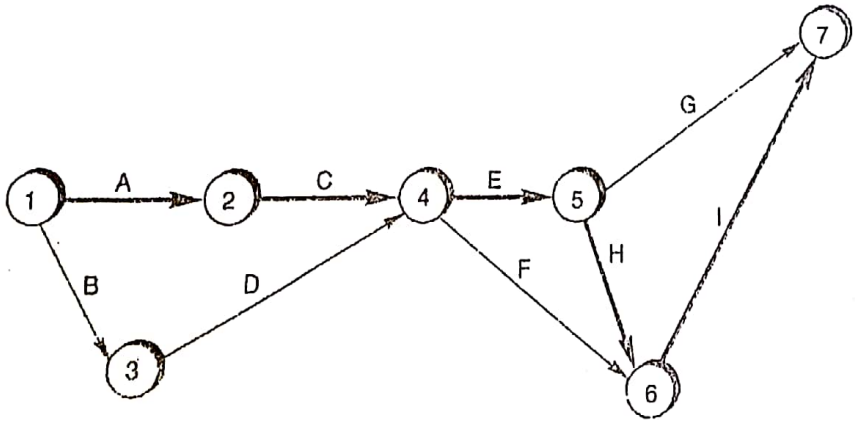
Ministry of higher education
Higher Institute for Eng. and Tech.
in New Damietta

Autumn Term Exam January 2018
ENG 402 Project Management
Time allowed: 3 hours

Answer the following problems

Question 1: (20 marks)

For the network shown in Figure and the information given below, develop complete PERT analysis as below, the contract calls for project completion within 30 weeks, with penalties imposed for late delivery.



a) the activity's expected time (t_e),
b) T_E, T_L and slack time for each event
c) The critical path
d) the activity's variance $(\sigma^2)_{critical}$
e) the activity's standard deviation (σ),
f) the project expected completion time
g) the non-critical paths which also must have a watch over?
h) Is there any penalty for the aircraft company?

Activity	t_0 weeks	t_m	t_p
A	4	5	6
B	4	6	8
C	3	5	7
D	1	3	11
E	2	5	14
F	8	11	20
G	8	12	16
H	4	4	10
I	2	4	6

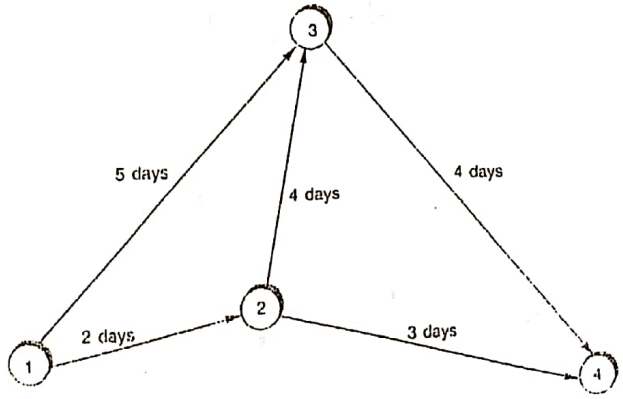
i) Which activities can be delayed beyond the data of the T_E without delaying the project completion time? And by how many weeks
j) What will happen if the expected time of activity G increases by 2 weeks
k) What will happen if the expected time of activity F increases by 3 weeks
l) calculate the probability of completing the project in 29 days
m) find out in how many days the project can be completed with a probability of 95%

Question 2: (15 marks)

a. Table given shows the activity list of a project. Draw the network (5 marks)

Activity	A	B	C	D	E	F	G	H	I	J	K
Predecessors	-	A	-	C	A, D	A	-	D	D	B, E	G, H, I, J

b. project consists of five activities. The network of activities and the duration of these activities are given in figure and table below. The maximum available manpower is only 10 per day. Schedule the activities in such a way that the manpower requirement does not exceed the limit and the project duration. (10 marks)



Activity	duration	Manpower required/day
1-2	2	4
1-3	5	5
2-3	4	5
3-4	4	7
2-4	3	3

Question 3: (25 marks)

