College of Engineering
Civil Engineering Department

GE 404: ENGINEERING MANAGEMENT

Second Semester 1438/1439H

(MODEL ANSWER)

FIRST MIDTERM EXAM

Monday 24/6/1439H (12/3/2018G) from 7:00 to 8:30 PM

Time allowed: 1.5 hours

Student name	
University number	
Section Number	
Instructor name	
Serial Number in the class	

Total number of Questions: 4

Attempt all questions

Questions	Maximum Marks	Marks obtained
Q1	20	
Q2	25	
Q3	30	
Q4	25	
	Total marks	_____ 100

Total marks obtained (in words):_____

Student name	
University number	
Section Number	
Serial Number in the class	

Question 1 (2×10 = 20 Marks) (CLO1: 80%; CLO2: 20%)

This question consists of 10 multiple choice questions (MCQs). These MCQs must be answered in the first 20 minutes of the exam.

Out of the given four choices, encircle the most appropriate answer:

1.1 Project Management functions include:

a. Planning, scheduling, and controlling
b. Time, Cost, and scope
c. People, money and materials
d. Safety, quality and modernizing

1.2 Balancing of project objective key factors affects the _____ of the project.

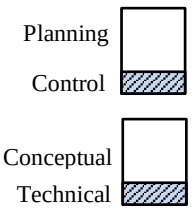
a. Budget
b. Safety
c. Quantity
d. Quality

1.3 The project life cycle includes: i) closure ii) concept iii) planning and iv) execution. The proper order of these phases is as follows:

a. ii, iv, iii, i
b. iii, ii, iv, i
c. iv, ii, iii, i
d. ii, iii, iv, i

1.4 The figure shown below indicates that the level of management is:

a. Top
b. Middle
c. Low
d. No indicator



1.5 The first process in the Time Planning Processes is:

a. Estimate the duration of activities
b. Schedule the activities
c. Visualize and define the activities
d. Sequence the activities

1.6 Limitations for using Gantt Chart include:

a. Effective for project shortening
b. Simple graphical form
c. Difficult to forecast the effect of changes
d. Good form of communication

1.7 The amount of time by which the completion of that activity can be deferred without delaying the early start of the following activities is defined as:

a. Free float
b. Critical path
c. Path float
d. Total float

1.8 What is not correct about AON technique:

a. Reveal interdependencies shown in other techniques
b. Easy to follow on large projects
c. Ability to calculate critical path
d. Assumes resources are unlimited

1.9 Point in time that has been identified as being an important reference point during the accomplishment of the work is known as:

a. Critical activity
b. Hammock activity
c. Activity with longest duration
d. Milestone

1.10 In burgess resource leveling procedure, we should start with:

a. The last critical activity
b. The first critical activity
c. The first non-critical activity
d. The last non-critical activity

Question 2 (15+5+5 = 25 Marks) (CLO1: 100%)

For the following Engineering project:

Activity	Time(weeks)	Successor
A	4	B,C,D
B	4	E
C	6	E
D	1	E
E	6	F,G,H,I
F	3	J
G	6	J
H	5	J
I	4	J
J	2	None

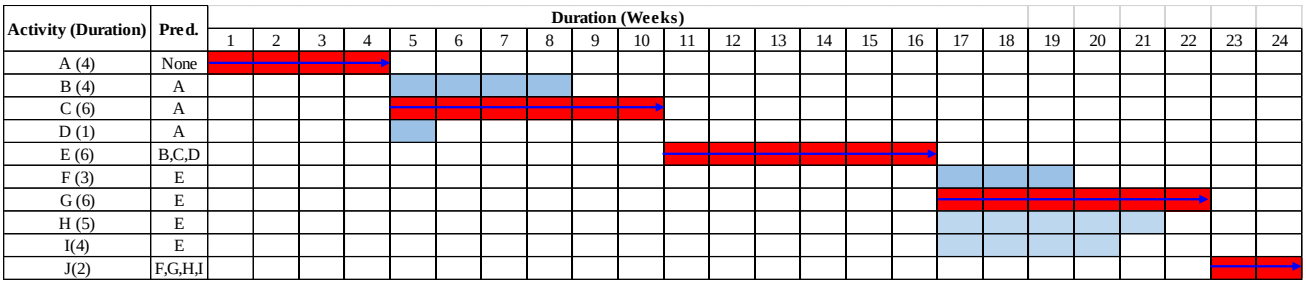
(a) Draw the Gantt Bar Chart. How many weeks are needed for the above project to be completed using bar chart technique?

(b) Determine the critical path(s).

(c) Without redrawing, what is going to happen to the project duration and critical path if activity B's duration prolongs by 3 weeks?

Solution:

(a) Gantt Bar Chart



Number of weeks needed for completion of the project = **24 weeks** *Ans.*

(b) Critical Path is: **A-C-E-G-J**

(c) If the activity B's duration prolongs by 3 weeks, activity B will become critical, and critical path and project duration will be changed to **A-B-E-G-J** and **25 weeks** respectively.

