

**NANYANG TECHNOLOGICAL UNIVERSITY**  
**SEMESTER 1 EXAMINATION 2010-2011**  
**CV4201 – CIVIL ENGINEERING MANAGEMENT**

December 2010

Time Allowed: 2½ hours

**INSTRUCTIONS**

1. This paper contains **FOUR (4)** questions and comprises **FIVE (5)** pages.
  2. Answer **ALL** questions.
  3. This is a Closed-Book Examination.
  4. All questions carry equal marks.
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1. (a) Name the 4 (four) basic ingredients of a Contract. (5 Marks)

(b) The terms of a contract set out the rights and obligations of both parties to the agreement. There are generally two kinds of contractual terms: Express and Implied terms. Please elaborate these two terms with some examples. (12 Marks)

(c) Consider the following two cases: (i) "selling and buying a television set" and (ii) "constructing a facility in accordance with a set of contract terms (example: a set of Specifications and Contract Drawings)" are implementation of a contract.

Explain and support with reasons why the contract for (i) does not need to be "administered" in accordance with a set of pre-agreed conditions, whereas that for (ii) does. State 3 (three) reasons for the necessity to do so.

(8 Marks)

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2. (a) The Singapore Professional Engineers (Code of Professional Conduct and Ethics) Rules has provisions regarding the conduct and behavior of a Professional Engineer (PE). Give your comments and state your understanding on whether it is appropriate for a PE to behave in the following manner:
- (i) In a coffee shop, you have just heard James Ng who is a PE, passed a comment "I heard that in Sky View project, they have their steel piles set only at 4 m instead of 18 m. This is extremely unsafe for a high-rise building...."
  - (ii) A registered PE Kenny Lim has accepted a slightly lower grade stainless steel in a building project in which he is engaged as consultant. In return of the favor, the main contractor deposited \$20,000 into Kenny's bank account with Kenny's consent.

(10 Marks)

- (b) In the light of the Singapore Building Control Act, briefly discuss the building control functions that are enforceable by the Commissioner of Building Control in the following aspects:
- (i) Occupation of buildings.
  - (ii) The requirement of independence of an Inspection Engineer under Section 28 of Building Control Act.

(8 Marks)

- (c) Er. Jeffrey Ho has just registered as a PE with a practicing certificate and is currently employed as a design engineer in ABC Consulting Engineers. Recently, the main contractor of project PR199 requested ABC to provide structural design of a temporary sheet-pile cofferdam for the construction of a basement car-park for this project. Upon the contractor's request, the managing partner of ABC directed Jeffrey to do the design and endorse it for the contractor. ABC is also currently serving as the structural consultant to the owner in project PR199.

With reference to the above case and the Singapore Professional Engineers Act, answer the following questions:

- (i) Discuss and give your opinion on whether it is appropriate for the managing partner of ABC to direct Jeffrey to do so on this matter.
- (ii) Assuming that you are in Jeffrey's position and you have acted in accordance to your boss direction, what would be the likely consequences if the temporary cofferdam collapses and claims a few workers' lives? Give reasons to support your answer.

(7 Marks)

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3. (a) Table Q3(a) contains the information of project activities and required manpower of a proposed minor project. Based on the information given in the table, sketch the project network and linked bar-chart. State the project duration and critical path.

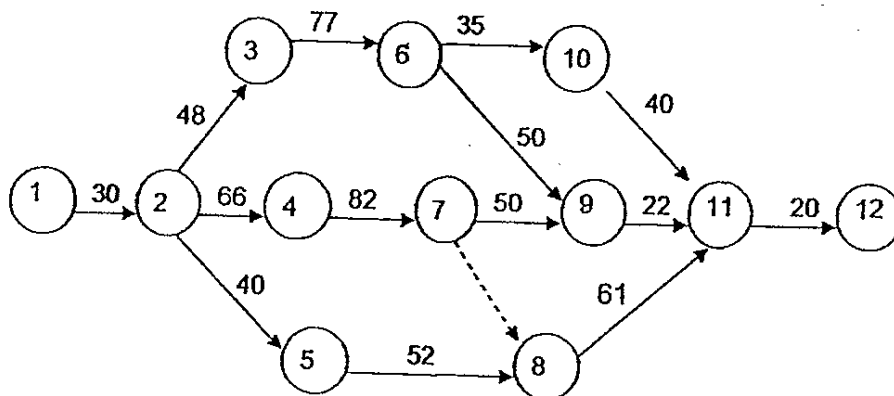
With the above workings, work out the resource requirements of "Worker" and draw the corresponding manpower histogram based on an earliest start schedule.