Cost and schedule data for a small project are given below. Assume the indirect cost of 200 LE/day,

Activity	Prede-Cessors	Cost (LE)		Duration (days)	
		Crash	Normal	Crash	Normal
A	--	3900	3600	3	4
B	A	6500	5500	1	3
C	B	6800	6400	7	9
D	B	4900	4700	18	19
E	B	2200	2050	9	10
F	C	1700	1200	6	8
G	F	7200	7200	5	5
H	E	10000	9850	10	11
I	D,G,H	4775	4500	1	2

a. Develop the time-cost curve for the project and determine the minimum contract duration (18 marks)

b. Based on the normal cost, prepare a schedule of funds requirement during the course of project implementation based on both Early Finish and Late Finish schedule of activities (7 marks)

Table of Standard Normal Distribution Probabilities (0 < z < b): (MATH 2441/99)

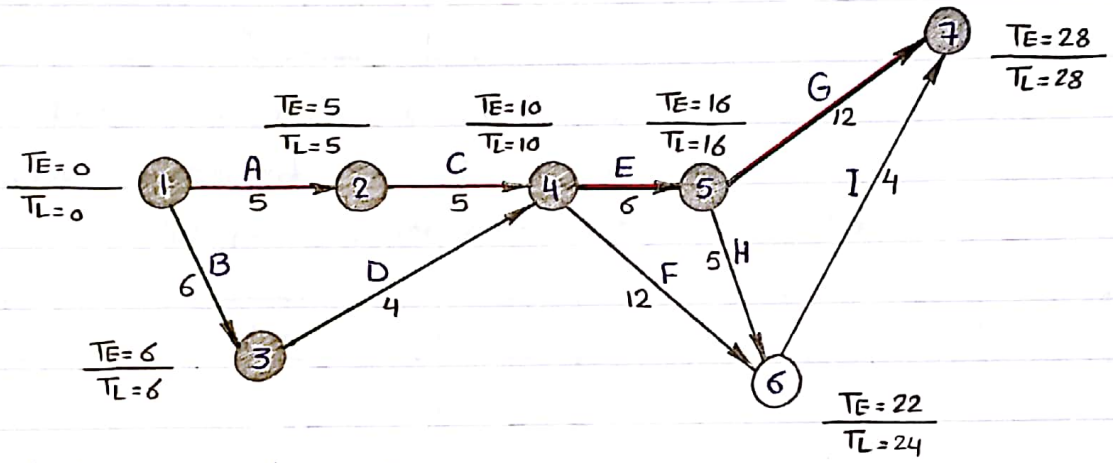
b	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.10	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.20	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.30	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.40	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.50	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.60	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.70	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.80	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.90	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.00	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.10	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.20	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.30	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.40	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.50	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.60	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.70	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.80	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.90	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.00	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.10	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.20	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.30	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.40	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.50	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.60	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.70	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.80	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.90	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.00	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.10	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.20	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.30	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.40	0.49966	0.49968	0.49969	0.49970	0.49971	0.49972	0.49973	0.49974	0.49975	0.49976
3.50	0.49977	0.49978	0.49978	0.49979	0.49980	0.49981	0.49981	0.49982	0.49983	0.49983
3.60	0.49984	0.49985	0.49985	0.49986	0.49986	0.49987	0.49987	0.49988	0.49988	0.49989
3.70	0.49989	0.49990	0.49990	0.49990	0.49991	0.49991	0.49992	0.49992	0.49992	0.49992
3.80	0.49993	0.49993	0.49993	0.49994	0.49994	0.49994	0.49994	0.49995	0.49995	0.49995
3.90	0.49995	0.49995	0.49996	0.49996	0.49996	0.49996	0.49996	0.49996	0.49997	0.49997
4.00	0.49997	0.49997	0.49997	0.49997	0.49997	0.49997	0.49998	0.49998	0.49998	0.49998
4.10	0.49998	0.49998	0.49998	0.49998	0.49998	0.49998	0.49998	0.49998	0.49999	0.49999

Model Answer- Project Management..

