



EASTERN MEDITERRANEAN UNIVERSITY
COMPUTER ENGINEERING DEPARTMENT

CMPE 412 – SOFTWARE ENGINEERING

Final Exam

29 May 2018

DURATION: 150 min

Instructor: Assoc. Prof. Dr. Alexander Chefranov

Master key

Name Surname:

Student Number:

| QUESTION | GRADE |
|--------------------|-------|
| Q 1 (4) | |
| Q 2 (10) | |
| Q 3 (6) | |
| Q 4 (7) | |
| Q 5 (6) | |
| Q 6 (10) | |
| Q 7 (30) | |
| Q 8 (20) | |
| Q 9 (7) | |
| TOTAL (100) | |

Instructions:

- There are **9** questions in total
- Questions Q1-Q5 (33 points) cover before- and Q6-Q9 (67 points) – after-MT material
- There are 17 pages in total.
- Calculators are allowed.
- GSM phones should be turned off and given to the invigilator.
- Passing any material including rubbers, pencils etc. to anybody else is strictly prohibited during the exam.
- Nine sheets of handwritten paper may be used for your help (photocopies, printouts, etc., are not allowed)

Before-MT QUESTIONS Q1-Q5 (33 points)

Q1 (4 points). What are the three constituents of the Weinberg's MOI model of a team leader abilities?

M - Motivation
 O - Organization
 I - Ideas/Innovation

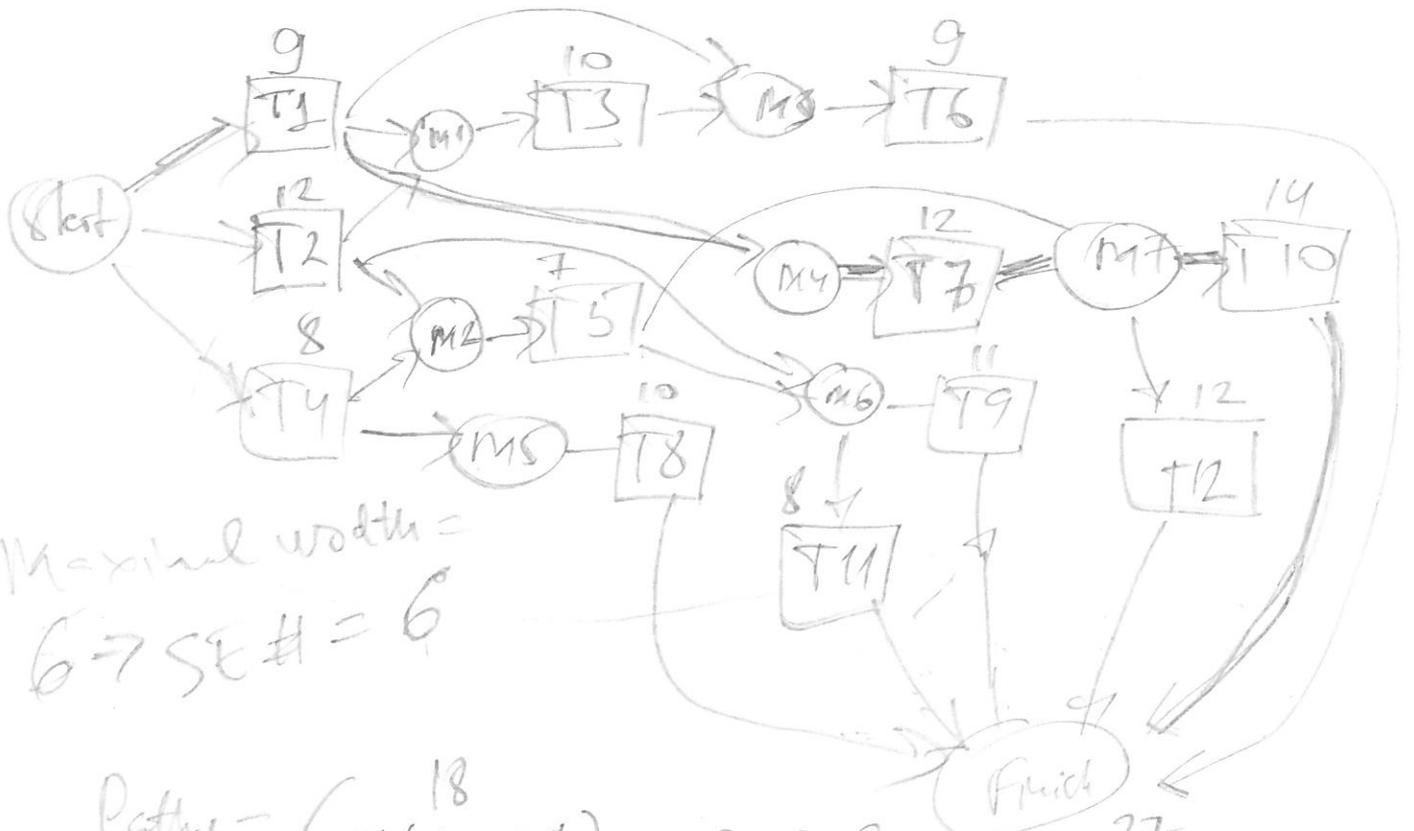
Q2. (10 points) Draw an activity network diagram for the following work breakdown:

| Task | Duration(Days) | Dependencies |
|------|----------------|--------------|
| T1 | 9 | - |
| T2 | 12 | - |
| T3 | 10 | T1, T2(M1) |
| T4 | 8 | - |
| T5 | 7 | T2, T4(M2) |
| T6 | 9 | T1, T3(M3) |
| T7 | 12 | T1(M4) |
| T8 | 10 | T4(M5) |

| | | |
|-----|----|-------------|
| T9 | 11 | T2, T5 (M6) |
| T10 | 14 | T5, T7 (M7) |
| T11 | 8 | T2, T5 (M6) |
| T12 | 12 | T5, T7 (M7) |

Project duration = 35

Define the minimal project duration and the reasonable number of software engineers to work on it. Show your calculations. Give necessary explanations.



Maximal width = 6
 6 → SE# = 6

- $P_{Path1} = (T4, T8)$
- $P_2 = (T4, T5, T11)$
- $P_5 = (T2, T5, T9)$
- $P_7 = (T1, T7, T12)$
- $P_9 = (T4, T5, T12)$
- $P_{11} = (T2, T5, T10)$
- $P_{13} = (T1, T6)$
- $P_3 = (T2, T5, T11)$
- $P_4 = (T2, T11)$
- $P_6 = (T2, T9)$
- $P_8 = (T2, T5, T12)$
- $P_{10} = (T1, T7, T10)$ Critical path
- $P_{12} = (T4, T5, T10)$
- $P_{14} = (T1, T3, T6)$
- $P_{15} = (T3, T3, T6)$

Q3. (6 points) What is incremental software development model? What are the five strengths of the incremental software development model

- 1) You can develop high-risk or major functions first
- 2) Each release delivers an operational product
- 3) Customer can respond to each build from each increment
- 4) Uses "divide and conquer" break down of tasks
- 5) Lowers initial delivery cost

Incremental software development model assumes definition of the requirements priorities and delivering software to a customer by increments starting with the implementation of the most important requirement

Q4. (7 points) Calculate adjusted function points count under the following conditions: the number of

- EI - external inputs 3,
- EO - external outputs 4,
- EQ - external enquiries 5,
- ILF - internal logical files 5,
- EIF - external interfaces 2.

All 14 adjusting factors, F_j , are equal to 2 (Moderate). Show details of your calculations. Make necessary assumptions and give explanations.

Hints:

FIGURE 4.5
Computing function points

| Measurement parameter | Count | Weighting factor | | | |
|-------------------------------|-------|------------------|---------|---------|------|
| | | Simple | Average | Complex | |
| Number of user inputs | 3 | 3 | 4 | 6 | = 12 |
| Number of user outputs | 4 | 4 | 5 | 7 | = 20 |
| Number of user inquiries | 5 | 3 | 4 | 6 | = 20 |
| Number of files | 5 | 7 | 10 | 15 | = 35 |
| Number of external interfaces | 2 | 5 | 7 | 10 | = 10 |
| Count total | | | | | 97 |

To compute function points (FP), the following relationship is used:

$$FP = \text{count total} \times [0.65 + 0.01 \times \sum(F_j)] \tag{4-1}$$

where count total is the sum of all FP entries obtained from Figure 4.5.

