Version BBS/3

EGT3/EGT2
ENGINEERING TRIPOS PART IIB
ENGINEERING TRIPOS PART IIA

Friday 9 May 2025 09.30 to 11.10

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 at the start of the exam.

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

You may not remove any stationery from the Examination Room.

1 (a) Define construction innovation and explain why it is considered essential for the architectural, engineering, and construction (AEC) sector. Provide two examples of innovation in construction and describe their potential impact on project outcomes. [10%]

(b) Discuss current trends in technological innovation in construction. Highlight one technological innovation and elaborate on its possible applications during construction as well as possible benefits and challenges. [30%]

(c) Describe the concept of offsite construction and list the categories of offsite construction specific to the UK. Explain how offsite construction might contribute to efficiency in construction projects. [20%]

(d) Analyse the implications of construction innovation policies on organisations and professionals in the AEC sector. Provide suggestions for organisations to enhance their success with innovation. Your answer should follow an essay style structure. [40%]

2 (a) What is a cash flow analysis? Provide two reasons for conducting it. [10%]

(b) Explain the concepts of earned value, schedule performance index (SPI) and cost performance index (CPI). Explain why it may not be appropriate to extrapolate CPI and SPI to forecast performance for the remainder of a project. [15%]

(c) The cost and schedule data for a small project are given in Fig. 1 and Table 1 below. The indirect cost for the project is £450/day. Activities should be stopped from crashing when the cumulative cost starts increasing. Perform a time-cost trade-off analysis to determine the following:

(i) The project's total duration, direct and indirect cost without crashing any activities. [25%]

(ii) The minimum overall cost of the project and its associated duration by crashing specific activities. [50%]

Hint: Calculate the cumulative total cost for every cycle of crashing.

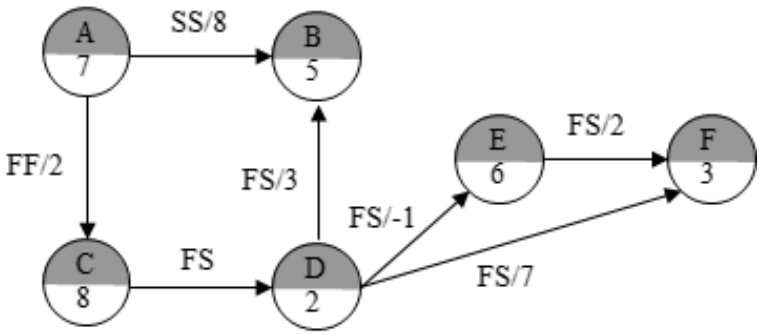

Fig. 1: Project network diagram.

Activities	Cost (£)		Duration (days)	
	Crash	Normal	Crash	Normal
A	5000	1500	2	7
B	2500	2250	1	5
C	3500	2750	4	8
D	4000	3500	1	2
E	900	750	4	6
F	1400	1000	1	3

Table 1: Normal and crash activity costs and durations.

3 (a) What are the main aims of a good procurement strategy? List three factors that might influence a client's choice of procurement route. [15%]

(b) Describe the main features of the Construction Management procurement route. Use a diagram to show the relationships between the key parties. What are the advantages and disadvantages of choosing this route versus traditional procurement from a client's perspective? [35%]

(c) (i) Identify and explain two important factors that may affect the "time value of money". [5%]

(ii) Explain the term "Net Present Value" and why it is an important factor to consider when bidding for competitive projects. [5%]

(d) Determine the optimum markup on an estimated direct cost of £3 million for a new building in Cambridge. Table 2 provides past cost estimates of your company together with the actual project costs, offering insight into the accuracy of previous estimates and aiding adjustments for this bid. The competition includes one identified competitor and three unidentified competitors. Data for the known competitor are summarised in Table 3. [40%]

Project No.	Estimated cost (£)	Actual cost (£)
1	975,000	800,000
2	1,650,000	1,850,000
3	450,000	800,000
4	3,375,000	3,575,000
5	2,550,000	2,825,000
6	6,300,000	5,900,000
7	2,700,000	2,300,000

Table 2: Past cost estimates and actual costs of previous projects.

