



# UNIVERSITY OF RUHUNA

## Faculty of Engineering

End-Semester 7 Examination in Engineering: March, 2021

Module Number: CE7301

Module Name: Construction Management

[Three Hours]

[Answer all questions, each question carries twelve marks]



- Q1. a) "Project Monitoring and Controlling is necessary throughout a construction project". Explain this statement giving emphasis to the cyclic nature of the monitoring and controlling process. [2.0 Marks]
- b) Table Q1 shows planned and actual work of a construction project with respect to time, cost and progress. Prepare the progress monitoring bar chart. Use the provided Data Sheet Q1 when answering. [4.0 Marks]
- c) Based on the information available in Table Q1, explain whether;  
i the project experiences a cost overrun.  
ii the project is behind the schedule. [4.0 Marks]
- d) Calculate the additional cost and the additional time at project completion based on the available data at the end of day 20. [2.0 Marks]
- Q2 a) Table Q2 displays the planned time and cost for different activities of a project with possible crashing information. Figure Q2 (a) represents the corresponding network diagram. You have been asked to recommend on the most economical approach to reduce the project duration to a minimum by utilizing all possible crashing time available at once. However, you are not permitted to alter the critical path. Calculate the minimum possible total project duration and corresponding extra cost. Consider indirect cost of Rs.850.00 per day. [6.0 Marks]
- b) Consider the network diagram shown in Figure Q2 (b). It represents the activity relationships for a construction project with resource requirements.  
i Draw the Bar chart based on all the activities starting as early as possible and indicate the available total floats. Use the provided Data Sheet Q2 when answering.  
ii Prepare labour histogram below the bar chart in Data Sheet Q2.  
iii Discuss the nature of above resource histogram and advantages/disadvantages to the contractor if he decides to use resource requirements as in your resource histogram. [6.0 Marks]

Q3. A private contractor company was awarded a contract to construct a housing scheme consisting of 20 identical houses. The contractor with his agreement informed to the client that the completion rate cannot be given as a number of houses but completion rate for individual activities. The main activities to be completed for the completion of one housing unit is shown in Table Q3 together with necessary man hours, available gang sizes and completion rate for corresponding activities. The company decided to sub-contract main activities while other minor activities are done by the main contractor. Main contractor's activities does not affect sub-contractors' work. All the sub-contractors work 8 hours per day and 6 days per week. Assume that you are the planning engineer of the main contractor and you decided to prepare a plan using Line of Balance technique.

a) Carry out the necessary calculations in tabular form and plot a line of balance schedule for information shown in Table Q3 (use a graph sheet provided). In your plot, clearly indicate the expected total project duration. [6.0 Marks]

b) Assume that, at the end of the 140<sup>th</sup> day, the contractor realized that he can increase the labours for a gang for activity D by two fold and for activity F by one and half times. What is the effect to total project duration with this labour increase? [4.0 Marks]

d) Identify limitations in application of the line of balance diagram;  
 i. As a planning technique and  
 ii. As a scheduling technique. [2.0 Marks]

Q4. a) "Feasibility study is a management-oriented activity". Explain this statement. [2.0 Marks]

b) Explain the use of 'Payback Period' for decision making during the feasibility stage. [2.0 Marks]

c) Why is it important to check the technical feasibility of a project? [2.0 Marks]

d) Table Q4 represents the cash flow statement of a project that started in January, 2021. It was prepared considering following assumptions.

- Contractor is responsible for paying wages weekly.
- Material suppliers will be paid at the end of each month.
- Client will pay to the contractor in the same month keeping 10% retention.
- Sub-contractors will be paid with one-month delay keeping 10% retention.
- Half retention will be released to both contractor and sub-contractors after two months and second half of the retention will be released at the end of the year.

Based on the available information, answer for following:

i Contractor is planning to start the project by taking a bank loan. What is the minimum amount he has to get as a loan considering the whole construction period?

ii What is the best time he can invest for any other business?

iii Draw the monthly cash flow diagram for the information given in Table Q4.

