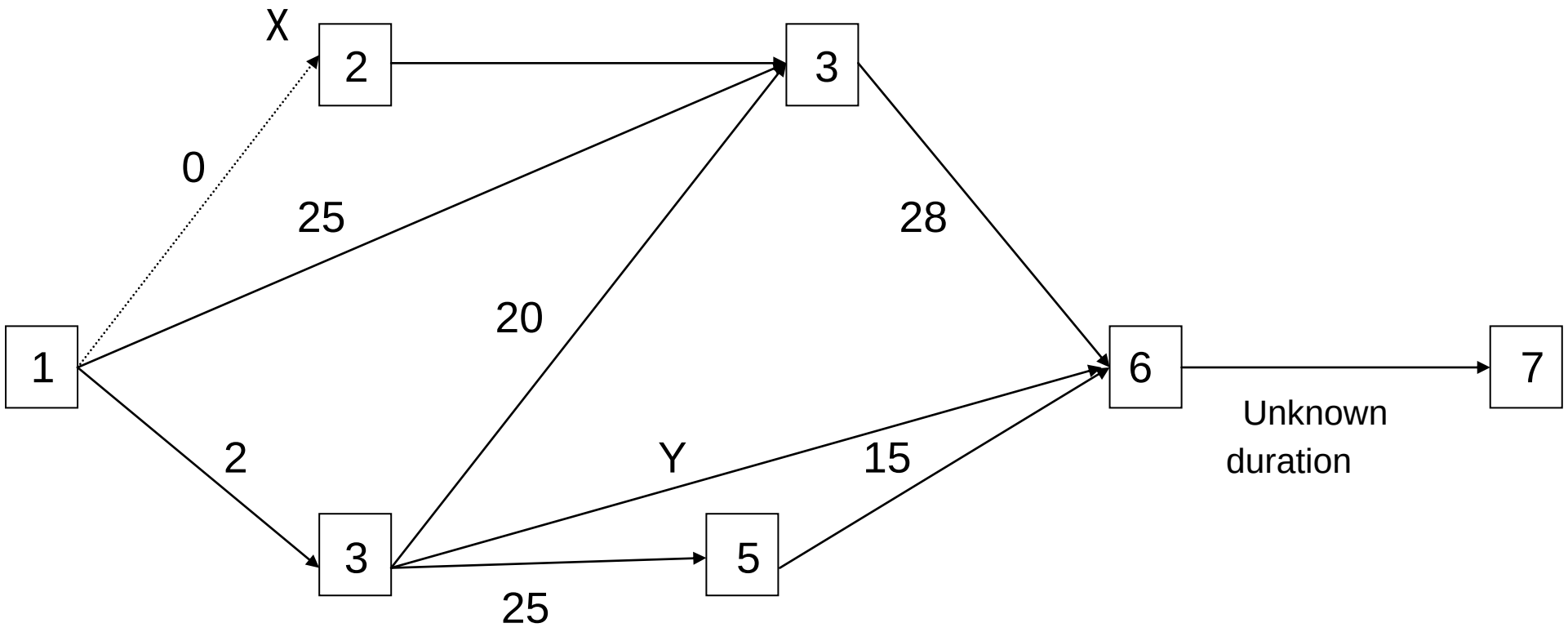
PROJECT MANAGEMENT PROBLEMS

PROBLEM 1

The activities X and Y of a complex IT project (see next page) represent the two main installation works of a large computer network. Each one of the installation works can be carried out by four candidates IT companies according to their corresponding submitted offers, shown in the table below.

Activity	X				Y			
Company	A	B	C	D	E	F	G	H
Cost (000 €)	101	70	80	90	91,5	95	70	85
Time (man hours)	18	28	35	23	30	25	52	45

