	EF	LF	SL
1-EE	0	0	2	2	0
2-EE	3	3	7	7	0
3-ME	0	0	3	3	0
4-EE	2	2	3	3	0
5-ME	3	3	9	9	0
6-ME	9	9	11	11	0
7-EE	7	7	11	11	0

LEGEND

ES	ID	EF
SL	↑	SL
LS	DUR	LF

RESOURCE