R	Number of times
$R < 1.00$	0
$1.00 < R \leq 1.02$	1
$1.02 < R \leq 1.04$	4
$1.04 < R \leq 1.06$	6
$1.06 < R \leq 1.08$	11
$1.08 < R \leq 1.1$	6
$1.1 < R \leq 1.12$	2
$1.12 < R \leq 1.14$	1

Table 3: Bidding history of the known competitor. Note: R is the ratio of the bid price of the competitor to the estimated cost.

4 (a) Define the following terms: Free Float, Total Float, Lag, and Critical Path. [20%]

(b) Use the project activity information provided in Table 4 below to:

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

(ii) Perform backward pass calculations to determine the Total Float and Free Float for each activity. Indicate which activities belong to the Critical Path. [30%]

Activity #	**Durations (days)**	**Predecessor Activities: Relationships**	**Resource Demand (Labourers)**
A	6	-	6
B	8	-	4
C	4	A:FS	6
D	4	C:FF+3	4
E	2	C:FS	10
F	4	B:FS, C:SS+2	4
G	4	D:FS, E:SF+8	6
H	6	F:FS+1	4

Table 4: Project activities. Note: FS = Finish to Start; FF = Finish to Finish; SS = Start to Start; SF = Start to Finish.

(c) You have 14 available labourers. Perform resource allocation for the above project. What is the revised total project duration? How many extra labourers are needed to avoid any delays to the original project plan? [30%]

5 (a) Discuss the roles and responsibilities of non-executive directors under the UK Corporate Governance Code. How do they contribute to ensuring effective corporate governance in public-listed companies? [10%]

(b) (i) Explain the differences between debt financing and equity financing as sources of corporate finance. Provide one advantage and one disadvantage of each method. [20%]

(ii) Recommend the most suitable source of finance for a construction company planning to:

- Purchase new heavy machinery for long-term use.
- Fund an innovative but high-risk project to develop smart infrastructure technology.

Justify your recommendations based on the characteristics of each financing option. [30%]

(c) A private client is procuring a new high-profile life sciences research building in the centre of London. You have been asked to provide a recommendation on the financial health of the top-ranked tenderer for the project (a public limited construction company). For the year 2024, the company's turnover was £1.5 billion and their profit before tax was £3,980,934. The company balance sheet is given in Fig. 2. Using four appropriate financial ratios, comment on the financial health of the company and thus provide a recommendation on whether to proceed with this tender. [40%]

(cont.

COMPANY BALANCE SHEET		
	2024 (£)	**2023 (£)**
FIXED ASSETS		
Intangible assets	17,209,866	15,346,759
Property, plant and equipment	33,836,498	41,104,881
Investments	33,363,701	2,230,451
	84,410,065	58,682,091
CURRENT ASSETS		
Inventories	180,983	527,822
Trade and other receivables	291,688,214	272,458,782
Cash and cash equivalents	63,030,006	71,771,741
	354,899,203	344,758,345
CREDITORS: amounts falling due within one year	(266,479,064)	(305,489,945)
NET CURRENT ASSETS	88,420,139	39,268,400
TOTAL ASSETS LESS CURRENT LIABILITIES	172,830,204	97,950,491
Creditors: amounts falling due after more than one year	(76,999,022)	(71,112,849)
Provisions for liabilities	(6,572,000)	-
NET ASSETS	89,259,182	26,837,641
CAPITAL AND RESERVES		
Called up share capital	10,801,787	10,332,144
Share premium account	87,975,000	84,150,000
Hedging reserve	29,205	(6,874)
Retained earnings	23,105,851	19,016,873
TOTAL SHAREHOLDERS' FUNDS	121,911,843	103,174,675

Fig. 2: Company balance sheet.

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