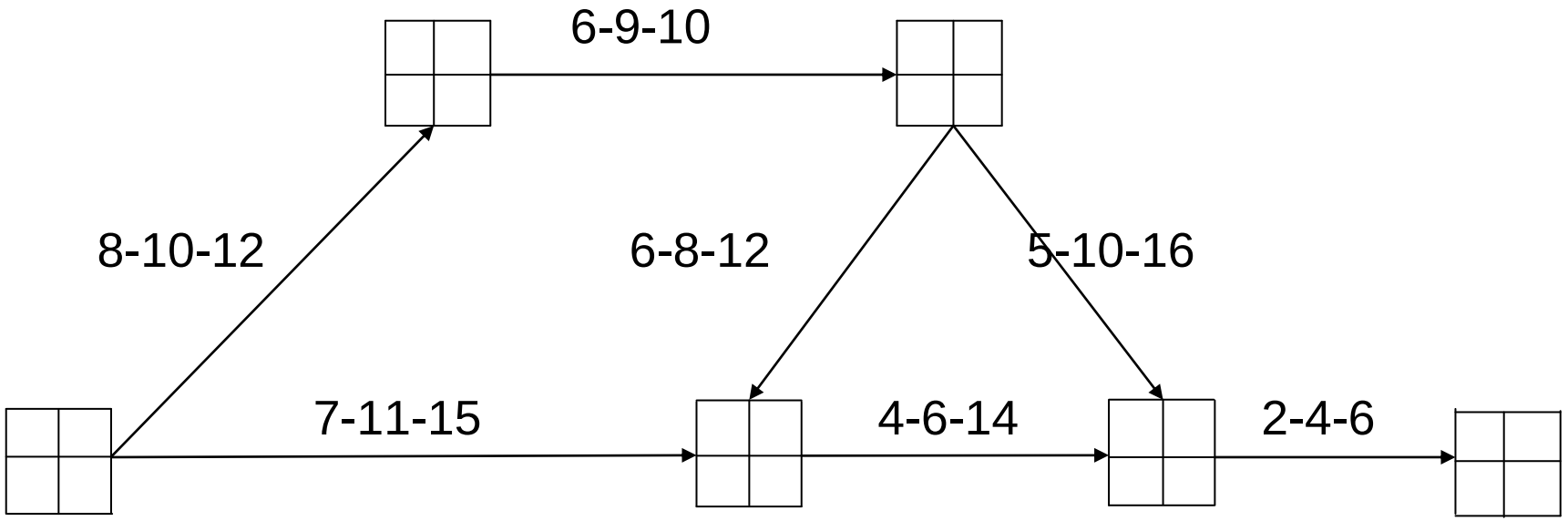
Identify the company, to which each one of the activities of X and Y should be assigned in order to complete the project in the minimum possible time without any undue costs. Justify your answer in detail.



PROJECT MANAGEMENT - PROBLEMS

PROBLEM 2

The three times indicated next to each activity of the following network is its minimum, most likely and maximum duration respectively.



Provide answers to the following questions:

a) Which activities constitute the critical path?

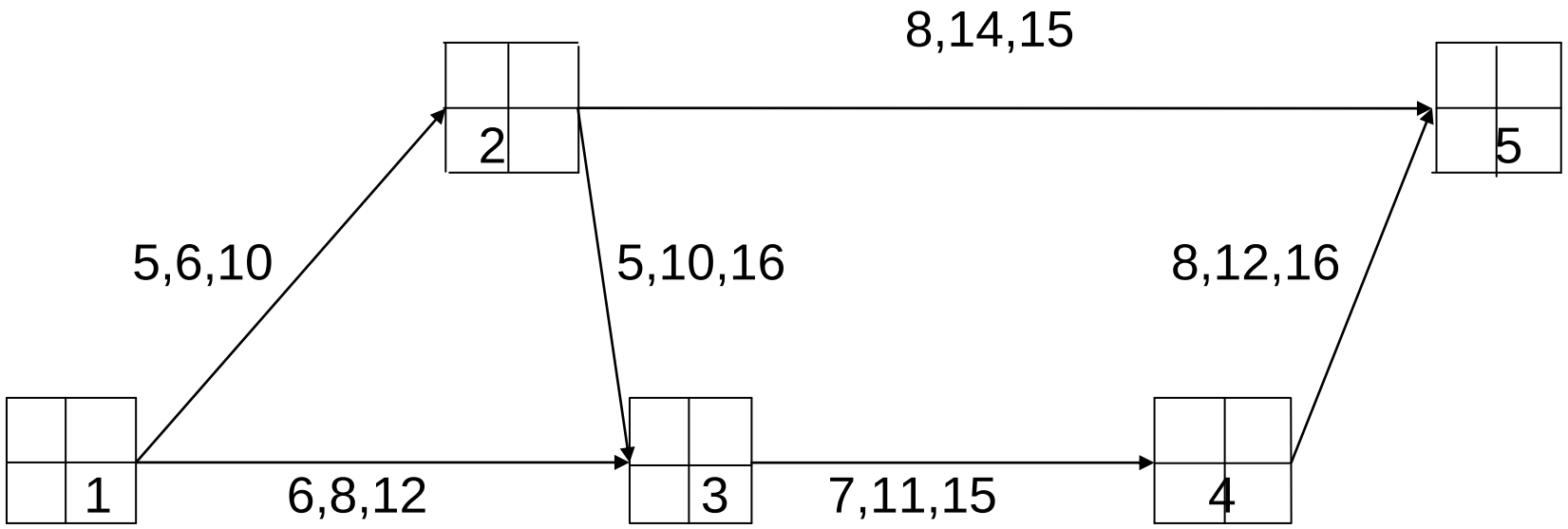
b) Which is the mean duration of the project?