Final Exam- Jan. 2018

Question 1:

For the network shown in fig. and the information given below, develop complete PERT analysis as below, the contract calls for project completion within 30 weeks, with penalties imposed for late delivery.



a: The activity's expected time (te).

d: The activity's variance (σ^2).

e: The activity's standard deviation (σ).

Act.	t_o	t_m	t_p	$t_e = \frac{t_o+4t_m+t_p}{6}$	$\sigma^2 = \left(\frac{t_p-t_o}{6}\right)^2$	σ
A	4	5	6	5	0.11	0.33
B	4	6	8	6	0.45	0.67
C	3	5	7	5	0.45	0.67
D	1	3	11	4	2.79	1.67
E	2	5	14	6	4	2
F	8	11	20	12	4	2
G	8	12	16	12	1.77	1.33
H	4	4	10	5	1	1
I	2	4	6	4	0.45	0.67

b: TE, TL and slack time for each event.

Event	TL	TE	Slack (TL-TE)
1	0	0	0
2	5	5	0
3	6	6	0
4	10	10	0
5	16	16	0
6	24	22	2
7	28	28	0

C: The critical path. [A→C→E→G], [B→D→E→G].

F: The project expected completion time. 28 weeks.

g: The non critical paths which also must have a watch over.

Path	Duration	Type	$\Sigma\sigma^2$	$\Sigma\sigma$	
A→C→E→G	5+5+6+12 = 28	Critical	0.11+0.45+4+1.77 = 6.33	2.52	Critical
A→C→E→H→I	5+5+6+5+4 = 25	non	0.11+0.45+4+1+0.45 = 6.01	2.45	—
A→C→F→I	5+5+12+4 = 26	non	0.11+0.45+4+0.45 = 5.01	2.24	—
B→D→E→G	6+4+6+12 = 28	Critical	0.45+2.79+4+1.77 = 9.01	3	Critical
B→D→E→H→I	6+4+6+5+4 = 25	non	0.45+2.79+4+1+0.45 = 8.69	2.95	watch over
B→D→F→I	6+4+12+4 = 26	non	0.45+2.79+4+0.45 = 7.69	2.77	watch over

h: Is there any penalty for the aircraft company?

- There isnot any penalty because of the project time ≯ contract time.

i: Which activities can be delayed beyond the data of the TE without delaying the project completion time? And by how many weeks?

- According to the event ⑥ : the slack time = TL − TE = 24 − 22 = 2 weeks, So the related act. :

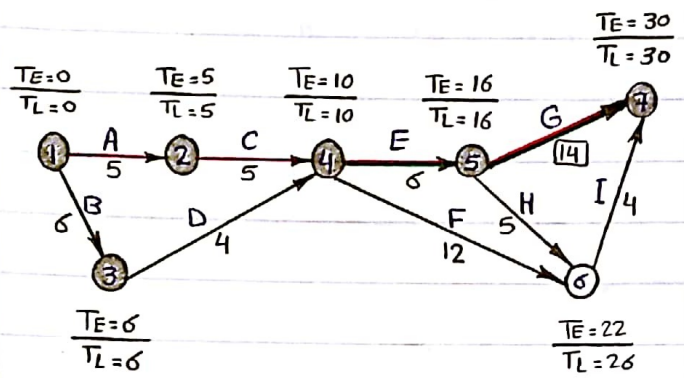
1: Act. F → T.F. = TL⑥ − TE④ − DF = 24 − 10 − 12 = 2 weeks.

2: Act. H → T.F. = TL⑥ − TE⑤ − DH = 24 − 16 − 5 = 3 weeks.

3: Act. I → T.F. = TL⑦ − TE⑥ − DI = 28 − 22 − 4 = 2 weeks.

