

**King Saud University**

**College of Engineering**

**Department of Civil Engineering**

**Model Answer**

Second Mid-term Exam

**GE 402 Management of Engineering Projects – 1st Semester 1431- 32H**

**Sunday, 13 Muharram 1342 H – 19 December 2010**

**Time allowed: 1.5 hrs**

|  |  |
| --- | --- |
| **Student name** |  |
| **Student number** |  |
| **Section** |  |
| **Student No. in class** |  |

*Total number of Questions: 2*

**Attempt all questions**

|  |  |  |
| --- | --- | --- |
| **Questions** | **Maximum Marks** | **Marks obtained** |
| **Q** # **1** | 50 |  |
| **Q** # **2** | 50 |  |
|  | **Total marks** | \_\_\_\_\_\_\_  100 |

Total marks obtained (in words):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 1 (50% of max. credit)**

The initial AON diagram for a small engineering project is shown below with its planned activity times in days. At the end of the 10th day, the field progress report gives you the following information:

* Activity “P” was completed on schedule.
* Activity “T” was completed one day later than planned.
* Activity “W” started as planned but two days were lost due to waiting for the required materials.
* Remaining duration of Activity “Q” is 2 days.
* Estimated percentage of completion of activity "U" equals 80%.
* Estimated percentage of completion of activity “X” is 50%.
* Activity “A” cannot start until the morning of day 13.
* Due to owner requirement the volume of work of activity “Z” will be increased by 50%.
* Correct duration of activity “S” is found to be 5 days
* Due to owner requirement the volume of work of activity “B” will be decreased by 25%.
* Activity "B" must depend on activities "R" and "A" instead of activities "V" and "A".
* Duration of activity “C” will be reduced to 2 days instead of 3 days.

**Required:**

1. Construct the updated AON diagram, calculate new activity times, total flat and free float, and indicate the critical path(s).
2. If there is a delay in the completion date of the project, what is your recommended action?



**Answer Question No. 1**

**a)**



**b)** The project will be delayed by 5 days. We should determine the party who is responsible for delay. If the contractor is responsible for delay, he should use time-cost trade-off to reduce the project duration time. If the owner is responsible for delay (like activity Z), he should extend the project time and pay overhead costs.

**Question 2 (50% of max. credit)**

The arrow network for an engineering project and the time-cost trade-off data are given below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Activity** | **Normal** | | **Crash** | |
| **Time (days)** | **Cost (SR)** | **Time (days)** | **Cost (SR)** |
| A (0, 1) | 8 | 840 | 6 | 1120 |
| B (0, 2) | 16 | 1600 | 12 | 2240 |
| C (1, 2) | 12 | 2000 | 8 | 2400 |
| D (1, 4) | 18 | 2160 | 14 | 2400 |
| E (2, 3) | 8 | 2000 | 2 | 4400 |
| F (2, 4) | 10 | 600 | 8 | 960 |
| G (3, 5) | 6 | 600 | 6 | 600 |
| H (4, 5) | 14 | 2400 | 12 | 3000 |

Compute the minimum total cost of the project if its indirect cost rate is SR 250/day and its desired to be completed as early as possible (reduce project time from normal to crash duration).

**Answer Question No. 2**



Network paths are:

|  |  |  |
| --- | --- | --- |
| **Network path** | **Normal time (day)** | **Crash time (day)** |
| A C E G | 8 +12 + 8 + 6 = 34 | 6 + 8 + 2 + 6= 22 |
| A D H | 8 + 18 + 14 = **40** | 6 + 14 + 12 = 32 |
| A C F H | 8 + 12 + 10 + 14 = **44** | 6 + 8 + 8 + 12 = **34** |
| B E G | 16 + 8 + 6 = 30 | 12 + 2 + 6 = 20 |
| B F H | 16 + 10 + 14 = **40** | 12+ 8 + 12 = 32 |

* Crash the project from **44** days (normal time) to **34** days (crash time) using Modified Siemens Algorithm.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Activity** | **Normal** | | **Crash** | | **Cost Slope**  **(SR/day)** | **Time Reduction Available (day)** |
| **Time (days)** | **Cost (SR)** | **Time (days)** | **Cost (SR)** |
| A (0, 1) | 8 | 840 | 6 | 1120 | 140 | 2 |
| B (0, 2) | 16 | 1600 | 12 | 2240 | 160 | 4 |
| C (1, 2) | 12 | 2000 | 8 | 2400 | 100 | 4 |
| D (1, 4) | 18 | 2160 | 14 | 2400 | 60 | 4 |
| E (2, 3) | 8 | 2000 | 2 | 4400 | 400 | 6 |
| F (2, 4) | 10 | 600 | 8 | 960 | 180 | 2 |
| G (3, 5) | 6 | 600 | 6 | 600 | ---- | ---- |
| H (4, 5) | 14 | 2400 | 12 | 3000 | 300 | 2 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Activity** | **Path s Requiring Reduction** | | | **Cost Slope** | **Effective Cost Slope** | **Time Reduction Available** |
| **A-C-F-H** | **A-D-H** | **B-F-H** |
| A (0,1) | 2 | 2 |  | 140 | 70 | 2 0 |
| B (0,2) |  |  | 2 | 160 | 160 | 4 2 |
| C (1,2) | 4 |  |  | 100 | 100 | 4 0 |
| D (1,4) |  | 2 |  | 60 | 60 | 4 2 |
| F (2,4) | 2 |  | 2 | 180 | 90 | 2 0 |
| H (4,5) | 2 | 2 | 2 | 300 | 100 | 2 0 |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Initial Path Length | 44 | 40 | 40 | Iteration | Action | Iteration Cost | Cumulative Direct Cost |
| Remaining time reduction required (34 day project duration) | 10 | 6 | 6 | 0 | ----- | --- | 12200 |
| 8 | 4 | 6 | 1 | Cut A by 2 days | 280 | 12480 |
| 6 | 4 | 4 | 2 | Cut F by 2 days | 360 | 12840 |
| 4 | 2 | 2 | 3 | Cut H by 2 days | 600 | 13440 |
| 0 | 2 | 2 | 4 | Cut C by 4 days | 400 | 13840 |
| 0 | 0 | 2 | 5 | Cut D by 2 days | 120 | 13960 |
| 0 | 0 | 0 | 6 | Cut B by 2 days | 320 | 14280 |

* **Min. Total cost of the project = 14280 + 34\*250 = SR 22780**