c) Which is the standard deviation of the critical path?

d) Which is the expected completion time of the project with probability 10%, 30%, 80% and 95% respectively?

PROBLEM 3

The implementation of a project requires carrying out the activities noted in the following network. For each activity three estimates of the required duration (in days) are given.



Find the times, in which the project can be completed with probability 20%, 50% and 80% respectively.

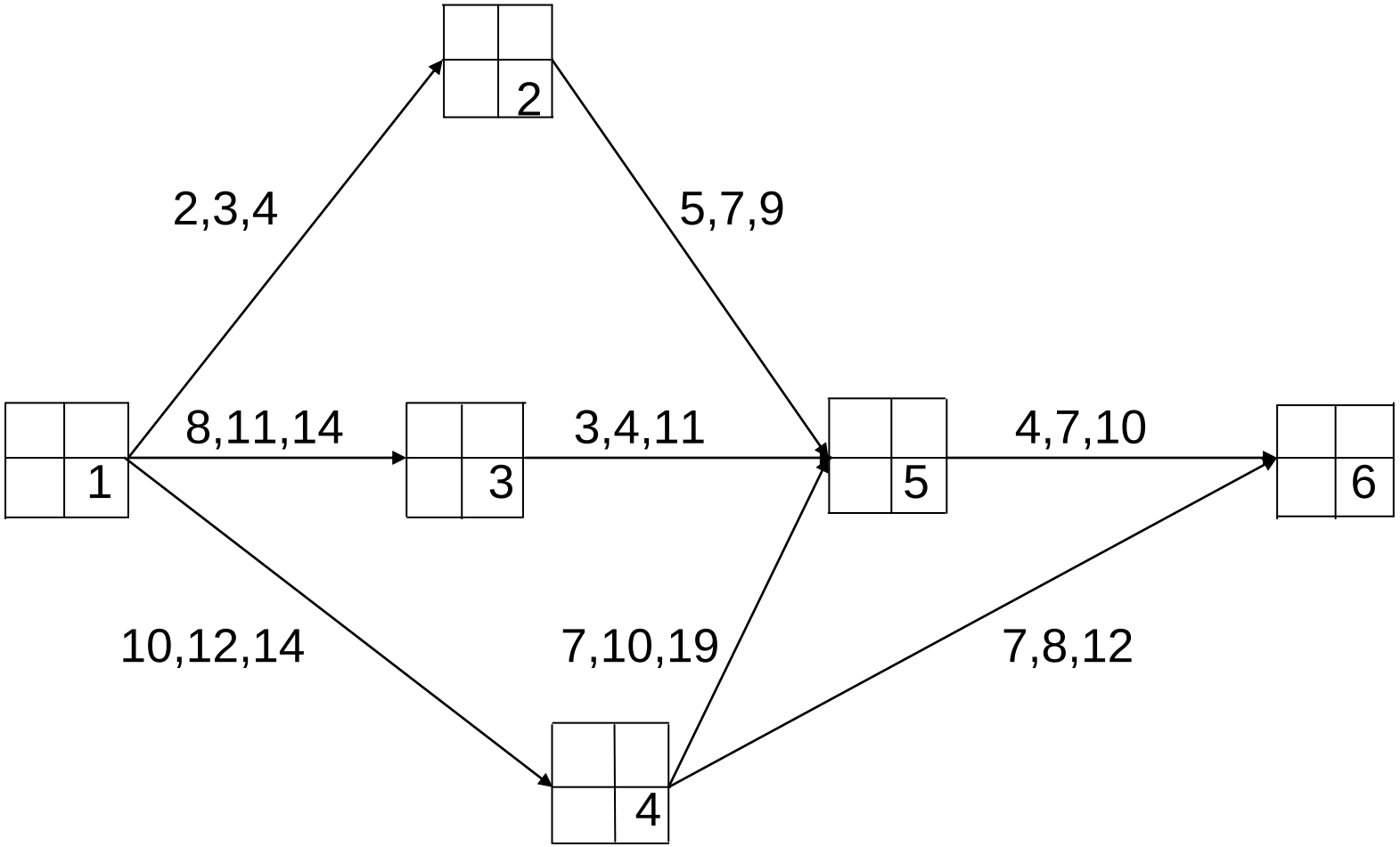
PROBLEM 4

Consider the following network and calculate:

a) The probability of completing the project in 35 time units.

b) The probability of completing the project in 27 time units.

c) The probability of completing event 5 in 20 time units.