Each of the following tables assists in the ranking process (the numerical rating is in parentheses). For example, an EI that references or updates 2 File Types Referenced (FTR's) and has 7 data elements would be assigned a ranking of average and associated rating of 4. Where FTR's are the combined number of Internal Logical Files (ILF's) referenced or updated and External Interface Files referenced.

EI Table

| FTR's | DATA ELEMENTS | | |
|-----------|---------------|------|------|
| | 1-4 | 5-15 | > 15 |
| 0-1 | Low | Low | Ave |
| 2 | Low | Ave | High |
| 3 or more | Ave | High | High |

Shared EO and EQ Table

Handwritten calculations:
 $\sum F_j = 14.2 = 28$
 $FP = 97 (0.65 + 0.28) = 97 \cdot 0.93 = 90.21$

EO EQ
4/4

| FTR's | DATA ELEMENTS | | |
|-------|---------------|------|------|
| | 1-5 | 6-19 | > 19 |
| 0-1 | Low | Low | Ave |
| 2-3 | Low | Ave | High |
| > 3 | Ave | High | High |

ILF

| Rating | VALUES | | |
|---------|--------|----|----|
| | EO | EQ | EI |
| Low | 4 | 3 | 3 |
| Average | 5 | 4 | 4 |
| High | 7 | 6 | 6 |

For both ILF's and EIF's the number of record element types and the number of data elements types are used to determine a ranking of low, average or high. A Record Element Type is a user recognizable subgroup of data elements within an ILF or EIF. A Data Element Type (DET) is a unique user recognizable, non-recursive (non-repeating) field on an ILF or EIF.

| RET's | DATA ELEMENTS | | |
|-------|---------------|---------|------|
| | 1-19 | 20 - 50 | > 50 |
| 1 | Low | Low | Ave |
| 2-5 | Low | Ave | High |
| > 5 | Ave | High | High |

5 ILF
2 EIF

| Rating | Values | |
|---------|--------|-----|
| | ILF | EIF |
| Low | 7 | 5 |
| Average | 10 | 7 |
| High | 15 | 10 |

Q5. (6 points) For COCOMO intermediate semi-detached model, estimate effort and development time if the project size is 128 KLOC. Show your calculations, specify units for values defined. Make necessary assumptions and give explanations..

Hints:

- The Intermediate COCOMO model computes effort as a function of program size and a set of cost drivers. The intermediate COCOMO equation is:

$$E = a(KLOC)^b \times EAF$$

$$T_{dev} = cE_{nom}^d$$

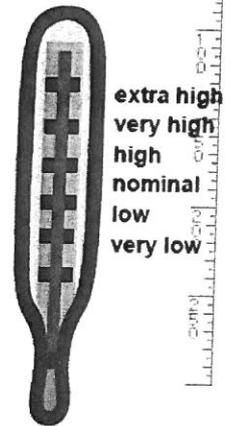
- The factors a , b , c and d for the intermediate model are shown in the table.

| Mode | a | b |
|---------------|-----|------|
| Organic | 3.2 | 1.05 |
| Semi-detached | 3.0 | 1.12 |
| Embedded | 2.8 | 1.20 |

| Mode | c | d |
|---------------|-----|------|
| Organic | 2.5 | 0.38 |
| Semi-detached | 2.5 | 0.35 |
| Embedded | 2.5 | 0.32 |

The effort adjustment factor (EAF) is calculated using 15 cost drivers.

- The effort adjustment factor (EAF) is calculated using 15 cost drivers. ← project related features
- The cost drivers are grouped into 4 categories: *product*, *platform*, *personnel*, and *project*.
- Each cost driver is rated on a 6 point ordinal scale ranging from *very low* to *extra high* importance. Based on the rating, the *effort multiplier (EM)* is determined (Boehm, 1981). The product of all effort multipliers is the EAF .



$$E = E_{nom} \times EAF \qquad EAF = \prod_{i=1}^{15} EM_i$$

$$E_{nom} = a(KLOC)^b \times EAF$$

Cost drivers information is absent, hence, $EAF = 1$ (all drivers having nominal values)

$$a = 3.0 \quad b = 1.12$$

$$E_{nom} = E = 3 \cdot 128^{1.12} = 3.229 = 687 \text{ person-months}$$

$$C = 2.5 \quad d = 0.35$$

$$T_{dw} = C E_{nom}^d =$$

$$= 2.5 \cdot 687^{0.35} =$$

$$= 2.5 \cdot 9.84 = 24.6 \text{ months}$$

After MT Exam questions Q6-Q9

Q6. (10 points) What is use case scenario? How is it defined? What is pre-condition? What is post-condition? What is normal events flow? What is alternative events flow? What is initiating actor? What is participating actor? Why the goal of the initiating actor is specified in the scenario?