Q5.

- a) Explain the following with respect to ICTAD standard bidding documents.
- i One bid per Bidder
  - ii Cost of Bidding
  - ii Site Visit

[3.0 Marks]

- b) A government institution requested for tenders using ICTAD standard bidding documents (SBD02) for the construction of a four story building and tenders were to submit on 21<sup>st</sup> October, 2020 at 2.00PM. The following happened during the process. Assuming that you are the procurement officer, state your decisions with reasons.

- i One contractor (Contractor A) submitted his bid without bid security at the time of submission but submitted it around 2.30PM after the opening of tenders.
- ii Another contractor (Contractor B) has submitted two sets of documents; but without marking "ORIGINAL" and "COPY".
- ii A third contractor (Contractor C) submitted the bid around 1.30PM and submitted a letter around 1.50PM stating that he is offering 10% discount on bid value.

[6.0 Marks]

- d) Explain three important factors of using concessional method to construct an infrastructure for a developing country.

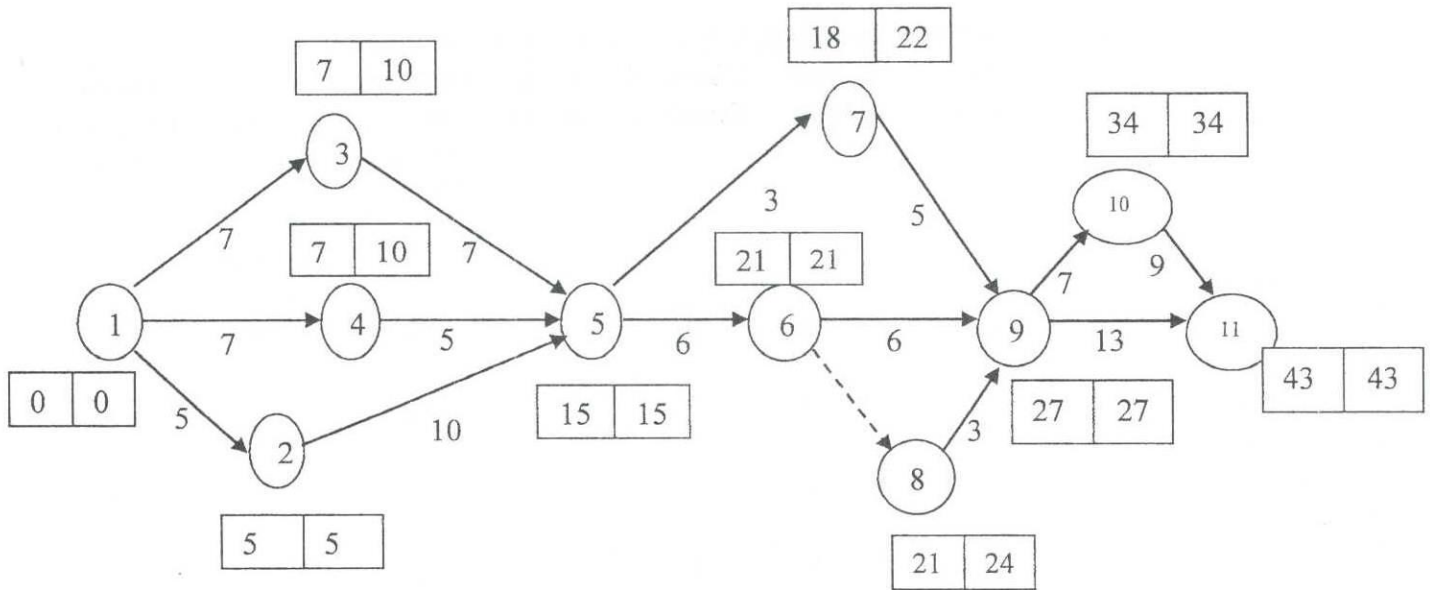
[3.0 Marks]