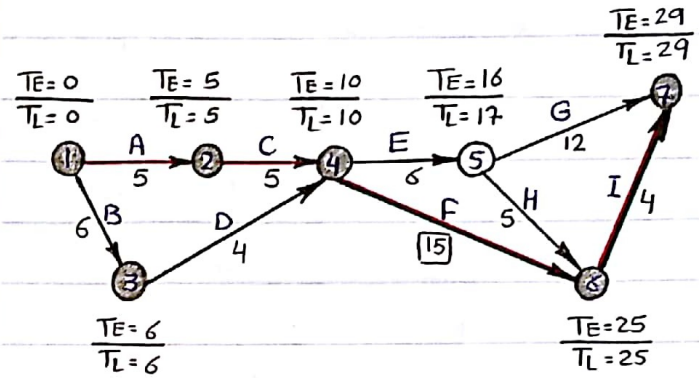
- So the act. F can be delayed by 2 weeks, or act. H can be delayed by 3 weeks, or act. I can be delayed by 2 weeks without delaying the project completion time.

J: What will happen if the expected time of act. G increases by 2 weeks?



- The project completion time will increase by 2 weeks to become 30 weeks.

K: What will happen if the expected time of act. F increases by 3 weeks?



- The project completion time will increase by 1 week to become 29 weeks.
- The critical paths will change to:
  [A → C → F → I] , [B → D → F → I].
- The two activities F, I will change from non critical to critical.
- The two activities E, G will change from critical to non critical.

L: Calculate the probability of completing the project in 29 weeks.

- $T_S = 29$ weeks , $T_e = 28$ weeks , σ (for C.P.) = 3
- $Z = \frac{T_S - T_e}{\sigma} = \frac{29-28}{3} = 0.333$

  Table value $= 0.1293 + \frac{(0.1331 - 0.1293) * (0.333 - 0.33)}{(0.34 - 0.33)} = 0.13044$

- Probability $= 0.5 + 0.13044 = 0.63044 = 63.04\ \%$

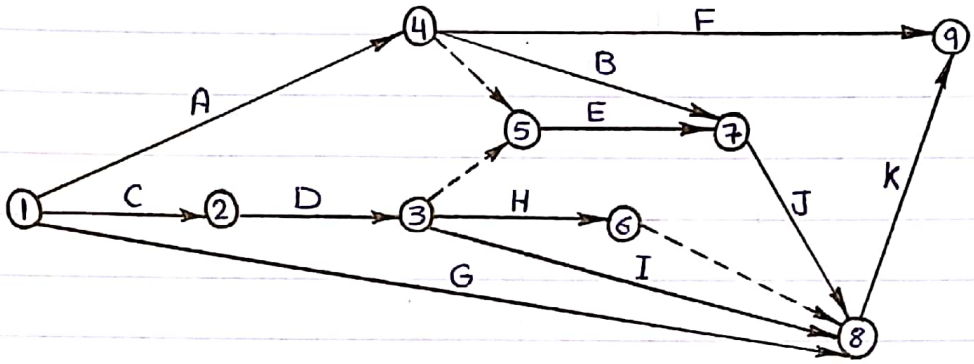
m: Find out in how many weeks the project can be completed with a probability of 95%.

- Table value $= 0.95 - 0.5 = 0.45 \Rightarrow Z = 1.64 + \frac{(1.65 - 1.64) * (0.45 - 0.4495)}{(0.4505 - 0.4495)} = 1.645$
- $Z = \frac{T_S - T_e}{\sigma} \Rightarrow 1.645 = \frac{T_S - 28}{3} \Rightarrow T_S = 33$ weeks.

Question 2:

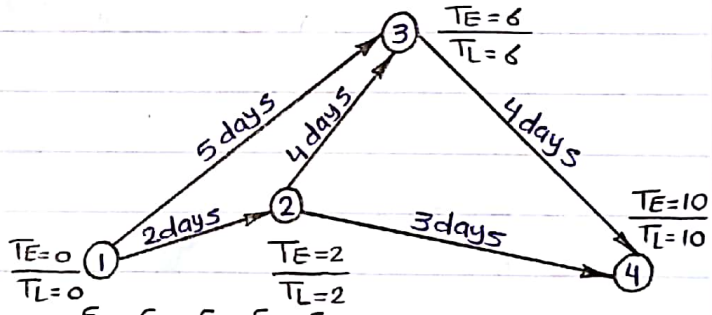
a: Table given shows the activity List of a project. Draw the network.

