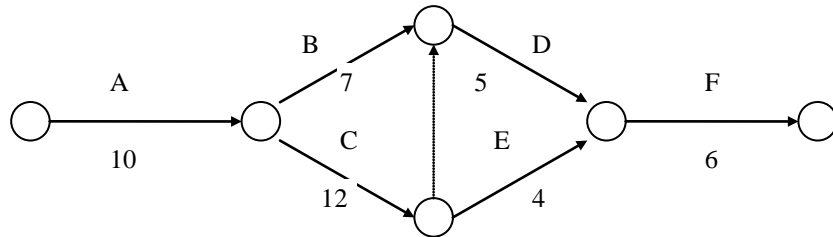


**Homework No. 8**  
**(Solution)**

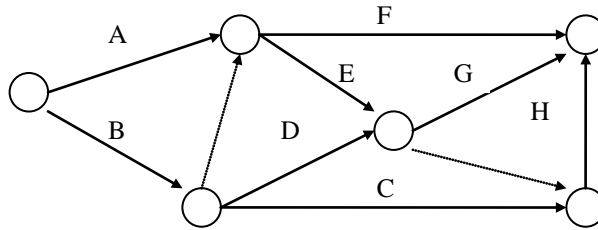
**Problem 1.**



- (a) Critical path = A - C - D - F. Duration = 10 + 12 + 5 + 6 = 33.  
 (b) New critical path = A - C - E - F. Duration = 10 + 12 + 4 + 6 = 32.

**Problem 2.**

(a)



b)

Activity	Duration $\left(\frac{a + 4m + b}{6}\right)$	ES	EF	LS	LF
A	10.33	0	10.33	0	10.33
B	1.08	0	1.08	9.25	10.33
C	20.17	1.08	21.25	11.12	31.29
D	5.17	1.08	6.25	14.99	20.16
E	9.83	10.33	20.16	10.33	20.16
F	2.08	10.33	12.41	30.25	32.33
G	12.17	20.16	32.33	20.16	32.33
H	1.04	21.25	22.29	31.29	32.33

Critical path (shaded area) = A - E - G, and Duration = 32.33 days

(c) Standard deviation of the critical path =  $\sqrt{\frac{36+25+81}{36}} = 1.98$

$Z = -3/1.98 = -1.51$

From Normal distribution tables, probability = 6.5522 %

- (d) Second critical path = B-E-G Duration = 23.08 days  
Third critical path = B-C-H Duration = 22.28 days

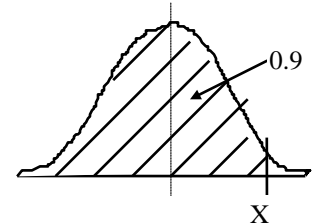
- (e) Four most critical activities are A, B, E and G.

**Reason:** These four activities are included in the first and second critical paths.

- (f) From Normal distribution tables, for probability = 0.9,  $Z = 1.28$ .

$$\frac{X - CT}{\sigma_{CT}} = 1.28$$

or  $X = 1.28\sigma_{CT} + CT = 1.28(1.98) + 32.33 = 34.86$  days



- (g)

(i) **ACTIM**

ACT.	A	B	E	C	D	G	F	H
ACTIM	32.33	23.08	22.00	21.21	17.34	12.17	2.08	1.04
DURATION	10.33	1.08	9.83	20.17	5.17	12.17	2.08	1.04
RES.	2	1	1	2	1	1	2	1
TEARL	0	0	10.33	1.08	1.08	20.16	10.33	30.50
TSTART	0	0	10.33	10.33	1.08	20.16	30.50	32.33
TFIN	10.33	1.08	20.16	30.50	6.25	32.33	32.58	33.37

TNOW	0	1.08	6.25	10.33	20.16	30.50	32.33
Res. Avail.	3,2,0	1,0	1	3,2,0	1,0	2,0	1,0
Act. Allowed	A,B	C,D	C	E,C,F	G,F	F,H	H
Iteration #	1	2	3	4	5	6	7

Duration = 33.37 days.

(ii) **ACTRES**

ACT.	A	B	C	E	D	G	F	H
ACTRES	42.66	42.46	41.38	22.00	17.34	12.17	4.16	1.04
DURATION	10.33	1.08	20.17	9.83	5.17	12.17	2.08	1.04
RES.	2	1	2	1	1	1	2	1
TEARL	0	0	1.08	10.33	1.08	20.16	10.33	30.50
TSTART	0	0	10.33	10.33	1.08	20.16	30.50	32.33
TFIN	10.33	1.08	30.50	20.16	6.25	32.33	32.58	33.37

TNOW	0	1.08	6.25	10.33	20.16	30.50	32.33
Res. Avail.	3,1,0	1,0	1	3,1,0	1,0	2,0	1,0
Act. Allowed	A,B	C,D	C	C,E,F	G,F	F,H	H
Iteration #	1	2	3	4	5	6	7

Duration = 33.37 days.

**Problem 3.**

(a) Using SPT, the sequence is:

Job	$J_6$	$J_2$	$J_5$	$J_4$	$J_3$	$J_7$	$J_1$
$t_j$	4	5	5	7	8	8	10
$F_j$	4	9	14	21	29	37	47

Mean flow time =  $(4+9+14+21+29+37+47)/7 = 23$ 

(b) Using LPT, the sequence is:

Job	$J_1$	$J_7$	$J_3$	$J_4$	$J_5$	$J_2$	$J_6$
$t_j$	10	8	8	7	5	5	4
$F_j$	10	18	26	33	38	43	47

Mean flow time =  $(10+18+26+33+38+43+47)/7 = 30.71$ 

Therefore,

Mean flow time with LPT &gt; Mean flow time with SPT.

**Problem 4.** Using Johnson's Algorithm, the optimal sequence is $J_{10} - J_5 - J_8 - J_7 - J_4 - J_1 - J_2 - J_9 - J_3 - J_6$ .

The makespan = 54.

**Problem 5.** Since minimum  $M1 = 9 > 8 =$  Maximum  $M2$ , we can apply Johnson's Algorithm by converting the three machine problem to a two machine problem.

Job	M1+M2	M2+M3
1	18	15
2	17	14
3	22	19
4	10	11
5	14	12
6	19	11

The optimal sequence is  $J_4 - J_3 - J_1 - J_2 - J_5 - J_6$ .

The makespan = 81.