Table Q1: planned and Actual Work of a Construction Project

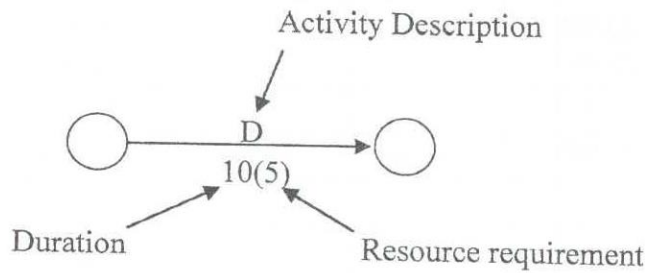
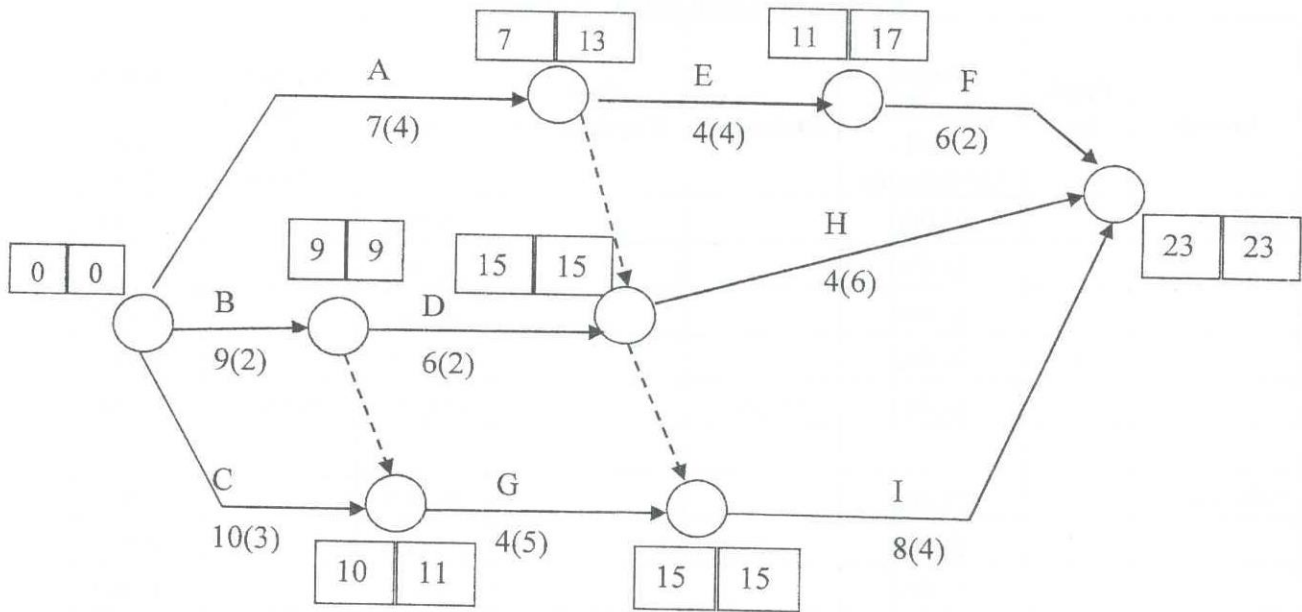
Activity	Planned start	Actual Start	Planned duration	Time spent	Planned cost (Rs.000.00)	Actual cost at the end of day 20 (Rs.000.00)	Work Progress (%)
Mobilization to the Site	Day 1	Day 1	2	2	100	100	100
Preliminary services preparation	Day 3	Day 3	3	3	250	255	100
Setting out the building	Day 6	Day 6	2	2	50	51	100
Excavation for trenches	Day 8	Day 9	6	6	350	365	100
Foundation Construction	Day 11	Day 13	7	4	1,400	900	50
Wall Construction	Day 16	Day 18	15	2	3,000	450	15
Roof Construction	Day 31	-	6	-	2,800	-	-
Door/Window Fixing	Day 37	-	6	-	1,700	-	-
Plastering Work	Day 41	-	8	-	900	-	-
Painting	Day 49	-	5	-	750	-	-
Other Finishes	Day 54	-	4	-	400	-	-

