RUBRIC

- This exam paper consists of THREE questions.
- Candidates should attempt ALL THREE questions.
- Question 1 is worth 40 marks
- Questions 2 and 3 are worth 30 marks each.
- This is a CLOSED BOOK exam

Question 1 (40 marks total)

Part I: CPM

You are planning the construction of 5 wind turbines. Construction is due to start on 1st January 2024. Table Q1 lists the main construction activities with their durations, predecessors and required resources. The resources are defined as follows:

- CC = Concrete Crew;
- EC = Erection Crew;
- C = Crane;
- SUC = Start Up Crew

Table Q1 Main Construction Activities with Durations and Required Resources

WBS ID	ID	Description	Duration (weeks)	Resource Requirement	Predecessor
1		*Turbine 1*			
1.1	A	Foundations	8	1 CC	-
1.2	B	Tower + Blades	4	1 EC + 1C	B
1.3	C	Start Up	2	1 SUC	C
2		*Turbine 2*			
2.1	D	Foundations	8	1 CC	A
2.2	E	Tower + Blades	4	1 EC + 1C	D; B
2.3	F	Start Up	2	1 SUC	E; C
3		*Turbine 3*			
3.1	G	Foundations	8	1 CC	D
3.2	H	Tower + Blades	4	1 EC + 1C	G; E
3.3	I	Start Up	2	1 SUC	H; F
4		*Turbine 4*			
4.1	J	Foundations	8	1 CC	G
4.2	K	Tower + Blades	4	1 EC + 1C	J; H
4.3	L	Start Up	2	1 SUC	K; I
5		*Turbine 5*			
5.1	M	Foundations	8	1 CC	J
5.2	N	Tower + Blades	4	1 EC + 1C	M; K
5.3	O	Start Up	2	1 SUC	N; L

a) Using the worksheet in your answerbook, develop the Early-Start Gantt chart for this project programme, and highlight the Critical Path. In addition, use the bottom rows of the template document ("Resource Requirements") to establish the resource requirements over time. Note: in the template, each of the increments on the horizontal axis covers two weeks. **(10)**

Question 1 continues on next page

Question 1 continued

b) For the delivery of the project, the following resources are available: 1 CC; 1 EC; 1 C; and 1 SUC. In addition, you aim to have resource demands that are, as much as possible, both levelled and continuous to reduce the need to mobilise and demobilise teams.

Given this information, what changes, if any, would you recommend to your initial schedule? If you propose any change, please highlight its potential benefits and disadvantages. **(10)**

c) Describe the purpose of the Work Breakdown Structure (WBS) in engineering project planning? What characteristics should a WBS exhibit to support effective project planning? **(5)**

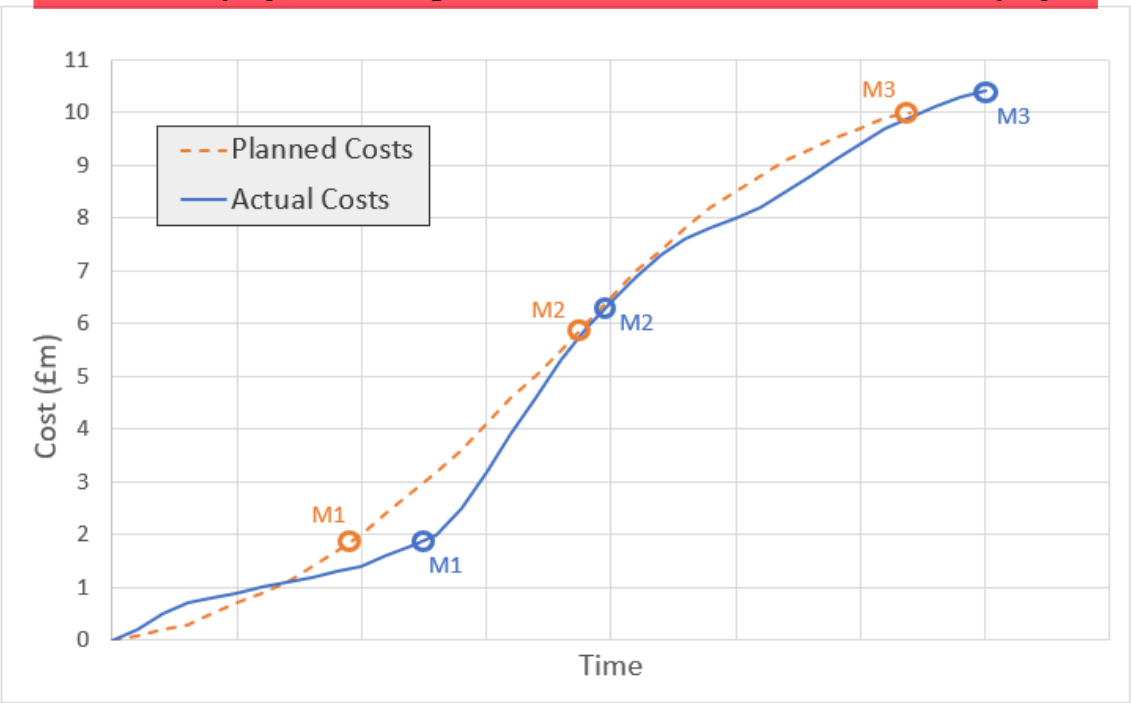
Part II: Milestone Monitoring

To monitor the delivery of the wind turbine project, the Milestone Monitoring method was used.