2
2,3,4
5,7,9
8,11,14
3,4,11
4,7,10
1
3
5
6
10,12,14
7,10,19
7,8,12
4

PROBLEM 5

The process of analyzing a system consists of 20 basic activities. After solving the corresponding network it was found that the critical path consists of six activities, with the following features.

Activity	Average duration (hours)	Standard deviation (hours)
A	8	1.5
D	14	2
G	10	1
N	12	0
P	6	0.5
Y	10	2.5

Design a complete p-T diagram (probability of completion – completion time) of five points with different given probabilities of completing the entire project.
Draw up also the relevant numeric array of probabilities and corresponding durations.

PROBLEM 6

A product is produced according to the following procedure. Machines M1, M2 and M3 produce components A, B, C and D. Immediately after production, every component is tested for the correctness of its construction.
The assembly of the components consists of the following phases:
Phase 1: Assembly of A and B.
Phase 2: Assembly of the product of phase 1 and C.
Phase 3: Assembly of the product of phase 2 and D.

The final product is tested with the use of specialized equipment. The activities and times consisting the assembly line of the product are presented in the following table.

		Duration		
Code	Activity description	Optimistic	Most likely	Pessimistic
A1	Supply of machine M1	1	2	3
A2	Supply of machine M2	1	3	5
A3	Supply of machine M3	1	2	3
A4	Production of product A	1	2	3
A5	Production of product B	1	1.5	5
A6	Production of product Γ	1.5	3	4.5
A7	Production of product Δ	2	9	10
A8	Control of A	1	3	5
A9	Control of B	2	3	10
A10	Control of Γ	1	3	5
A11	Control of Δ	12	18	33
A12	Assembly of A and B	1	3	5
A13	Assembly of A and B with C	5	6	13
A14	Final assembly	1.5	3	4.5
A15	Construction of final control device	16	18	32
A16	Control of the final product	3	4	11

Answer the following questions:

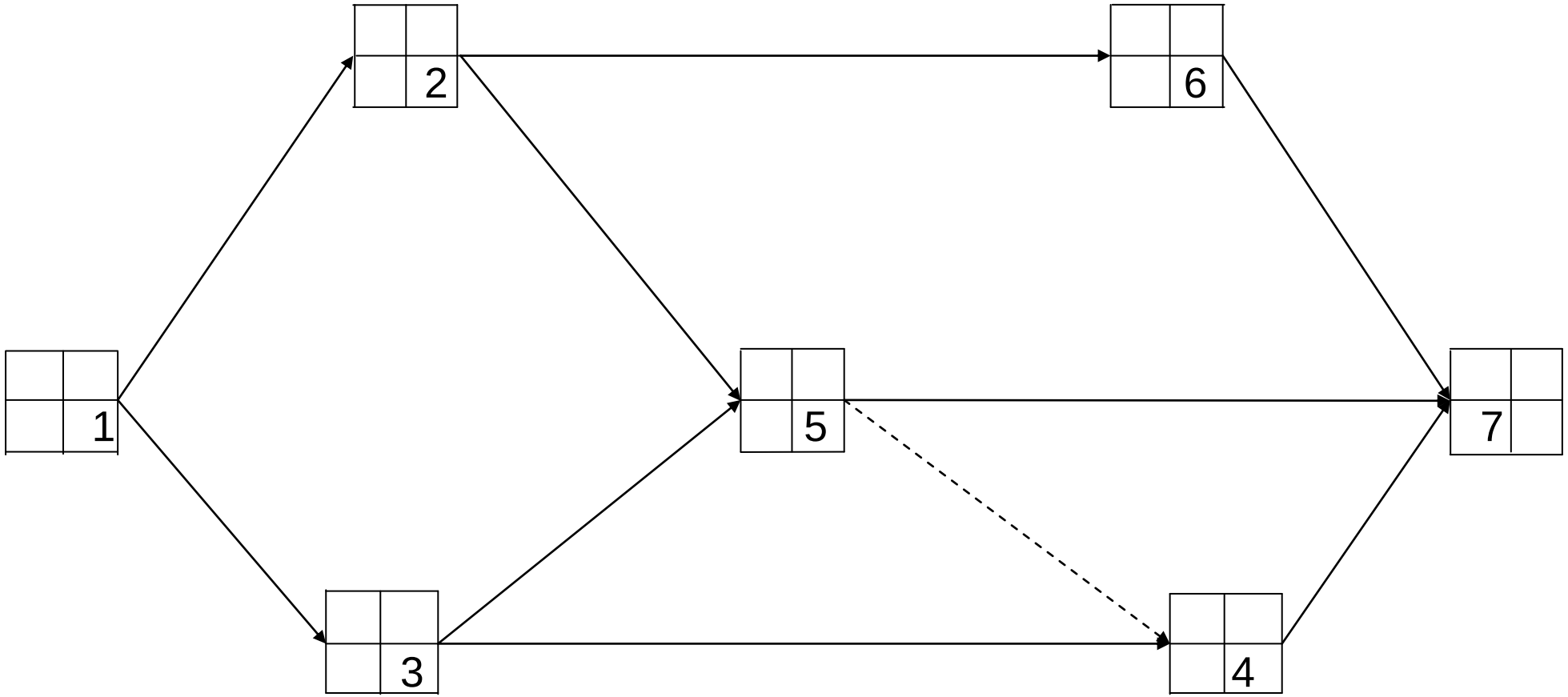
a) Design the network corresponding to the complete production of the first batch of the final product.