Question 3 (15+15 = 30 Marks) (CLO1: 100%)

The table shown below represents the activities, the job logic and the activities' durations of a small project.

(a) Draw an activity on node network to represent the project and then calculate ES, EF, LS, LF, TF, and FF and identify the Critical Path(s).

Activity	Predecessors	Durations (Days)
A	—	12
B	A	16
C	D	13
D	B	12
E	C	15
F	C	17
G	C, F	18

LEGENDS

ES	D	EF
	Act	FF
LS	TF	LF

(b) Draw an updated AON and calculate ES, EF, LS, LF, and TF if the following lead-lag relationships were added to the above relationships. Identify the critical path(s) and find the new duration of the project. The newly added relationships are presented below.

Related activities	Lead-Lag relationships
D-C	FS = 6
C-G	SS = 4
C-E	SF = 5
B-D	FF = 3

The equations for the calculations of ES, EF, LS and LF are given below.

FORWARD PASS COMPUTATIONS

$$ES_j = \text{Max(all}_i)\begin{pmatrix}\text{Initial Time}\\ EF_i + FS_{ij}\\ ES_i + SS_{ij}\\ EF_i + FF_{ij} - D_j\\ ES_i + SF_{ij} - D_j\end{pmatrix}$$

$$EF_j = ES_j + D_j$$

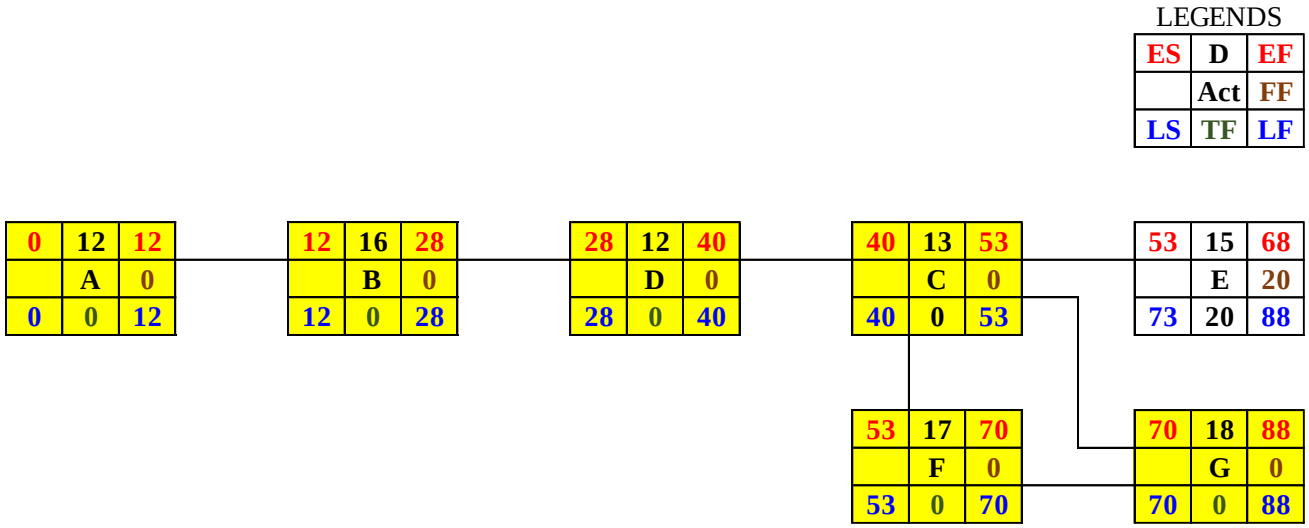
BACKWARD PASS COMPUTATIONS

$$LF_i = \text{Min(all}_j)\begin{pmatrix}\text{Terminal Time}\\ LS_j - FS_{ij}\\ LF_j - FF_{ij}\\ LS_j - SS_{ij} + D_i\\ LF_j - SF_{ij} + D_i\end{pmatrix}$$

$$LS_i = LF_i - D_i$$

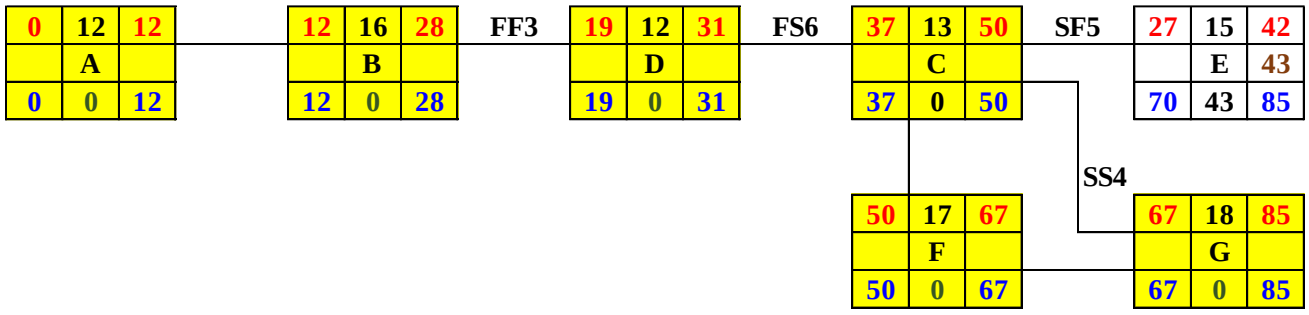
Solution:

(a) AON Network diagram:



Critical path(s): **A-B-D-C-F-G; A-B-D-C-G** *Ans.*

(b) Updated AON Network diagram:



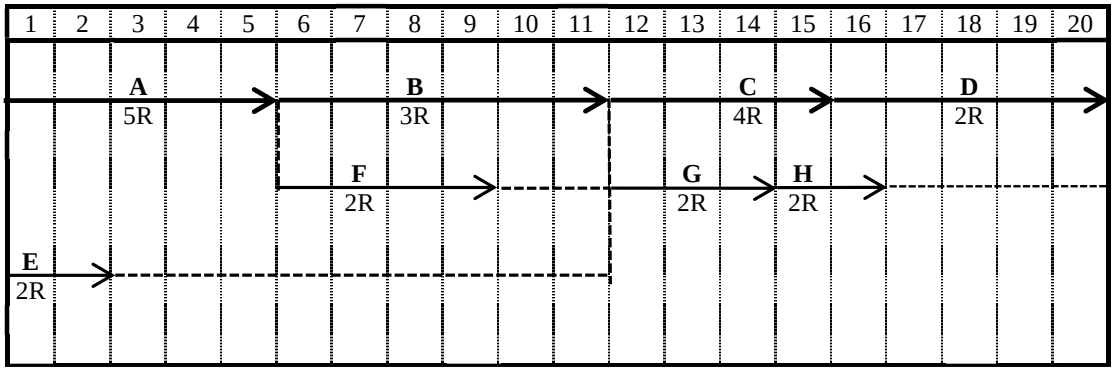
The critical paths will remain the same. However, the project duration will be changed to 85 days. *Ans.*

Question 4 (20+5 = 25%) (CLO2: 100%)

A small project time-scaled network is shown below, do the following:

(a). Perform the necessary activity moves to determine the best leveling of the project resources. Show your calculations in two trials.

(b). Calculate the criticality-index of the levelled resources, and as a project manager comment on the answer.



The time shown in the diagram are in days.

Solution

(a) Time-Scaled Network

T (Days)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	A					B						C				D					
	5	5	5	5	5	3	3	3	3	3	3	4	4	4	4	2	2	2	2	2	
						F						G			H						
						2	2	2	2			2	2	2	2	2					
	E																				
	2	2																			
R	**7**	**7**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**3**	**3**	**6**	**6**	**6**	**6**	**4**	**2**	**2**	**2**	**2**	91
ΣR^2	**49**	**98**	**123**	**148**	**173**	**198**	**223**	**248**	**273**	**282**	**291**	**327**	**363**	**399**	**435**	**451**	**455**	**459**	**463**	**467**	

(b) Resource Leveling using Estimated Method:

	Trial-1																				
T (Days)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	
	A					B						C				D					
	5	5	5	5	5	3	3	3	3	3	3	4	4	4	4	2	2	2	2	2	
						F										G			H		
						2	2	2	2							2	2	2	2	2	
	E																				
	2	2																			
R	**7**	**7**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**3**	**3**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	91
ΣR^2	**49**	**98**	**123**	**148**	**173**	**198**	**223**	**248**	**273**	**282**	**291**	**307**	**323**	**339**	**355**	**371**	**387**	**403**	**419**	**435**	

	Trial-2																				
T (Days)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	
	A					B						C				D					
	5	5	5	5	5	3	3	3	3	3	3	4	4	4	4	2	2	2	2	2	
						F						G				H					
						2	2	2	2							2	2	2	2	2	
										E											
										2	2										
R	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	91
ΣR²	**25**	**50**	**75**	**100**	**125**	**150**	**175**	**200**	**225**	**250**	**275**	**291**	**307**	**323**	**339**	**355**	**371**	**387**	**403**	**419**	

As the sum of the squares of the resources ($\sum R^2$) is substantially smaller than the original time-scaled network diagram, the above network diagram is much leveled than the original diagram.

(b) Criticality Index for the levelled resources

Total units of resources, $T = \sum_{j=1}^{j=n} R_j = 91$

Average daily requirement, $DR_A = \frac{Total\ unit\ of\ resources}{Project\ duration} = \frac{T}{D} = \frac{91}{20} = 4.55$

Criticality index, $I_c = \frac{DR_A}{A_{max}} = \frac{4.55}{5} = 0.91$ *Ans.*

Comment: As the criticality index is less than one, there is no constrained of resources and there will be no delay due to resources. However, since the value of criticality index is close to one, the resources can not be considered as unlimited.