Use case scenario is a description of a system's behavior as it responds to requests originating from outside of the system.

It may be defined using textual description, forms, or sequence diagrams.

Pre-condition is the system's state expected at the beginning of the scenario.

Post-condition is the system's state expected after the end of a scenario.

Normal events flow means the sequence of actions normally applied in the scenario run.

Alternative events flow is the sequence of actions used when something goes wrong.

Initiating actor is an actor requesting a scenario invocation.

Participating actor is an actor requested by the system in the course of running the scenario.

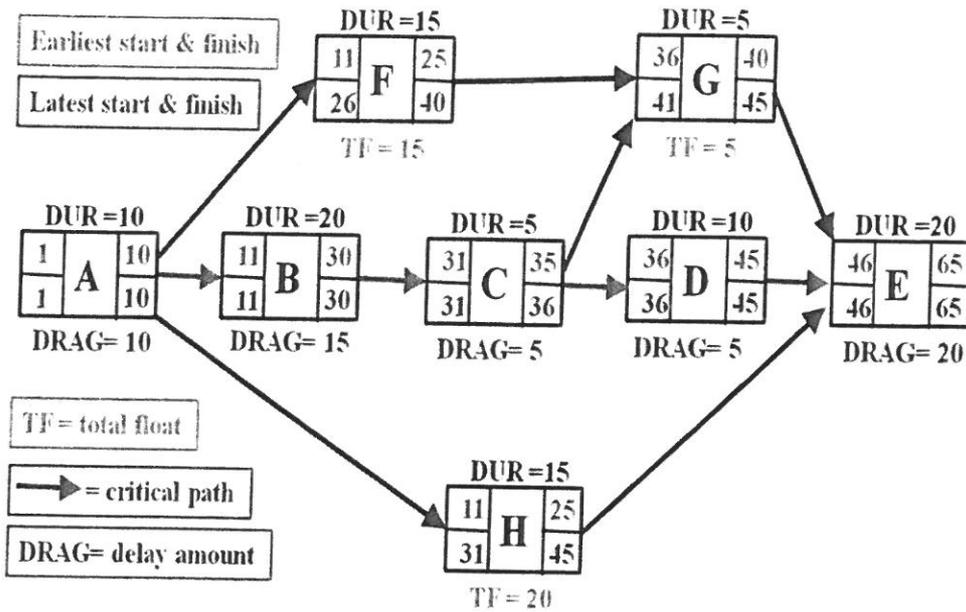
The goal of the initiated actor is specified in the scenario to be able checking that the scenario meets the goal.

Q7. (30 points) For the set of hierarchical tasks below, define activity network diagram preserving only leaf-level tasks. For the activity network diagram obtained, calculate early and late start and completion times, slacks, and drags (where appropriate). Show details of your calculations. Give necessary explanations.

| Tasks | Depends on | Duration (days) |
|---|------------|-----------------|
| 1. Design system database | | 7 |
| 2. Implement system database | | 7 |
| 3. Test system database | 1 | 2 |
| 4. Develop user interface | | |
| 4.1. Develop login screen | | 3 |
| 4.2. Develop sysadmin screen | | 3 |
| 4.3. Develop user screen | | 3 |
| 5. Integrate screens and database | 2 | |
| 5.1. Integrate login screen and database | 3.1 | 2 |
| 5.2. Integrate sysadmin screen and database | 4.1, 3.2 | 2 |
| 5.3. Integrate user screen and database | 4.2, 3.3 | 2 |
| 6. Test integrated screens and database | 4 | |
| 6.1. Test integrated login screen and database | | 2 |
| 6.2. Test integrated sysadmin screen and database | 5.1 | 2 |

| | | |
|---|-----|---|
| 6.3. Test integrated user screen and database | 5.2 | 2 |
|---|-----|---|