b) Identify the critical activities and the statistical characteristics of the critical path.

c) Find the recommended project completion time with delay probability of just 1%.

PROBLEM 7

To complete a small, though significant project some tasks need to be performed in the order indicated in the following network.



Durations, costs and rates of cost coefficients of all activities are given in the following table. The indirect cost is € 20 per day.

Activity	Favorable time (days)	Minimum cost (€)	Minimum time (days)	Maximum cost (€)
(I,j)	$t_0(i,j)$	$k_0(i,j)$	$t_1(i,j)$	$k_1(i,j)$
1-2	8	160	5	205
1-3	10	150	5	200
2-5	9	225	6	300
2-6	11	275	7	355
3-4	7	126	4	186
3-5	8	144	4	204
4-5	-	-	-	-
4-7	8	200	6	260
5-7	9	144	5	184
6-7	6	180	4	230

Specify the project duration corresponding to the minimum total implementation cost.

Find also find the recommended durations of all project activities.

PROBLEM 8

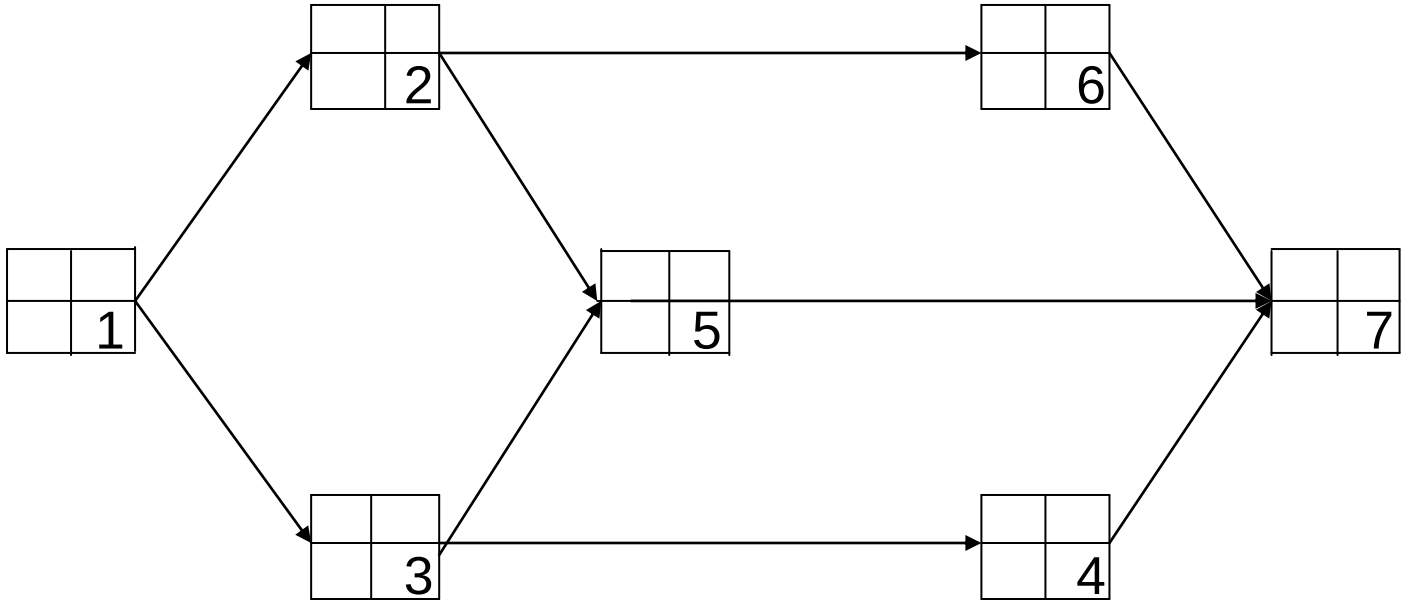
The activities needed to be carried out for the implementation of a project are presented in the network of next page. The direct cost of each activity is related to its duration according to the following table.