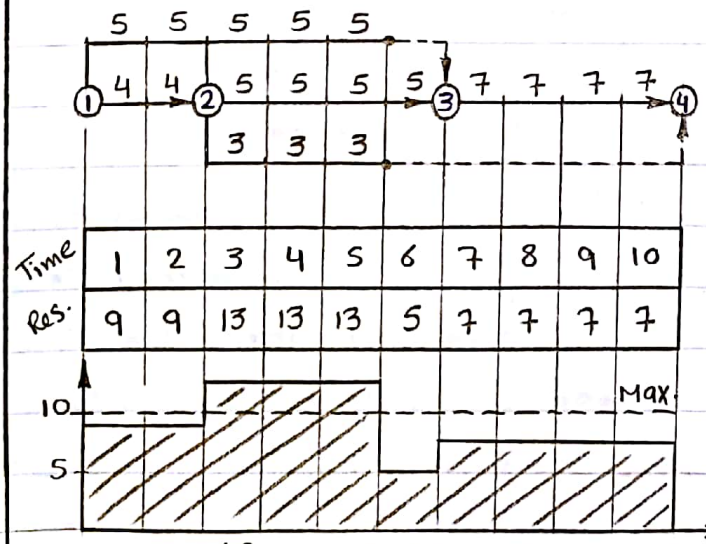
Act.	A	B	C	D	E	F	G	H	I	J	K
Pre.	-	A	-	C	A,D	A	-	D	D	B,E	G,H,I,J



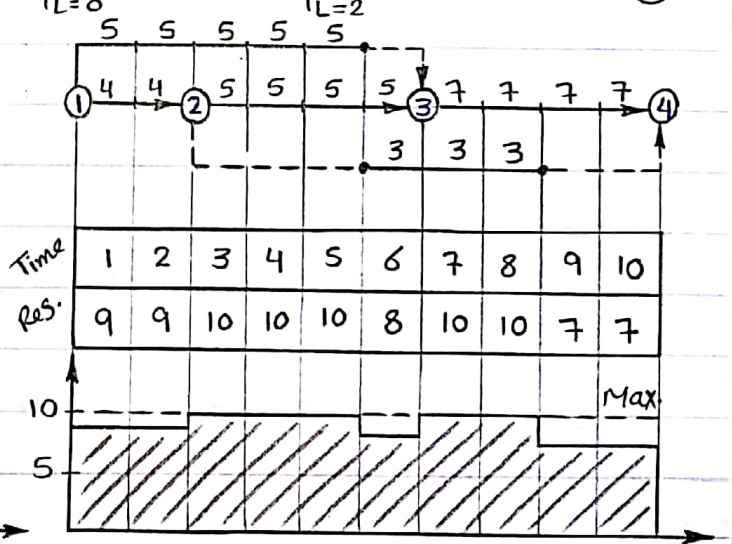
b: Project consists of five activities. The network of activities and the duration of these activities are given in fig. and table below. The max. available manpower is only 10 per day. Schedule the activities in such a way that the manpower requirement does not exceed the limit and the project duration.

Path	Duration	Type
1 → 3 → 4	5+4 = 9	non
1 → 2 → 3 → 4	2+4+4 = 10	Critical
1 → 2 → 4	2+3 = 5	non





(Resource Allocation) time



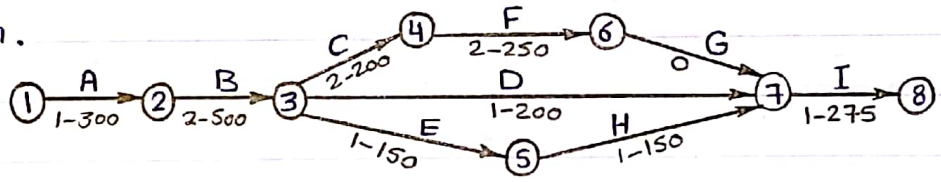
(Resource Leveling) time

Question 3:

Cost and schedule data for a small project are given below. Assume the indirect cost of 200 LE/day.