(12 Marks)

**Table Q3(a): Summary of project schedule**

Activity	Duration (days)	Preceding Activities	Manpower (No. of worker)
A - Clear site	2	-	3
B - Grade site	3	A	1
C - Excavate & lay lean concrete	2	B	2
D - Fabricate forms	2	B	2
E - Cut & bend reinforcement	2	B	2
F - Tie reinforcement	2	C, E	2
G - Set up forms	1	D, F	2
H - Mix and pour concrete	2	G	3
I - Remove forms	1	H	2

- (b) Figure Q3 shows the project network of a civil engineering project with activity durations in days indicated alongside the activity arrows. All the activities of this project were originally scheduled to commence at their earliest start times. At the current time at end of day 200, the progress has been monitored and all except those activities reported in Table Q3(b) have been completed.



**Figure Q3: Project network diagram**

Note: Question No. 3 continues on page 4.

**Table Q3(b): Progress of work at end of day 200**

Activity	Actual Start Time (day)	Per cent complete (%)
7-9	178	40
6-9	155	80
8-11	178	20
10-11	Not started, can start on day 210	—

- (i) Assuming all activities are being worked at a uniform rate over their respective duration, conduct a quick review on the progress of the work at day 200.
- (ii) Assuming no corrective action is to be taken and the activities that have not been started would have the same duration as planned initially, construct the status network at day 200 for the remaining work.
- (iii) Based on the status network constructed in part (ii), comment on the ensuing situation and suggest any appropriate action that can be considered to expedite the progress for the remaining work.

(13 Marks)

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4. (a) In the initial construction planning, resources are frequently assumed to be readily available. When work gets started, actual problems relating to resource availability and its utilization may set in.

In the midst of carrying out the planning using CPM network for a new project, you foresee that resources availability will not be a problem but the manpower utilization fluctuates tremendously. Briefly discuss what approach a planner can adopt so as to minimize the fluctuation of manpower utilization. Explain the theoretical basis of your approach and the key steps involved in this process of alleviating the manpower fluctuation.

(12 Marks)

- (b) Briefly describe the important aspects of financial planning and cost control in the operations of a construction organization.

(7 Marks)

- (c) Discuss the measures that could help the cash flows of a construction organization and reduce its working capital requirements. Name two sources that would normally provide working capital for contractor.

(6 Marks)

**END OF PAPER**

**CV4201 – Civil Engineering Management**  
**Semester 1 Examination 2010 – 2011**

**Question 1**

(a)

The basic ingredients of a Contract mainly comprise the following:

- An offer willingly made by one contracting party (contractor), and such offer is willingly accepted without any conditions by another contracting party (owner)
- A "consideration", in the form of a financial or non-financial reward is promised to be given by the party accepting the offer (owner)
- The presence of a firm intention of the contracting parties to enter into a legal relationship and to be legally bound
- There is evidence of the contracting parties performing the contract in accordance with pre-agreed contract terms and conditions.

(b)

Express terms are the terms and provisions explicitly stated in specifications for work, general conditions of contract (including all addenda thereof) and the like. It is unlikely that express terms of a contract could cover all contractual obligations to be discharged by the contracting parties, hence the need for Implied terms.

Implied terms are important in order to give the contract "commercial efficacy". They are empowered by the court of law that a contract is commercially unworkable if there are no implied terms, not only to enable the contract more reasonable in its consequences. There are many cases which works are carried out at the request of the project owner ("Employer") but no price has been mentioned between the contracting parties beforehand, the law would imply a term that a reasonable price should be paid for it.

However, the limitation to note is that Implied terms which are inconsistent with, contrary to or vary from any express terms of the contract, are not valid. Hence, before a term can be implied, all circumstances and background of a particular case and all express terms have to be carefully examined, and it follows that every case must be determined in the light of its own particular facts.

