EGT3/EGT2
ENGINEERING TRIPOS PART IIB
ENGINEERING TRIPOS PART IIA

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Monday 24 April 2017   9.30 to 11

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Module 4D16

CONSTRUCTION MANAGEMENT

*Answer not more than **three** questions.*

All questions carry the same number of marks.

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

*Write your candidate number **not** your name on the cover sheet.*

STATIONERY REQUIREMENTS
Single-sided script paper

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM
CUED approved calculator allowed
Engineering Data Book

10 minutes reading time is allowed for this paper.

You may not start to read the questions printed on the subsequent pages of this question paper until instructed to do so.

1   (a)   What is the difference between a finish-to-start and a start-to-finish relationship? Describe a scenario where a start-to-finish relationship would be more appropriate.   [20%] 4

(b)   Use the project activities information provided in the table below to:

(i)   Draw their Activity-on-Node (A-on-N) diagram. Perform forward pass calculations in order to determine for each activity the early start time and early finish time.   [20%] 4

(ii)   Perform backward pass calculations in order to determine for each activity the total float and free float. Indicate which activities belong to the critical path.   [30%] 6

Activity #	Durations (days)	Predecessor Activities : Relationships	Resource Demands (Common Labourers)
A	1	-	3
B	8	A:FS	4
C	4	A:FS/3	3
D	2	A:FS, B:FF/2	2
E	7	C:FS	3
F	5	B:FS, E:SS/4	2
G	3	E:FS, F:FS	3
H	1	F:FS, I:FF/2	2
I	2	D:FS	1
J	1	G:FS, H:FS, I:SF/-12	4

(c)   You have six available labourers. Perform resource allocation for the above project using the rules presented in class. What is the revised total project duration? How many extra labourers are needed to finish the project in less than 22 days?   [30%] 6

2   (a)   What is an outflow delay? When does it occur? When should general contractors use it?   [15%] 3

(b)   The cost and schedule data for a small project are given below. Perform a time-cost trade-off analysis to determine the following. Assume an indirect cost of £200/day. Stop crashing activities when the cumulative cost starts increasing.

   (i)   What is the project's total duration, direct and indirect cost without crashing any activities?   [25%] 5

   (ii)   Determine the minimum overall cost of the project and its associated duration.   [60%] 12

Hint: Calculate for the project the cumulative total cost for every cycle of crashing.
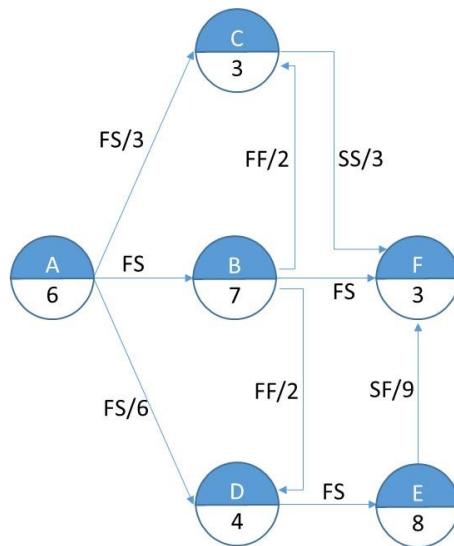
Activities	Cost		Duration (days)	
	Crash	Normal	Crash	Normal
A	£2,400	£2,000	2	6
B	£3,200	£2,800	3	7
C	£4,500	£4,100	1	3
D	£4,300	£3,600	2	4
E	£5,400	£3,400	6	8
F	£1,200	£1,000	2	3

3   (a) Define risk in the context of construction management. Provide at least three reasons with supporting explanation on why projects have a tendency to exceed target cost projections.   [30%] 6

(b)   (i) Provide three reasons with supporting explanation in favour of purchasing project insurance policy to cover the design liabilities in a major infrastructure project worth £100m plus.   [15%] 3

(ii) Name one potential disadvantage. How could it be overcome?   [5%] 1

(c)   You have just been appointed to advise the Estate Management Department at the University of Cambridge on the Health and Safety aspects relating to the construction of a new building. The University does not undertake a large number of developments and hence the Estate Management Department employs only a small number of people. Therefore, advisors are appointed to provide specific expertise when needed.

(i) The client, Estate Management, is vaguely aware that they need to comply with the new CDM Regulations 2015. Provide four pieces of advice to Estate Management in order to ensure compliance with CDM Regulations 2015.   [10%]

(ii) Which party bears the responsibility for making sure that the client is aware of their duties under the regulations?   [10%]

(iii) Estate Management is planning to follow the Design & Build procurement route, where the designer is novated to the contractor at the start of the project. Advise Estate Management on the Health and Safety implications on following this procurement route.   [30%]

4   (a) What are the main factors that influence a client's procurement strategy?   [20%]

(b)   You have just been appointed to advise the Estate Management Department at the University of Cambridge on a suitable procurement route for the construction of a new building. The University does not undertake a large number of developments and hence the Estate Management Department employs only a small number of people. Hence, advisors are appointed to provide specific expertise when needed. At the time of your appointment:

- No appointments have been made yet (i.e. no consultants or contractors appointed)

- Estate Management has calculated an outline budget estimate for the construction cost based on a schedule of areas

- As a world-leading higher education organisation, Estate Management wants a particularly high quality building

- The new building needs to be ready for the start of the 2018/2019 academic year

Suggest a procurement route for Estate Management and explain the reasons behind your choice.   [30%]

(c)   What conditions of engagement (in terms of scope of obligation/liability) would you recommend your client should follow with the contractor and the consultant? Why?   [25%]

(d)   If your client was a very experienced client (i.e. regularly undertakes development projects), would you suggest a different procurement route? Why?   [25%]

5   (a) Describe the "Construction Management" procurement route, and at least four of the duties of the "Construction Manager" in this route. Can a Construction Manager be held liable if a project goes wrong? Under what condition can this happen?   [30%]

(b) Many construction businesses have gone bankrupt not through lack of work but as a result of improper management of cash flow. Draw a typical project cash flow diagram making sure that the axes and all notable points/regions in the diagram are labelled and defined appropriately.   [20%]

(c) This part of the question relates to the construction of a reinforced concrete basement (size 50m x 30m x 10m deep) built below ground on a green field site. As the contractor's estimator, you are required to **estimate** an appropriate Bill of Quantities rate **making appropriate assumptions when necessary.** Consider two alternative construction methods (using diagrams if necessary):   [50%]

Method A – Open cut with battered sides (assume total volume of excavation equals 2.5 x net volume). The open-cut method will require additional working space to allow for erecting and stripping the shutter to the outer face.

Method B – Steel cofferdam built around net perimeter of basement.

Assume the following net costs (based on quotations from subcontractors):

- Excavation open cut – £10 per m^3

- Disposal on site – £1 per m^3

- Bring back and fill – £2 per m^3

- Excavation restricted within cofferdam – £25 per m^3

- Sheet piling (assume 15 m deep) – £35 per m^2

- Mobilisation/demobilisation-piling rig – £5,000 each way

- Extract cofferdam piling – £5,000

END OF PAPER

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Answers

Q1 (b) Critical path: A-C-E-F-G-J

(c) 28 days; 1 extra labourer

Q2 (b) 21 days; £21,500

Q5 (c) Method B; £40/m^3