Act.	Pre.	Crash cost	Normal cost	Crash time	Normal time	Time can be crashed	Crash cost/day
A	–	3900	3600	3	4	1	300
B	A	6500	5500	1	3	2	500
C	B	6800	6400	7	9	2	200
D	B	4900	4700	18	19	1	200
E	B	2200	2050	9	10	1	150
F	C	1700	1200	6	8	2	250
G	F	7200	7200	5	5	0	0
H	E	10000	9850	10	11	1	150
I	D,G,H	4775	4500	1	2	1	275

a: Develop the time-cost curve for the project and determine the min. contract duration.

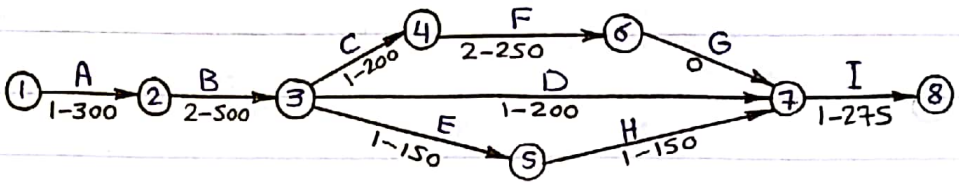


Path	Duration	Type
A→B→C→F→G→I	4+3+9+8+5+2 = 31	Critical
A→B→D→I	4+3+19+2 = 28	non
A→B→E→H→I	4+3+10+11+2 = 30	Sub-critical

- stage one:
- No crashing.
- Project duration = 31 days.
- Total cost = Crash السابق + Crash الحالي + direct cost + Indirect cost

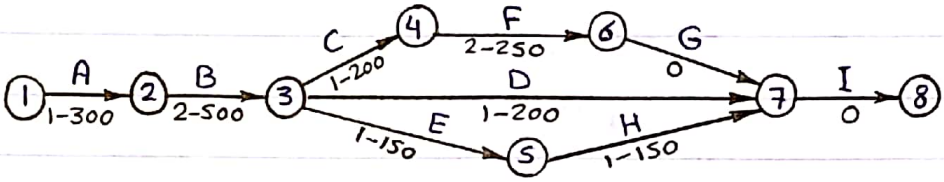
  = 0 + 0 + 0 + (200)(31) = 6200 LE.

P.D. = 31 days
T.C. = 6200 LE.



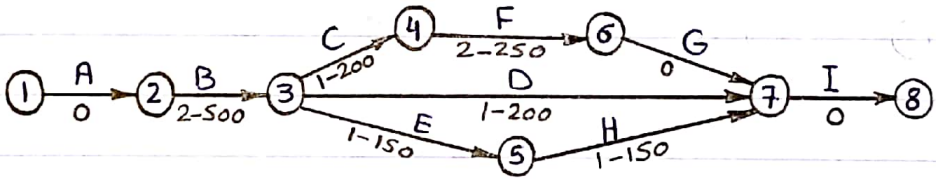
- Stage two:
- Crashing act. C by 1 day.
- Project duration = 30 days.
- Total cost = 0 + (1)(200) + 0 + (200)(30) = 6200 LE.

P.D. = 30 days
T.C = 6200 LE



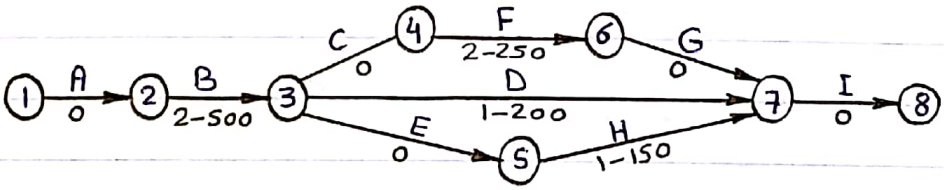
- Stage three:
- Crashing act. I by 1 day.
- Project duration = 29 days.
- Total cost = (1)(200) + (1)(275) + 0 + (200)(29) = 6275 LE.