**Examples of Implied Terms**

- i. In the absence of express descriptions (specification requirements), there will usually be an implied term that materials used in and workmanship of works shall be of proper (generally accepted in the trade) standard and quality.
- ii. Where a project owner does not employ any technical adviser for project implementation and he is relying only on the skill and judgment of his contractor, and the contractor provides the design and/or specifications, there will be an implied term that not only works should be carried out in proper and workmanlike manner with materials of generally accepted standard and quality, but also when the works are completed, will be fit for their intended purposes.

*\*Take note that when a contractor is only carrying out works strictly in accordance to plans and/or specifications issued by the project owner (or his technical advisers), there will be no implied term in respect of "fit for intended purpose".*

- iii. When one buys an existing house, no undertaking as to the quality and suitability of house will be implied on the part of its seller. [The maxim of "caveat emptor" (let the buyer beware) will apply.] However, in the case of a sale of a house under construction, if the seller is undertaking to complete it according to his (the seller) plans and specifications, there will be an implied term that the completed house will be fit for its intended purposes.

- iv. Where a project owner's Architect (or Engineer or Superintending Officer) is vested with the power under the contract to decide matters between the project owner and the contractor in his capacity as a "*certifier*" under the contract, there will be an implied terms that the project owner will not interfere with the free and independent exercise of that function (certifying function) by the Architect.
- v. In the event of the contracted date for completion having been passed and no "*Extension of Time*" having been granted in accordance with the express terms of the contract, there will be an implied obligation on the part of contractor to complete his works within a reasonable time and to carry out outstanding works with reasonable diligence and due expedition throughout the period of construction.

(c)

The contract for (i) does not need to be administered, as the entire procuring process is complete in a short duration with no negotiations involved and supplemented with valid supporting documents. The analogy is as below.

A customer goes into an electronic shop to enquire about a television set with particular features and functions (supplying "Tender/Contract Drawings" and "Specifications"). The shop assistant would show the customer the television set that meets his requirements and reveal the selling price (submitting a tender, making an offer). The customer may then find out how to operate the set and the terms of warranty ("Defect Liability Period" and extent of defect liability) the shop and the manufacturer would provide (seeking clarification on the tender submitted/offer made). Upon clinching a deal, the customer may ask for discount on the stated price which would not be agreed on as it is a fixed retail price (contract negotiation). The customer would go around other electronic shops and look for the same television set model for price comparison (review, evaluate and compare tenders) and finally return to the first shop to for purchase in accordance with the terms quoted by the shop assistant earlier (awarding a "Lump-sum Contract"). An invoice is issued to the customer, payment is made and the television set would be delivered to customer's place (performance of contract by contracting parties).

The contract for (ii) needs to be administered as "constructing a facility in accordance with a set of contract terms (a set of Specifications and Contract Drawings)" involves different stages of expertise and construction works, a substantial duration and huge amount of capital. The Contract Administrator plays the role of an authorised representative of or a quasi-adjudicator between the project owner and the contractor to oversee the performance of the contractor, without bias and could exercise professional judgments independently. This is necessary to:

- Ensure the designs and specifications fully satisfy the design brief issued for tendering, form an integral part of the Contract and set up proper and efficient procedure to do so
- Ensure that the works completed are in full compliance with all requirements stated in Specifications and are carried out in accordance with a pre-agreed schedule and completed within pre-agreed "Date/Dates of Completion"
- Set up procedures, schedule, terms and conditions and ensure compliance thereof when the contractor claims for interim payments for works done from time to time and for the owner/employer to effect the payments correspondingly
- Clearly identify bases for the determination of "Variations" to the Contract, for assigning responsibility and liability for delays caused to the pre-agreed "Date of Completion" of all works and assessing EOT to be rightly granted.

## Question 2

(a)

- i) The PE (James Ng) should refrain from expressing publicly (since he is in a coffee shop) an opinion (as he said "I heard that..") on an engineering project unless he is informed of all the

facts. He should not criticize the works undertaken and injure the professional reputation of another organization or PE, but has the moral obligation to expose unethical conduct before the proper authorities if he is aware of the full facts.

