15. Sequencing

A. Activities

1) The data given below indicate the processing time in hours of 5 jobs A, B, C, D and E on two machines M_1, M_2, M_3

Job	A	B	C	D	E	Total
Machine M_1	4	13	7	12	6	42
Machine M_2	3	15	5	6	11	40

Using the optimal sequence alongthem, the optimal sequence is

M_1 →	E	B	D	C	A	M_2

The working table is

Job	Machine M_1		Machine M_2	
	In time	Out time	In time	Out time
E	0	6	6	17
	6	19	19	34
D	19	31	34	40
	31	38	40	45
A	38	42	45	48

∴ Total elapsed time = 48 hrs.

Idle time for machines

M_1 = 48 - 42 = 6 hrs.

M_2 = 48 - 40 = 8 hrs.

2) Given five jobs, each of which is to be processed through three machines A, B and C in the order ABC. Processing time in hours are

Job	1	2	3	4	5	Total
A	3	8	7	5	4	27

B	4	5	1	2	3	15
C	7	9	5	6	10	37

Min (A) = 3, Max (B) = 5, Min (C) = 5

since Min (C) = 7 Max (B) is satisfied, the problem can be converted into 5 jobs and 2 machine problem. Consider two fictitious machines G and H

Such that

G = A + B

H = B + C

The problem is

Job	1	2	3	4	5
G	7	13	8	7	7
H	11	14	6	8	13

Using optimal sequence algorithm. We get following optimal sequence.

4	1	5	2	3

The working table is

Job	Machine A		Machine B		Machine C	
	In time	Out time	In time	Out time	In time	Out time
4	0	5	5	7	7	13
	5	8	8	12	13	20
5	8	12	12	15	20	30
	12	20	20	25	30	39
3	20	27	27	28	39	44

Minimum elapsed time = 44 hr

Idle time for machines

A = 44 - 27 = 17 hrs

B = 44 - 15 = 29 hrs

C = 44 - 37 = 7 hrs

B. Solve the Following

Q.1. There are six jobs each of which is to be processed through the machines M_1 and M_2, in the order M_1 M_2. The processing time is given in hours. Determine the sequence of these jobs which minimizes the total elapsed time and the minimum elapsed time. Also find the idle times for the machines M_1 and M_2:

Jobs	1	2	3	4	5	6
Processing time on M_1	5	9	4	7	8	5
Processing time on M_2	8	4	8	3	6	6

Min(M_{i1}, M_{i2}) = 3, ... which corr to M_2 ∴ Job 4 is Processed in last.

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Problem reduce to 5 jobs.
Min (M_{i1}, M_{i2}) = 4 which covers to M_1 & M_2

3				2	4

The Problem reduce to 3 jobs
Min (M_{i1}, M_{i2}) = 5 which corresponds to M_1.

	1	6		2	4

	6	1		2	4

The remaining must be

Processed next to Job 6 or Job 1.

3	1	6	5	2	4

OR.

3	6	1	5	2	4.

Total elapsed time :⇒

Job Sequence	M_1 In	M_1 Out	M_2 In	M_2 Out	Idle time for M_2
3	0	4	4	12	4
1	4	9	12	20	0
6	9	14	20	26	0
5	14	22	26	32	0
2	22	31	32	36	0
4	31	38	38	41	2

The min total elapsed time T = 41 hrs.
Idle time for M_1 = 41 − 38 = 3 hrs.
Idle time for M_2 = 4 + 2 = 6 hrs.

Q.2. Find the sequence that minimizes the total elapsed time required to complete the following tasks. The table below gives the processing time in hours. Also find the minimum elapsed time and idle times for both the machines:

Jobs	1	2	3	4	5
M_1	3	7	4	5	7
M_2	6	2	7	3	4

Min $(M_{i1}, M_{i2}) = 2$ which correspond to M_2 o/o Job 2 is processed in last

				2

Problem reduce to 4 jobs, Here Min $(M_{i1}, M_{i2}) = 3$ which correspond to both M_1 and M_2

1			4	2

Now Problem reduce to 2 jobs Min $(M_{i1}, M_{i2}) = 4$ which correspond to both M_1 & M_2 Job 3 is processed first next to Job 1 and Job 5 is Processed in last next to Job 4. Thus the optimal seq is

1	3	5	4	2

Total elapsed time :⇒

Job sequence	M_1 In	M_1 Out	M_2 In	M_2 Out	Idle time for M_2
1	0	3	3	9	3
3	3	7	9	16	0
5	7	14	16	20	0
4	14	19	20	23	3
2	19	26	26	28	0

Total elapsed time T = 28 hours

Idle time for M_2 = 6 Hours.

Idle time for M_1

= T - {Sum of Pro. time of all five jobs on M_1}.

= 28 - 26

= 2 Hours.

Q.3. Suppose there are five jobs each must go through machines M_1, M_2 and M_3 in the order $M_1M_2M_3$. Processing times in hours are given below. Determine the optimal sequence and total elapsed time. Also find the idle times for three machines:

Jobs	1	2	3	4	5
M_1	8	5	4	6	5
M_2	6	2	9	7	4
M_3	10	13	11	10	12

Here min $M_1 = 4$, Max $M_2 = 9$, Min $M_3 = 10$.

Since Min $M_3 \geq$ Max M_2 is satisfied, the problem can be converted into two machines problem. Let G and H be two fictitious machines such that $G = M_1 + M_2$ and $H = M_2 + M_3$. Then the Problem written as

Jobs	1	2	3	4	5
G	14	7	13	13	9.
H	16	15	20	17	16

Observe that Min(G, H) = 7 corresponds to Job 2 on G

∴ Job 2 is placed first in sequence.

2				

then sequence problem reduced to

Jobs	1	3	4	5
G	14	13	13	9
H.	16	20	17	16

Now :

Min (G, H) = 9 corresponds to job 5

2	5			

on machine G which is placed in second in sequence. then Problem reduced to

Jobs	1	3	4.
G	14	13	13
H.	16	20	17.

Now, Min (G, H) = 13 corresponds to Job 3 on machine G as well as job 4 on remaining job 1 placed last in the sequence. we consider the optimal sequence as:

2	5	3	4	1

Total elapsed time :⇒

Jobs	M_1		M_2		M_3	
	In	Out	In	Out	In	Out
2 (5, 2, 13)	0	5	5	7	7	20
5 (5, 4, 12)	5	10	10	14	20	32
3 (4, 9, 11)	10	14	14	23	32	43
4 (6, 7, 10)	14	20	23	30	43	53
1 (8, 6, 10)	20	28	30	36	53	63

Total elapsed time (T) = 63 hours

Idle time for M_1 = 63 − 28 = 35 hours.

Idle time for M_2 = (63 − 36) + 5 + 3 = 35 hours.

Idle time for M_3 = 11 hours.

Sign of Teacher :