P.D. = 29 days
T.C. = 6275 LE



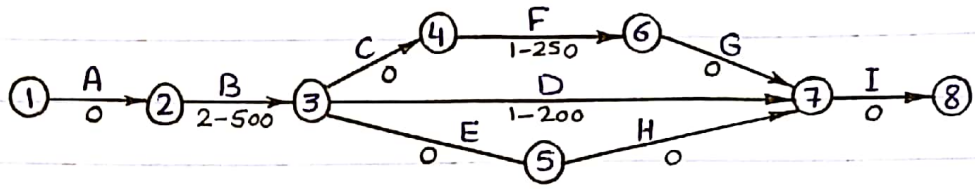
- Stage Four:
- Crashing act. A by 1 day.
- Project duration = 28 days.
- Total cost = (1)(200) + (1)(275) + (1)(300) + 0 + (200)(28) = 6375 LE.

P.D. = 28 days
T.C = 6375 LE



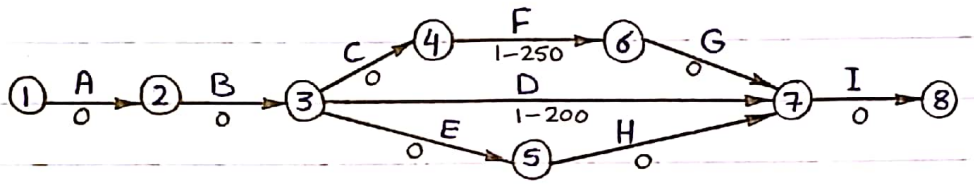
- Stage Five:
- Crashing act. C and act. E by 1 day.
- Project duration = 27 days.
- Total cost = (1)(200) + (1)(275) + (1)(300) + (1)(350) + 0 + (200)(27) = 6252 LE.

P.D. = 27 days
T.C = 6525 LE



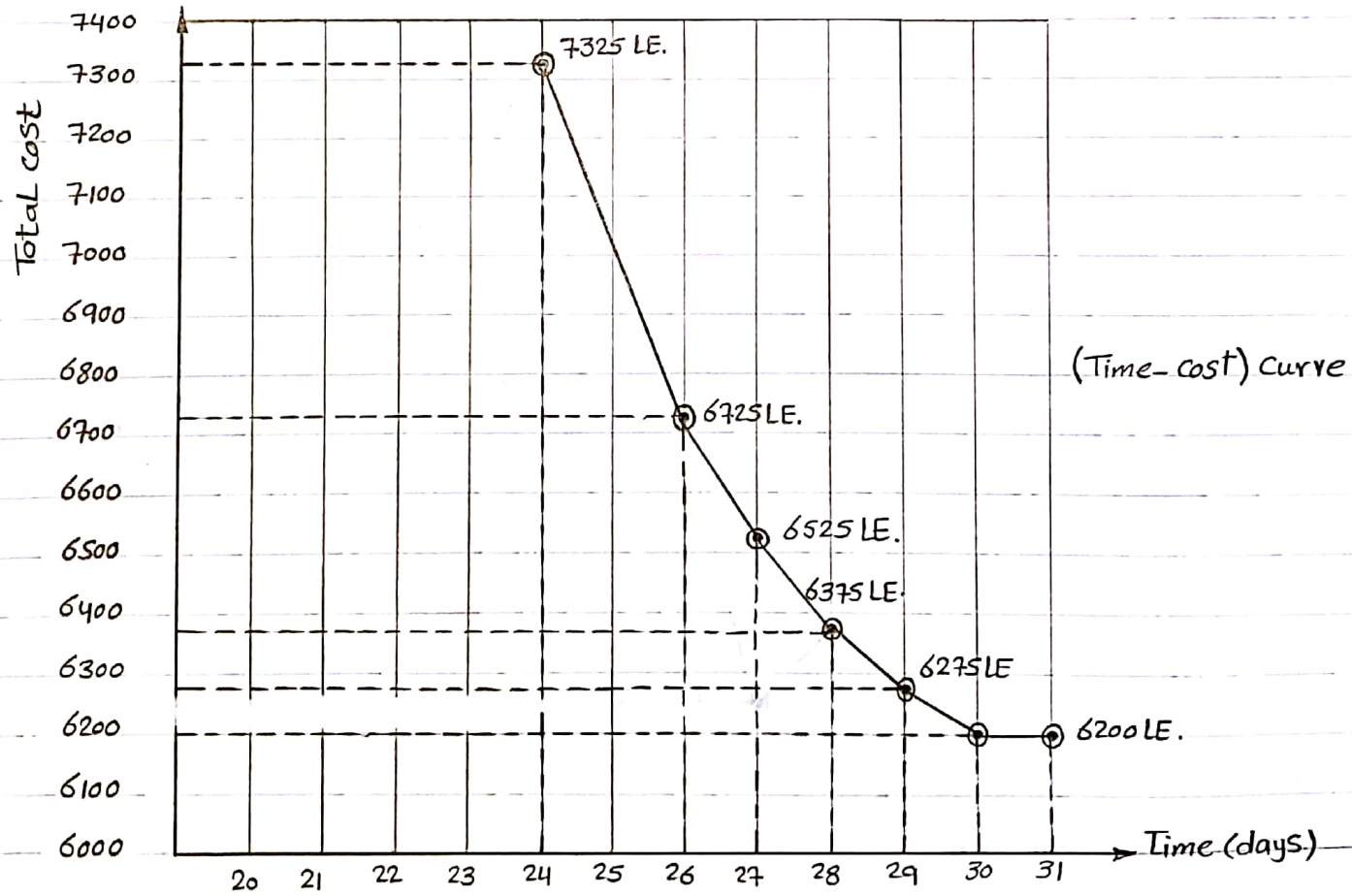
- Stage six:
- Crashing act. F and act. H by 1 day.
- Project duration = 26 days.
- Total cost = (1)(200) + (1)(275) + (1)(300) + (1)(350) + (1)(400) + 0 + (200)(26) = 6725 LE

