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| **National University of Computer and Emerging Sciences, Lahore Campus** | | | | |
| C:\Users\saif\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Word\final design.jpg | **Course:** | **Introduction to Software Engineering** | **Course Code:** | **SE110** |
| **Program:** | **BS (SE)** | **Semester:** | **Spring 2021** |
| **Duration:** | **180 Minutes (3 Hours)** | **Total Marks:** | **120** |
| **Paper Date:** | **12-July-2021** | **Weight** | **60%** |
| **Section:** | **All** | **Page(s):** | **13** |
| **Exam:** | **Final** |  |  |
| **Instruction/Notes:** | 1. Attempt all questions on the question paper. Do not submit any extra sheet, it will not be graded.  2. You are allowed to use a two-sided, hand-written, A-4 size help sheet.  3. State your assumptions clearly  4. For all the code segments in the exam, assume that all variables have been declared, all required libraries have been included, and there are no compile time errors | | | |

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Roll Number: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Section \_\_\_\_\_

**Question 1** (15x2 = 30 Marks)

In each of the following MCQs, **circle** the most appropriate **single** option (unless otherwise specified). There are **no partial marks** in this question. Unclear answers will not be given any credit.

# Software Engineering is best described as:

* 1. the practice of designing, building, and maintaining off-the-shelf software from prefabricated parts.
  2. the practice of designing, building, and maintaining ad-hoc software without the use of formal methods.
  3. the practice of designing, building, and maintaining high-quality software in a timely and cost-effective manner.
  4. the practice of designing, building, and maintaining fast and flexible software specifically for Engineering applications.
  5. the practice of designing, building, and maintaining flashy, cheap, and buggy software engineered to generate large sales initially and an on-going market for updates.

# Which of the following is most closely related with scrum?

## Use cases

## Stories

## Scenarios

## Sprints

## Bad smells

# Pick the odd one out:

## Requirement gathering and documentation

## Analysis and design

## Project management

## Coding

## Testing

# Which one of the following is NOT an attribute of a good software test case?

## Has a high probability of finding an error

## Is not redundant

## Is capable of uncovering a whole class of errors

## Is neither too simple nor too complex

## Proves that the program does not have any errors

# The incremental software development process is

## a reasonable approach when the product is small in size and has only one module.

## a good approach when a working core product is required quickly.

## the same as the non-incremental software development process.

## a revolutionary approach that is not used for commercial products.

## a reasonable approach when requirements are vague.

# Maintenance may involve:

* 1. only additional coding and testing.
  2. only additional analysis and design.
  3. only additional design, coding, and testing.
  4. any of the development activities except analysis.
  5. any of the development activities.

# Which software engineering activity simplifies the design of a component without changing its function or behavior?

* 1. User interface design
  2. Requirements analysis
  3. Refactoring
  4. High level design
  5. Low level design

1. Which of the following can improve understandability of a computer program? **Note:** You may select multiple options**.**
   1. Good control structure
   2. Meaningful variable names
   3. Meaningful documentation of code
   4. All of the mentioned
2. Which of the following is an internal attribute of software quality?
   1. Performance
   2. Usability
   3. Efficiency
   4. Robustness
   5. Correctness
3. Which of the following can be attributed to the quality of software process? **Note:** You may select multiple options**.**
   1. Visibility
   2. Timeliness
   3. Productivity
   4. Understandability
   5. All of the mentioned
4. When estimating the effort required to engineer software, an estimate of size of the software is required. What are different ways to represent size of software (or what are units of measurement of software size)? **Note:** You may select multiple options**.**
   1. Context diagram
   2. Function points
   3. Block diagram
   4. Lines of Code
   5. COCOMO
5. Which of the following can help software engineers in software management activities? **Note:** You may select multiple options**.**
   1. Gantt Chart
   2. PERT Chart
   3. Status Report
   4. Milestones
   5. Critical path analysis
6. Which of the following help determine and achieve modularity in software? **Note:** You may select multiple options**.**
   1. Application points, function points
   2. Uses-graph, activity graphs
   3. Coupling, cohesion
   4. Milestones, deliverables
   5. WBS, critical path
7. During engineering of software, we sometimes focus on understanding the important aspects of a phenomenon and ignore the details for a certain time. Which principle of SE do we follow if we do so?
   1. Generality
   2. Anticipation of Change
   3. Rigor and Formality
   4. Abstraction
   5. Timeliness
8. Suppose that a software application has been serving business needs for the last many years (it has obviously evolved overtime), but now its maintenance cost is getting too high. An engineer has suggested to rebuild the software application without changing its functionality and behavior. Which software engineering concept is the engineer referring to when (s)he says the application should be rebuilt?
   1. Revamping
   2. Re-engineering
   3. Refactoring
   4. Revisiting
   5. Recycling

**Question 2** (5x2 = 10 Marks)

Specify which of the 3 golden rules of UI design is related to each of the following statements/screenshot. Mention the rule and indicate (by circling) whether that rule is being violated or followed.