Hints:



| Task | ES | EF | LS | LF | Slack | Drag |
|------|----|----|----|----|-------|------|
| 1 | 1 | 7 | 5 | 11 | 4 | |
| 2 | 1 | 7 | 1 | 7 | 0 | 4 |
| 3 | 8 | 9 | 12 | 13 | 4 | |
| 4,1 | 1 | 3 | 5 | 7 | 4 | |
| 4,2 | 1 | 3 | 7 | 9 | 6 | |
| 4,3 | 1 | 3 | 9 | 11 | 8 | |
| 5,1 | 8 | 9 | 8 | 9 | 0 | 2 |
| 5,2 | 10 | 11 | 10 | 11 | 0 | 2 |
| 5,3 | 12 | 13 | 12 | 13 | 0 | 2 |
| 6,1 | 4 | 5 | 12 | 13 | 8 | |
| 6,2 | 10 | 11 | 12 | 13 | 2 | |
| 6,3 | 12 | 13 | 12 | 13 | 0 | 2 |

Parallel to:

1|4,1|4,2|4,3

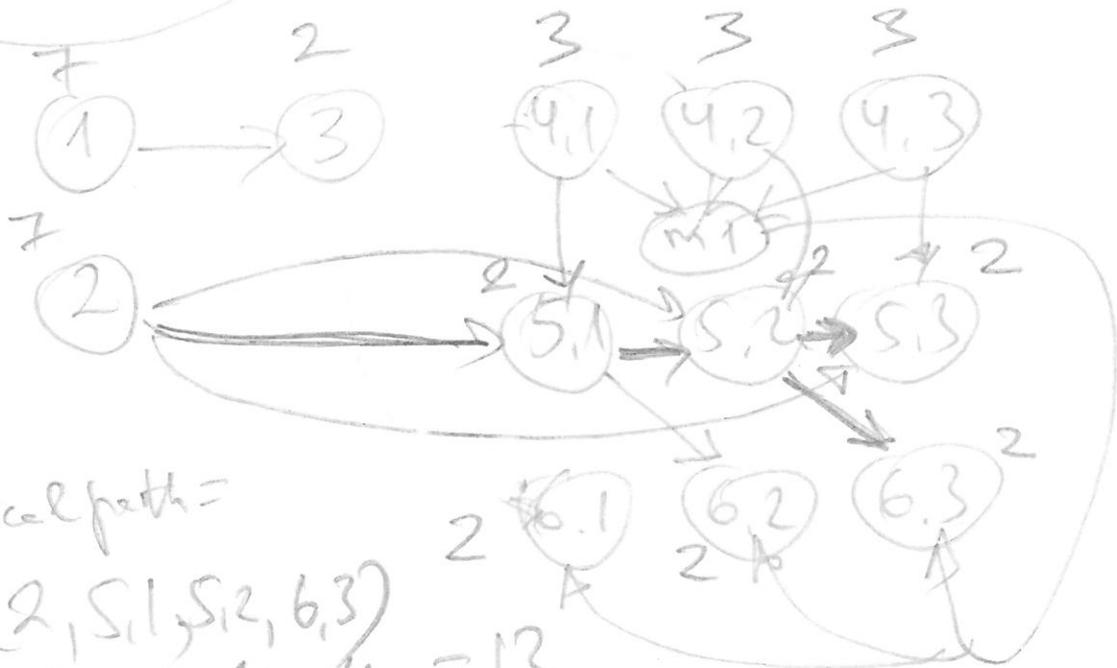
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3

3

3

ES set to 1 for the tasks not having preceding ones, $ES = \max(EF) + 1$, where max is over the preceding tasks
 LF set to critical path where $EF = CP$ and $LF = \min(LF) - 1$ where min is over the succeeding tasks! $Slack = LF - EF = LS - ES$