d) In around 100 words maximum, compare the benefits and drawbacks of the 'Milestone Monitoring' method and 'Earned Value Analysis (EVA)' method. **(6)**

e) Figure Q1 shows the Milestone Monitoring results obtained for this project. Analyse how the time and cost performances of the project evolved throughout its delivery. **(9)**

Figure Q1: The Planned and Actual cost curves for the delivery of the turbine construction project showing the three milestones identified for that project.



Question 2 (30 marks total)

[Note: for this question you should, *where appropriate*, provide examples in your answers that demonstrate your understanding. You may use examples that have been discussed during the lectures and seminars in the course, though greater weight and value may be given to your own examples, derived from either your own reading or experience.

Value is also given to the effectiveness of your communication of your understanding.]

a) "Global", "Factorial", and "Labour-hours" are types of estimating methods, but they would only be used at an early stage of an engineering project.

i. For what reasons are they only suitable for an early-stage estimate? **(5)**

ii. Identify two estimating methods that would be suitable for tender estimating. Why are these methods used in preference to "Global", "Factorial", or "Labour-hours" methods? **(5)**

b) At an early stage of an engineering project, a client may set a *budget* for their project. This is often mistaken by some for a *cost estimate*.

i. Discuss why this is and what you see as the differences between a budget and a cost estimate. **(5)**

Towards the end of a project when the final cost starts to be known with more certainty, it is often the case that this final cost is greater than the initial budget or than the initial cost estimate.

ii. Discuss the reasons why this might be the case. **(5)**

c) A project activity requires the delivery and unloading of 35 tonnes of steel whatsits®. The team decide to use a 20 tonne crane for this task, which is known to be able to unload 7 tonnes of whatsits per hour, and costs £20 per hour to rent.

i. Based on this information, how long do you estimate this activity will take, and how much will it cost? (Note, the actual cost of a whatsit does not need to be considered.) **(3)**

Once the whatsits start to be unloaded, they can be installed. The installers cost £19/hour and can install 1 tonne of whatsits every 1.5 hours.

ii. Based on this further information, how long do you anticipate the activity to take, and how much will it cost? Ensure you state your assumptions, and how you anticipate these assumptions affect your answer. (Note, the actual cost of a whatsit does not need to be considered.) **(4)**

iii. Comment on the efficiency of this activity and the utilisation of the resources that are used. **(3)**

Question 3 (30 marks total)

[Note: for this question you should, *where appropriate*, provide examples in your answers that demonstrate your understanding. You may use examples that have been discussed during the lectures and seminars in the course, though greater weight and value may be given to your own examples, derived from either your own reading or experience.

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a) A contract for the delivery phase (also known as the construction phase) of an engineering project can be classified in several different ways. Two of these are: first by the method by which the contractor is selected; and secondly by the method in which the contractor is paid.

i. A contractor may be selected through negotiation or by competitive tender. Discuss the reasons why a client may decide to negotiate with a single contractor rather than competitive tender to multiple contractors. **(5)**

Sainsrose Supermarkets are building a new store. They have a high level of knowledge of the site, the design, the size, the details of the project. They intend to appoint a contractor through competitive tendering.

ii. From the perspective of Sainsrose, what do you think the most suitable contract type is in terms of how the contractor is to be paid?; and **(2)**

iii. Why is this the best method?; and **(2)**

iv. Comment on the other methods of paying the contractor that are available? Indicate their suitability, or otherwise, in this situation. **(6)**

b) John Ruskin, the 19th Century all round polymath, is quoted as having said:

> *"It's unwise to pay too much, but it's worse to pay too little. When you pay too much, all you lose is a little money - that is all. When you pay too little, you sometimes lose everything because the thing you bought was incapable of doing the thing it was bought to do."*

While this quote was made approximately 150 years ago, discuss what you think it means in the context of engineering projects and how relevant it might be in the 2020s. **(7)**

c) After tenders are received, *Sainsrose Supermarkets* choose the well-known contractor *McGonagal and Haddock* (McG&H) to build their new supermarket. However, they do not issue a *Letter of Acceptance* to McG&H, instead they issue a *Letter of Intent*.

i. Why might Sainsrose issue a Letter of Intent? **(4)**

ii. What do you advise McG&H to do in this situation? **(4)**

END OF PAPER