1. All the applications in MS Office use the cross button to close the windows.

Rule: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Followed or Violated

1. You have developed a game in which the right cursor key makes the player jump, while the up and left cursor keys makes the player go right and left respectively.

Rule: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Followed or Violated

1. For a banking application, you have provided 10 menus with each menu containing ten to twelve options.

Rule: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Followed or Violated

1. When you are about to close an application with some unsaved data, the system responds “do you want to save your work?”

Rule: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Followed or Violated

1. The Apple iPhone allows only 4 app icons to sit in the main menu area at the bottom of the screen.

Rule: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Followed or Violated

**Question 3** (5x5 = 25 Marks)

**Answer the Following questions related to software quality**

1. A software requires its users to provide inputs and performs actions based on the input commands. A piece of C++ code has been taken from the software and is given below:

//code snippet starts

cout<<”Please press N to insert a new record, R to view an existing report: ”;

cin>>option;

if(option == ‘N’)

insertRecord(details);

else

showReport(details);

//code snippet ends

What modifications can be made to improve **Robustness** of the software? Rewrite the code on the next page after the modification(s).

1. Consider the following function written in C++:

int f(int a, int b){

int c = a + b;

return c;

}

What modifications can be made to improve **Readability** of the software code? Rewrite the code after the modification(s)

1. Consider an Operating System (OS) which is monolithic (one big unit) in nature. Revisiting its design might help us divide the OS into modules and improve the design. If the design is not improved and the OS is kept monolithic, which software quality attribute(s) is/are difficult to achieve? Why?

**Hint:** Consider the users of Microsoft Windows having problems using the Windows for example.

1. Software is considered **Reliable** if there is a high probability that the software will operate as expected over a specified period of time. A software system is **Repairable** if its defects can be corrected with a reasonable amount of work (i.e. errors can be located and corrected more easily). How does **Repairability** of a software product affect **Reliability** of the software product? Answer in terms of increase or decrease in reliability if the software has good repairability.
2. **Dangling pointers** keep pointing to a memory location that has already been deallocated in a program. A **Memory leak** is when a program does not deallocate the memory when the memory is not needed anymore or the program is no longer able to access a memory location (which has not been properly deallocated). If a software has dangling pointers in it and memory leaks related issues are also found in the software, which **quality attribute of software** seems to have been compromised or affected? Explain your answer.

**Question 4** (Max. Marks = 10)

A team of software engineers is working on a project following scrum. At the start of each spring they select a few user stories to work on. Assume that each user story is of 8 story points. Their selected and completed user stories in the first sprints are as follows:

**Sprint 1:** The team committed to complete 6 user stories (i.e. 48 story points). However, the team could complete **4** of the 6 user stories.

**Sprint 2:** The team committed 8 user stories (including the two that were not completed in sprint 1) and completed **5** of the 8 user stories.

**Sprint 3**: The team committed 9 user stories (including the three that were not completed in sprint 2) and completed **6** of the nine user stories.

**Sprint 4**: The team committed 9 user stories (including the three that were not completed in sprint 3) and completed **3** of the 9 user stories.

**To do:** Find project velocity to help the team provide a good estimate of work to be committed for sprint 5

**Question 5** (3x5 = 15 Marks)

**Answer the Following questions related to software engineering principles**

HyperText Markup Language (HTML), Cascading Style Sheets (CSS), and JavaScript (JS) are complementary languages used in the development of web applications. **HTML** is mainly used for organization of webpage content, **CSS** is used for definition of content presentation style, and **JS** defines how the content interacts and behaves with the user.

Which principle of software engineering is being followed in development of web applications that use HTML, CSS, and JS at the same time? Explain your answer.

A function is written by your fellow to perform simple operations of a calculator. The function takes 3 arguments (2 integer operands and an operator), performs the desired operation on both operands and return the result.

//the function calculate returns -1 if the operator is invalid

int calculate(int operand1, int operand2, char operator){

int result=0;

if (operator == ‘+’)

result = operand1 + operand2;

else if (operator == ‘-‘)

result = operand1 - operand2;

else if (operator == ‘\*‘)

result = operand1 \* operand2;

else if (operator == ‘/‘)

result = operand1 / operand2;

else

result=-1;

return result;

}

Considering the fact that there can be more operations in future such as finding mod, or nth root etc, one approach could be to have one if-else condition in the calculate function for each new operation. Is there any alternative approach that also gives better **modularity?** What can be done to have code for all the calculations in modular way? Rewrite the code after the modification(s), rewrite for the mentioned operations only.