P.D. = 26 days
T.C. = 6725 LE.

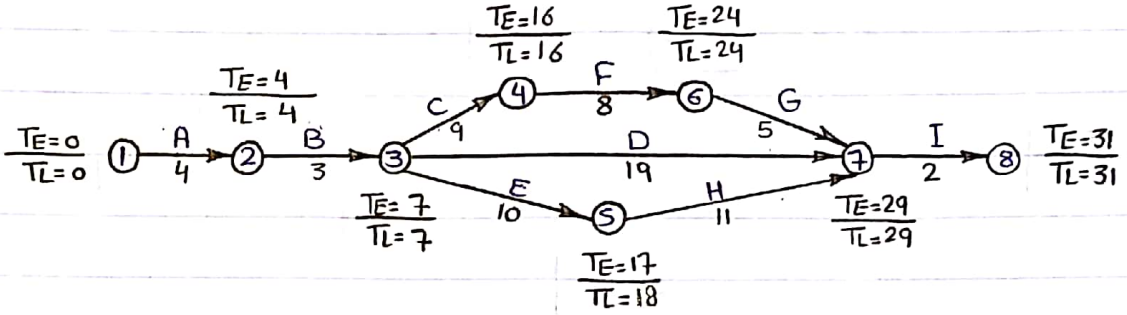


- stage seven:
- Crashing act. B by 2 days.
- Project duration = 24 days.
- Total cost = (1)(200) + (1)(275) + (1)(300) + (1)(350) + (1)(400) + (2)(500) + 0 + (200)(24) = 7325 LE.

P.D. = 24 days
T.C = 7325 LE.



b: Based on the normal cost, Prepare a schedule of funds requirement during the course of Project implementation based on both Early finish and Late finish schedule of activities.



Act.	TE	Funds req.	Comulative Funds
A	4	3600	3600
B	7	5500	9100
C	16	6400	15500
E	17	2050	17550
F	24	1200	18750
G	29	7200	25950
D	29	4700	30650
H	29	9850	40500
I	31	4500	45000

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