- ii) The registered PE (Kenny Lim) should not accept commission (\$20,000 deposited into his bank account from the main contractor) in connection with his professional work (his role as consultant). He violated the code of professional conduct and ethics as he compromised the quality of stainless steel in the building project. He did not discharge his duties to his employer with complete fidelity as he illegally accepted the slightly lower grade stainless steel in the project and consciously received remuneration from the contractor.

(b)

- i) On completion of any building works, the building shall not be occupied or used in any manner until the CBC has issued either a Certificate of Statutory Completion (CSC) or a Temporary Occupation Permit (TOP).

CSC is issued when:

- The building works have been fully completed according to approved plans
- All statutory and other requirements as required by the BC Act and the CBC have been complied with
- All progress reports and other specified reports have been duly submitted.

TOP is issued when the building works have yet to be fully completed. But it is not completed to an extent that, in the opinion of the CBC, the non-completion is not detrimental to the safety and well-being of the potential occupants of the building.

- ii) Section 28 of Building Control Act governs the periodic inspection of all buildings except detached houses, semi-detached houses, and terraced or linked house. The CBC may by a notice served on the owner require the building to be inspected by an independent Structural Engineer. The Structural Engineer has to be a registered PE in the civil or structural engineering discipline and he must not have any professional or financial interest in the building. The inspection is as follow:

- Buildings used solely for residential purposes. 10 years after the issue of the CSC and thereafter at intervals of not less than 10 years.
- Other buildings. 5 years after the issue of the CSC and thereafter at intervals of not less than 5 years.

(c)

- i) It is inappropriate for the managing partner of ABC to direct Jeffrey to design and endorse the structural design of a temporary sheet-pile cofferdam for the contractor as the company, ABC Consulting Engineers is serving as the structural consultant to the project owner. This situation is termed conflict of interest as the company assumes the role of consultant to the project owner as well as the contractor under the same project. In order to serve the best interest of one party (the contractor in the question), the best interest of another party (the project owner or vice versa) would be compromised. The managing partner should decline the contractor's request and engage experts or specialists to design the temporary cofferdam in the project owner's (the company's client) interest.

- ii) If the temporary cofferdam collapses and claims a few workers' lives, an Investigation Committee would be set up to investigate the cause of the collapse and submit a report. Jeffrey would be fined S\$10K and his PE status would be cancelled or suspended, struck off by the PE Board. The managing partner may face jail sentence as he's the mastermind. The company as a whole is likely to face a maximum fine of S\$200,000 and debarred from tendering future project.



#### Question 4

(a)

Large fluctuation of manpower utilization despite unlimited resources availability is undesirable as it results in continuous hiring and firing of men. Therefore, the planner could deploy the approach of resource levelling via a process called Activity Shifting to obtain a uniform histogram. This approach involves shifting of non-critical activities with float times to start any time between their Earliest Start Times (ES) and Latest Start Times (LS) without causing any extension to the project duration. Any solution is deemed acceptable if there is only one significant peak in the histogram diagram and the rise in the peak and the subsequent decline are gradual.

The process of alleviating the manpower fluctuation starts by loading the activities into a histogram according to the Earliest Start (ES) schedule. Critically examine and select protruding non-critical activities and roll them over while ensuring that they would not go beyond their Latest Finish (LF) times and still follow the logical sequence of activities.

(b)

Financial planning and cost control in the operations of a construction organization are vital to avoid inadequate cash resources during the execution of any project although the project would yield adequate profits at the end. Financial planning constitutes:

- incomes to be generated from individual projects
- costs of construction of the projects
- the overhead costs of the company and the apportionment of such costs.

While cost control refers to exercising control on

- the costs of construction at various sites
- expenditure on the overheads.

Such budgetary planning of construction costing techniques along with cash flow forecasting helps to

- establish limits on expenditure on company overheads
- income and profit levels
- capital requirements.

These should be worked out for all existing projects and anticipated new projects to enable the planner to determine

- the level of working capital required at different times
- the overdraft or credit requirements
- the feasibility of accepting future projects at that point in time.