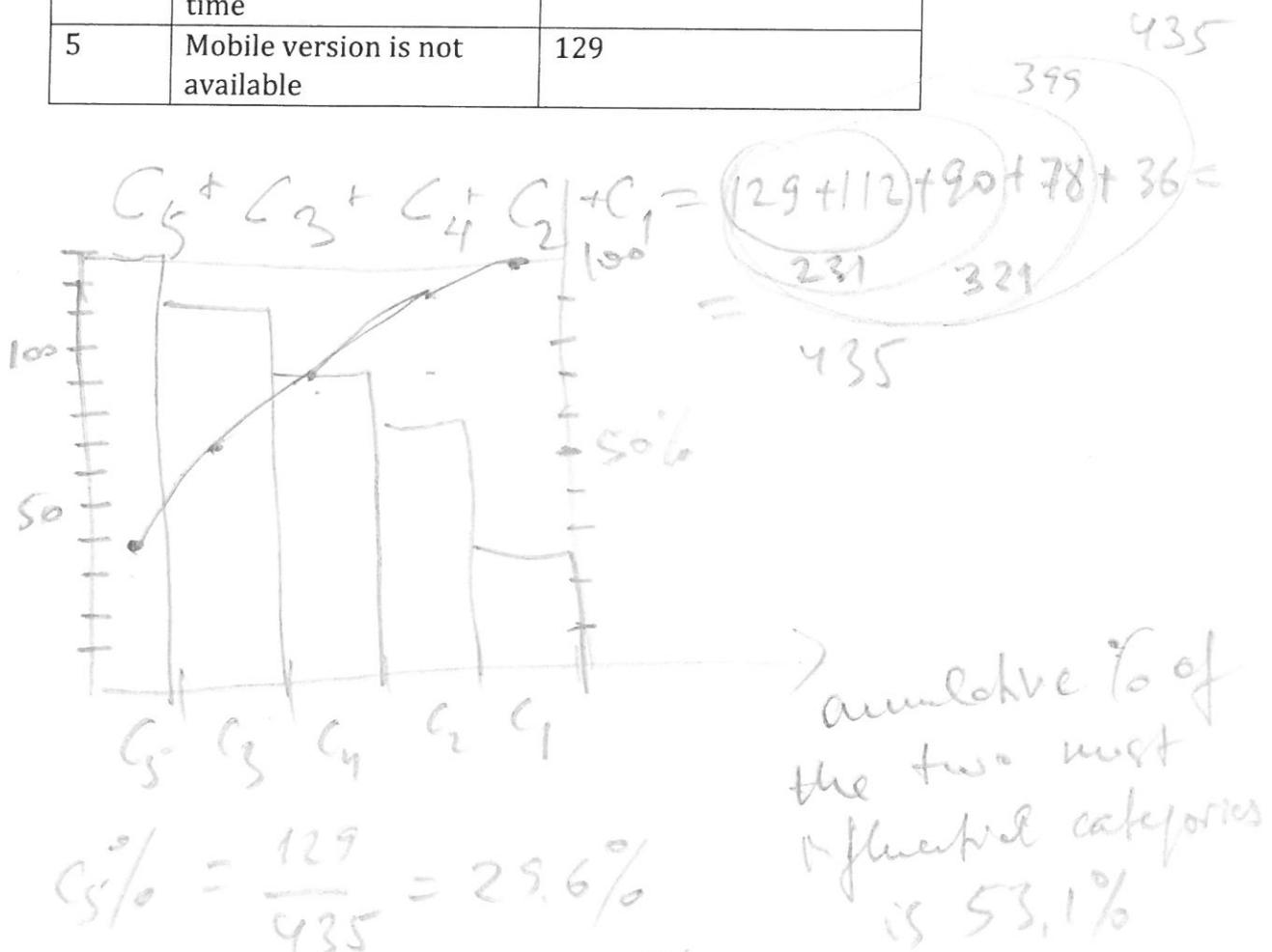
critical path =

$= (2, 5.1, 5.2, 6.3)$

Critical path length = 13

Q8. (20 points) For causes enlisted in the table below, build a Pareto diagram. Specify cumulative percentage of two most influential complaint categories. Show your calculations. Give necessary explanations.

| # | Complaint category | Frequency/week |
|---|---|----------------|
| 1 | System installation takes too much time | 36 |
| 2 | User interface is not friendly | 78 |
| 3 | System has not understandable help | 112 |
| 4 | Response time for queries takes too much time | 90 |
| 5 | Mobile version is not available | 129 |



$$C_5\% = \frac{129}{435} = 29.6\%$$

$$(C_5 + C_3)\% = \frac{231}{435} = 53.1\%$$

$$(C_5 + C_3 + C_4)\% = \frac{321}{435} = 73.7\%$$

$$(C_5 + C_3 + C_4 + C_2)\% = \frac{399}{435} = 91.7\%$$

Q9. (7 points) What are the five software configuration management tasks?

- 1) Identification of versions
- 2) Version control
- 3) Change control
- 4) Configuration auditing
- 5) Reporting