An engineer deployed 3 temperature sensors in a room and wrote following code to calculate and display the average temperature of these sensors.

//code snippet starts

void displayÁverage(float sensor1, float sensor2, float sensor3){

float sum = sensor1 + sensor2 + sensor3;

float average = sum/3

cout<<”The average temperature of 3 sensors is: ” <<average; }

//code snippet ends

Now (s)he has to deploy sensors in different **areas containing 5 rooms** and calculate the average temperature of the areas. The number of sensors in each room is not fixed, but each room has **at least 3 sensors**. (S)he comes to you with his code to make it more generalized to calculate average temperature of an area containing different number of sensors. The generalized function may be called separately for each room to get average temperature of a room.

How can you modify this code to achieve **Generality?** Rewrite the code after the modification(s).

**Question 6** (5x4 = 20 Marks)

List the process model that you think will be most appropriate for the following situations. Also, list your reason(s) for choosing a particular model. If you just list the process model without mentioning the reason(s), you will not be awarded any marks.

1. Assume that you work in a reputable software house of Lahore. A school requires a Laboratory Management System (LMS) and has contacted your company for assistance. Your company has 50 software engineers, but 40 of them are busy working on other projects. The project will be quite innovative and needs dynamic and adaptive team members. In order to be available for any required communication, a school representative is willing to stay at the software house premises during the development project. The annual evaluation of the school is due soon, in which computerization initiatives will be appreciated.

Process Model:

Reason(s):

1. Owing to growing number of students, FAST library staff believes that an interactive online system is needed to keep track of books and rentals. They believe that this will help provide better service to both the students and faculty members. Though the library staff believes that it is a small system but they are not clear about functionalities of this system. Therefore, the department team will be requiring frequent feedback and reviews from the users (i.e. library staff, faculty and students).

Process Model:

Reason(s):

1. Your team is starting work on a new project, but all the requirements are not clear right now. The internal quality of the project cannot be compromised as it may incur huge financial losses in future. The client requires quarterly releases and (s)he will be providing feedback on each release. Your team is not in a position to implement spiral model due to lack of training and exposure.

Process Model:

Reason(s):

1. An existing software needs to be developed in a newer and better technology and your company has been assigned this task. The software has been running successfully for a few years and does not require any major changes in its functionalities in the newer technology i.e. same functions that are available in the current version will also exist in the updated version.

Process Model:

Reason(s):

1. The management team of Asian airline Inc. is frustrated by long-running projects that failed to deliver results in the expected timeframe.  In fact, many projects in the IT portfolio span multiple years in length and still fail to satisfy important functional requirements.  Management also feels that the airline needed to be more responsive to the marketplace in general. So they have hired you to achieve the following:
   1. Teams can adapt to changing requirements while maintaining a clear focus on the project vision.
   2. Projects should deliver the most valuable features sooner, and provide better project visibility

Process Model:

Reason(s):

**Question 7** (10 Marks)

We as a software company have been awarded a maintenance project. Initially we are required to determine if the continued maintenance of the software application under maintenance is affordable anymore. During this phase we shall design and execute usage scenarios to determine if the application breaks too often during the regular use. We shall design and execute test cases to uncover faults in the application. We plan to remove the faults to see how long does it take to repair the application. We shall also modify existing features to determine if the cost of the changes is affordable or not. We shall extend the functionality of the application by adding new features to determine the effort required to add new functionality. After all these activities, an analysis will be performed and it will be decided if the software application should remain in maintenance as before or it should be reengineered. This phase will run for 3 months. In the second phase, if reengineering related decision has been made, the foremost step of business process reengineering will be performed. This step will define the business goals, identifies existing business processes, evaluate the existing processes, and create revised business processes. The second step will be reengineering of software. This step will include activities such as inventory analysis, document restructuring, reverse engineering, program restructuring, data restructuring, and forward engineering. This step will also include the activity of controlling versions of the programs. The third step will be to assess quality of the resultant software and measure maintainability of the resultant software.

Someone has told us that having a Work Breakdown Structure (WBS) will help us execute the project better. We have also been told that SE students at FAST Lahore are very good at making WBS to help managers of software projects. Assuming that the decision after phase 1 will be to go for reengineering, develop a WBS for the phases mentioned above to help our company. As an incentive you’ll be awarded good marks if the WBS helped. Use tree-like structure to show your WBS.