**Table Q2: Details of time and cost for normal and crash situations**

Activity	Time in days		Cost in Rs.	
	Normal	Crash	Normal	Crash
1-2	5	4	4,000	6,000
1-3	7	5	5,000	7,000
1-4	7	5	6,000	9,000
2-5	10	8	14,000	15,800
3-5	7	4	3,000	5,100
4-5	5	3	6,000	7,000
5-6	6	4	8,000	9,500
5-7	3	2	2,000	2,500
6-8	-	-	--	-
6-9	6	4	8,000	9,500
7-9	5	4	2,000	2,500
8-9	3	3	-	-
9-10	7	5	11,000	13,000
9-11	13	11	15,000	17,000
10-11	9	7	9,000	10,000



**Figure Q2 (a): Activity relationships**



Key for network diagram

Figure Q2 (b): Activity relationships

Table Q3: Information for LOB Diagram

Activity	Man hours	Optimum gang size	Completion Rate/Week
Earth Work and Foundation (A)	250	5	3
Concreting work including columns, beams, slab and stair cases (B)	350	8	1
Wall Construction (C)	300	4	2
Roof Work and Other Carpentry Work (D)	200	6	2
Plastering, Painting and Fool Finishes (E)	150	3	3
Plumbing (F)	100	4	2
Electrical Work (G)	75	5	4
All activities are sequential activities. Minimum buffer time for all activities is 2 days			

**Table Q4: Cash Flow Statement**

Month	Week No	Wages, plant hire and Overheads	Materials	Sub-Contractors	Total	Accounts received by the client	Cumul-ative cash flow
January	1	20,000			20,000		-20,000
	2	20,000			20,000		-40,000
	3	20,000			20,000		-60,000
	4	20,000			20,000		-80,000
	5	20,000	125,000		145,000	252,000	27000
February	6	20,000			20,000		7000
	7	25,000			25,000		-18000
	8	25,000			25,000		-43000
	9	20,000	115,000	45,000	180,000	252,000	29000
March	10	25,000			25,000		4,000
	11	25,000			25,000		-21000
	12	25,000			25,000		-46000
	13	25,000	150,000	49,950	224,950	216,000	-54950
April	14	25,000			25,000		-79950
	15	23,500			23,500		-103450
	16	15,000			15,000		-118450
	17	15,000	80,000	54,000	149,000	225,000	-42450
May	18	20,000			20,000		-62,450
	19	20,000			20,000		-82,450
	20	15,000			15,000		-97,450
	21	15,000	50,000	31,500	96,500	225,000	31,050
June				22,500	22,500		8550
July		half retention		11,275	11,275	65,000	62275
December		half retention		11,275	11,275	65,000	116000

Index No:

Data Sheet Q1

Activity	Duration (Days)	
	Start	End
Mobilization to the Site	1	2
Preliminary services preparation	3	4
Setting out the building	5	6
Excavation for trenches	7	8
Foundation Construction	9	10
Wall Construction	11	12
Roof Construction	13	14
Door/Window Fixing	15	16
Plastering Work	17	18
Painting	19	20
Other Finishes	21	22
	23	24
	25	26
	27	28
	29	30
	31	32
	33	34
	35	36
	37	38
	39	40
	41	42
	43	44
	45	46
	47	48
	49	50
	51	52
	53	54
	55	56
	57	

### Data Sheet Q2

Activity	Duration (Days)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A																								
B																								
C																								
D																								
E																								
F																								
G																								
H																								
I																								