Activity (i, j)	Duration (months)	Cost (€)	Minimum duration	Cost (€)
1-2	2	1500	2	1500
1-3	4	3000	4	3000
2-3	3	4000	2	6000
2-4	2	2000	2	2000
3-4	5	1500	3	4500
3-5	1	2000	1	2000
4-5	6	4000	4	7000

The indirect cost is a function of project duration, and is given by the linear function $k_e = 500_*t$, where t is the project duration in months. If the developer is implicated in a penalty of € 2000 for each month of project delivery beyond the 13^{th} month, identify the economically most favourable duration for the completion of the project.

PROBLEM 9

In order to complete a project it is necessary to perform nine tasks according to the following network.



Also in the table below are given the ideal and crash durations, the corresponding direct costs, as well as the cost coefficients c (i,j) of each activity.

Activity	Ideal duration (months)	Minimum cost	Crash duration (months)	Maximum cost	Cost coefficient (€/month)
(i,j)	t_{max}	K_{min}	t_{min}	K_{max}	c(i,j)
1-2	8	160.000	5	205.000	15.000
1-3	10	50.000	5	200.000	10.000
2-5	9	225.000	6	300.000	25.000
2-6	11	275.000	7	355.000	20.000
3-4	7	126.000	4	186.000	20.000
3-5	8	144.000	4	204.000	15.000
4-7	8	200.000	6	260.000	30.000
5-7	9	144.000	5	184.000	10.000
6-7	6	180.000	4	230.000	25.000

If the indirect project cost is € 40.000 per month, determine the duration for the completion of the project at minimum total cost.

PROBLEM 10

The analysis of an IT system composed of 9 sub-tasks, whose sequence, durations and required manpower are presented in the following table.

Activity	Directly preceding	Duration (hours)	Manpower (number of persons)
A	-	7	6
B	-	2	2
C	-	3	4
D	A	2	5
E	A	4	4
F	B	4	3
G	D, F	13	2
H	B, C	20	3
I	E	7	2

Answer the following:

a) Drawing of the network.

b) Identifying the critical path with the simplest way.

c) Designing the diagrams of resource aggregation and resource smoothing.

d) Is there a capability of further reducing the total required human resources, if the project duration is crashed?

   Design the appropriate resource leveling diagram.

PROBLEM 11

A small project consists of nine activities, whose individual (precedence, durations, resources) are given in the following table.

Activity	A	B	C	D	E	F	G	H	I
Following activity/ies	-	-	-	A,B	B	C	C,E	G	D,H
Duration (days)	1	2	7	1	3	2	1	3	4
Human resources	3	4	2	4	2	4	1	2	2

Required:

a) Draw the corresponding network.

b) Solve the network and identify the critical path.

c) Which are the minimum required resources to complete the work in the minimum possible time?

PROBLEM 12

For the completion of a project the activities listed in the table below must be carried out.

Activity	Preceding activities	Duration (days)	Required resources (electricians – mechanics)
a	-	3	3-4
b	-	5	1-5
c	-	4	2-2
d	c	1	2-3
e	c	4	1-3
f	a	4	2-4
g	b, d, e	4	1-1
h	f	2	3-4
ı	e	6	0-2

As the project should be finished as quickly as possible, it is necessary to plan it accordingly.

Do gradual resource leveling for both types of project resources.