(c)

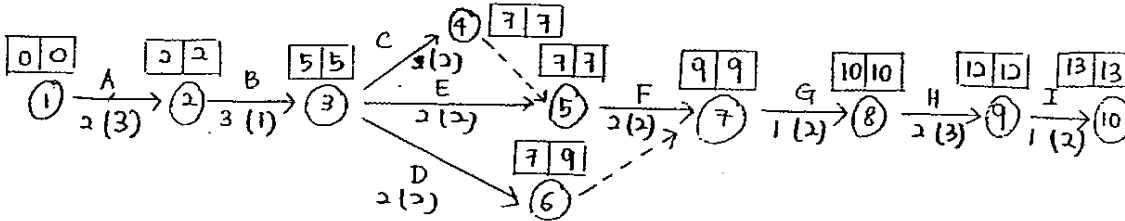
Measures that could help the cash flows of a construction organization and reduce its working capital requirements:

- allocate sufficient and reasonable resources in financial planning and constantly monitor the finance schedules of a project to ensure adequate cash resources are available throughout the execution of the project. Such finance schedules comprise the cumulative cost, value, progress payment receivable, cumulative cash outflow and cumulative cash inflow vs. time plots.
- optimize both the project duration and project cost by compressing or crashing some of the activities to shorten the time for project completion and activities of the project being carried out at lowest possible cost.

Two sources that would normally provide working capital for contractor are internal funds of the company and short-term borrowing from banks.

Question 3

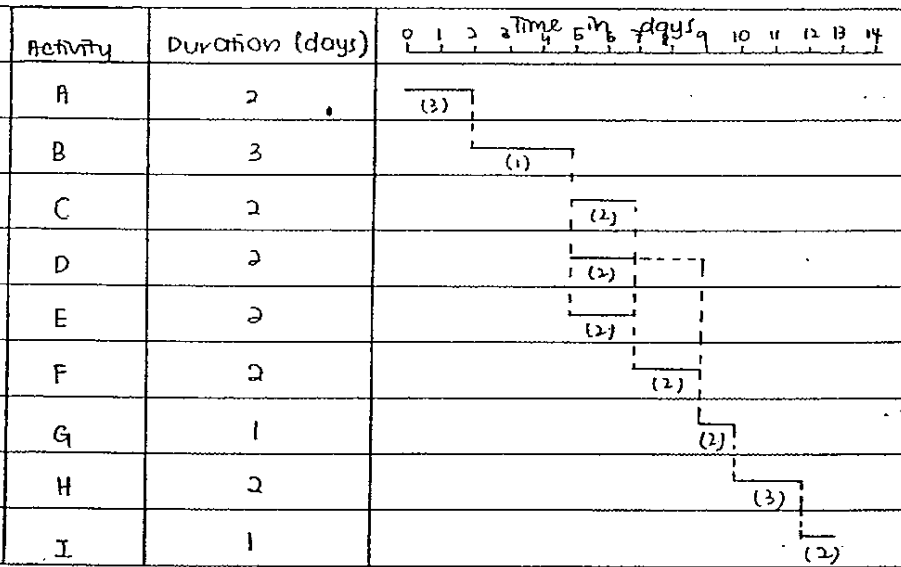
(a)



∴ Project duration = 13 days \*

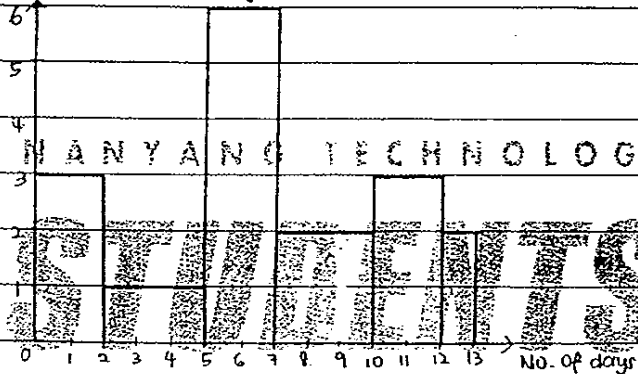
Critical path = ① → ② → ③ → ④, ⑤ → ⑦ → ⑧ → ⑨ → ⑩ \*

Lined bar-chart :

