ExamSoftware Management

- This is a closed book exam; no books/notes etc. are allowed during the exam.
- Please read the questions carefully, *especially the italic parts!*
- **For faster grading, please write the answers for each question on a new sheet: do not forget to add your name to each sheet** (e.g. do that immediately for all sheets)
- For each question, we wrote the number of points you can earn, to give you an indication of the rewards when answering right.
- Good luck with the exam!

Question 1

Consider the following product development situation:
- A company gets an assignment to develop navigation software for military aircraft.
- The expected effort for the assignment is ca. 200 person-years
- The total project takes over 5 years, with very strict and well-defined milestones defined in the contract.
- (Hence) Throughout the project, changes to the requirements are inevitable
- The expected life-time of the resulting product is 15 years
- The company has lots of experience and reusable software in this area.
- The product is soft-realtime (i.e. good response times at UI, but not time-critical at less than the milli-second level)
- Reliability (safety, fault-tolerance, security) is –obviously– critical, and must be guaranteed.

a) For each of the following development processes, write down *the most important advantage and disadvantage* for applying that process for the project described above; *motivate the answers*:
   1) **[2]** Waterfall model
   2) **[2]** Prototyping
   3) **[2]** Spiral model
   4) **[2]** Scrum

b) **[4]** In a few sentences, describe *and motivate* what –in your opinion– would be the *most suitable* development process for the project described above.

c) **[2]** Can the adoption of a quality management standard such as CMM be beneficial from the point of view of the project described above?? (*provide arguments*)

d) **[2]** Assume you are the customer: (for the project described above) would you require the company to be certified for a specific CMM level, and if so, which level? *Briefly motivate your answer!*

e) **[2]** Propose two particular practices or techniques that would be particularly useful to adopt in the development of the project described above. Examples (do not use these in your answer) would be: write a requirements specification, unit testing, coding guidelines, proving correctness of programs.

Question 2

[Start your answers on a separate sheet—with your name on it!]

a) For some software system which starts running at time t=0, it is known that it will fail before time t=10. Between t=0 and t=10 the probability density function (PDF) for the occurrence of the failure is linear (i.e. its graph is a straight line); it descends to 0 as t approaches 10.
   1) **[3]**What is the value of the PDF for t=0?
   2) **[3]**Give the cumulative density function (CDF) for the occurrence of the failure of the system.
   3) **[3]**Compute the mean time to failure (MTTF) for this system (i.e. the average of the failure times of many runs of the system).
   4) **[3]**Compute the median time to failure for this system (i.e. the time at which the failure is expected to have occurred in 50% of the runs of the system).

b)
   1) **[2]** What is the main difference between reliability and availability?
   2) **[2]**Give a metric for the availability of a software system.
   3) **[1]**Which kind of data do you need to compute the availability of the system?

Question 3

[Start your answers on a separate sheet—with your name!]

A software company is developing a product. During the development process the team performed tests in each phase in order to identify and fix defects. The following table gives data about the number of defects per phase. Columns represent phases.

	Detailed design review	Code inspection 1	Code inspection 2	Unit testing	Component testing	System testing
Defects found in a phase	75	35	21	20	22	15
Defects removed in a phase	70	30	21	15	21	15

Analyze the effectiveness of the defect removal in order to identify weak phases.

a) **[4]** Calculate the defect removal effectiveness of each phase

b) **[2]** Identify the two weakest phases

c) **[2]** How would you classify the defect removal effectiveness metric: product, in-process, software maintenance metric? Underline the correct answer.

The product was released on the market and entered the maintenance phase. The following table gives data for a period of 6 months. The following data are available for each month: number of sold licenses, number of reported defects, number of problems reported by the users.

	Sold licenses	Reported defects	Reported user problems (per type)	
			Documentation:	Support:
M1	25	20	20	35
M2	40	37	30	38
M3	60	45	35	15
M4	55	35	25	10
M5	51	20	28	7
M6	53	18	30	5

d) **[6]** Calculate the PUM metric for each month based on the data in the table.

[question continues on next page]

e) **[3]**Analyze the PUM data for the period of these 6 months. What was improved in order to low the PUM over the months? Is there any aspect of the product that is neglected?

Question 4

[Start your answers on a separate sheet—with your name on it!]

a) You are a project manager and get a report about the measures for some standard metrics applied for your project. These metrics are Lack of Cohesion in Methods (LCOM), Coupling Between Object Classes (CBO), Number of Children (NOC), and Weighted Methods per Class (WMC). The following table shows these measures for the most important classes in this project:

Class	LCOM	CBO	NOC	WMC
A	0	1	8	1
B	2	4	2	12
C	2	2	6	33
D	2	3	3	9
E	1	1	1	7
F	4	5	2	25
G	2	1	4	13

1) **[3]**The combination of the metrics LCOM and CBO often is used as indicator for "reusability". According to these two metrics, which two classes in this project are least re-usable? Explain your choice and what these two metrics indicate with respect to re-usability.

2) **[1]**Which of the remaining two metrics hint at a limited re-usability? Explain why.

3) **[3]**For the NOC metric, there is no clear guideline whether the value should be high or low, there is rather a trade-off to be made. Explain which class in the table above seems to have the worst design according to the NOC metric? Also consider the other metrics for making the trade-off discussion.

b) Give the definition of the Chidamber Kemerer (CK) Metric "Response for Class (RFC)", including:

1) **[2]**A description of the metric and how to calculate it.

2) **[2]** Discuss the meaning of a large value and the implications for the complexity and the expected defect rate of a class with a large value for RFC.

c) Consider the following two pieces of code and answer the questions below.

Listing 1

Listing 2

Listing 1	Listing 2

checksum = 0
while (number != 0) {
  checksum = checksum + number % 10
  number = number / 10
}
	checksum = 0
	while (number != 0) {
	  checksum += number % 10
	  number /= 10
	}

Distinct operators (n_1=10):
=, while, (, !=,), {, +, %, /, }

Distinct operators (n_1=10):
=, while, (, !=,), {, +=, %, /=, }

Distinct operands (n_2=4):
checksum, 0, number, 10

Distinct operands (n_2=4):
checksum, 0, number, 10

1) **[3]** According to Halstead's Software Science, which of the two programs is more difficult? Show the formulas you use and your calculation of the Difficulty measure as well as all measures it is derived from.

2) **[2]** Explain two of the disadvantages of Halstead's Software Science.

d) **[3]** Explain the relationship between test coverage and the software complexity measure of Cyclomatic Complexity.

e) **[2]** What is a Design Heuristic compared to a metric?