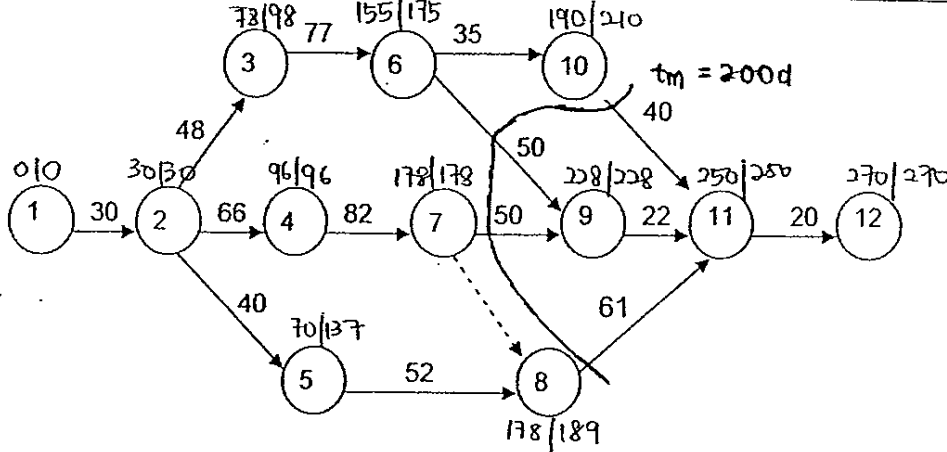


- Manpower needed for each activity is indicated in bracket.

Manpower histogram :



(b) The time analysis of the network planning:



(i) All activities started promptly except activity 10-11. However, its delay of 20 days ( $210 - 190$ ) sufficiently consumed its available float of 20 days, ( $250 - 190 - 40$ ). Therefore, activity 10-11 will not impose any delays.

As for activity 7-9, it belongs to the critical path and such delay in critical activity would impose delay the entire project. Its progress is such that:

$$\text{time used} = 200 - 178 = 22 \text{ days}$$

$$\text{progress rate} = \frac{40\%}{22} = 1.818\% \text{ per day}$$

$$\text{remaining time to completion} = \frac{60\%}{1.818\%} = 33 \text{ days}$$

Its total duration of 233 days ( $200 + 33$ ) would exceed 228 days, its supposing latest event time, therefore will cause a delay of 5 days.

As for activity 6-9, its progress of work:

$$\text{time used} = 200 - 155 = 45 \text{ days}$$

$$\text{progress rate} = \frac{80\%}{45} = 1.778\% \text{ per day}$$

$$\text{remaining time to completion} = \frac{20\%}{1.778\%} = 11.25 \text{ days} \approx 12 \text{ days}$$

Its total duration of 212 days will not impose any delays as it has a total float of 23 days. ( $228 - 155 - 50$ )

As for activity 8-11 :

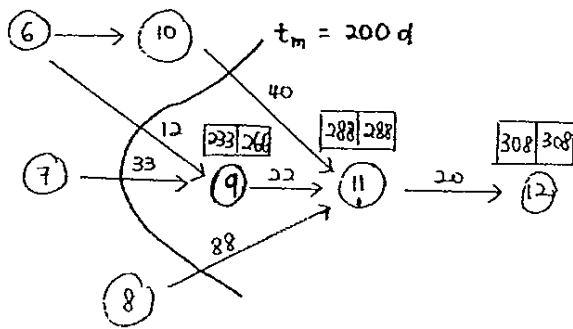
$$\text{time used} = 200 - 178 = 22 \text{ days}$$

$$\text{progress rate} = \frac{20\%}{22} = 0.909\% \text{ per day}$$

$$\text{remaining time needed for completion} = \frac{80\%}{0.909\%} = 88 \text{ days}$$

Its total duration of 288 days far exceeded its available float of 11 days (250 - 178 - 61) and will cause delay to the entire project duration.

(ii)



(iii) The new critical path : remaining of activities 8-11 and 11-12.

The project duration is extended to 308 days , instead of that of the original network of 270 days.

Suggestion of appropriate actions :

- to supply more manpower to activity 8-11 to reduce its delay of 88 days.