National University of Computer and Emerging Sciences

Lahore Campus

0268

Software Engineering (CS3009)

Final Exam

Total Time (Hrs): 2.5

Total Marks: 100

Total Questions: 2

Date: May 20th 2025

Course Instructor(s)

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Roll No _____ Section _____ Student Signature _____

Attempt all the questions on the question paper.

1. Do not submit any extra sheet(s).
2. Use of a two-sided, handwritten help sheet of A-4 size is allowed. Photocopies are not allowed.

CLO 3: Design architecture of a software system by choosing the most appropriate archi styles

Q1: WASA has decided to computerize its whole system including the billing module. The billing module needs to interact with different other modules performing functions such as tariff calculation (tarical), tax calculation (taxcal), printing, sewerage demand calculation (sdc), and water consumption calculation (wcc). The main responsibility of the billing module is to generate bill, this bill is used by another module responsible for printing the bill. The billing module receives information from the different modules through their respective interfaces. The wcc module is responsible for providing the number of consumed units to other modules on request after receiving the water meter readings (or house size based estimations) from the DBMS. This information of consumed units is required by the tarical module that provides the tariff based on the slabs of water consumption. The tariff is operated with the units consumed by the billing module to get an intermediate value. This value is used by the taxcal and sdc modules to perform their respective responsibilities of calculating tax and calculating sewerage demand. The sdc module uses the DBMS provided yearly consumption data of the consumers to suggest any non-negative sewerage demand figure. The taxcal module uses the tax slabs available through the DBMS and the provided tax value is used by the billing module.

a. Using the given information only, **design and provide** component interfaces (i.e. requires and provides interfaces) for all the components of the WASA system. **Use** ball and socket notation. Only show stand-alone components with their interfaces, do not connect the components with each other. [10 marks]

b. **Provide** a component diagram for the WASA system. **Use** ball and socket notation. [10 marks]

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b. **Provide** a component diagram for the WASA system. Use ball and socket notation. *[10 marks]*

Q2: Choose exactly one of the given options for every multiple choice question. Fill the appropriate box in the bubble sheet (page 13 of question paper). [1x60 + 2x10 = 80marks]

CLO 1: Select an appropriate software development process for a software project

1. While using Kanban, the amount of time taken to complete a task is called _____
a. WIP b. Pipeline c. Lead time d. Kanban board

2. While using Kanban, lead time can be reduced by
a. Limiting Work In Progress (WIP) b. Adding more team members to the team
c. Adding more stories to the Kanban board d. Conducting more meetings with the stakeholders

3. Which of the following problem is encountered when waterfall model is applied to develop a software system?

a. A customer may not see a running software until very late in the lifecycle
b. Major blunders are not detected early in the lifecycle
c. Customers find it difficult to explicitly state all requirements early in the lifecycle
d. All of the above

4. Prototyping model is suitable for large projects only if _____

a. The customer is not ready to review the work done by engineers
b. The engineers perform explicit effort to reduce system entropy during the whole lifecycle
c. The customer is ready to review the prototype developed by engineers
d. b and c only

5. What is common in prototyping and unified process models?

a. Continuous and frequent customer involvement
b. Comprehensive and good quality documentation
c. Work well for large projects
d. b and c only

6. In agile software development, cost of changing software is _____ as compared to the cost incurred in conventional software processes.

a. Higher b. Lower c. Same d. None of the above

7. A sprint in case of scrum is _____

a. Always 30 days long b. Always 15 days long
c. Not bounded by time d. None of the above

8. A sprint, once started, can be broken before the end time of the sprint is reached if:

a. Too many changes in sprint backlog are suggested
b. Size of product backlog increases drastically
c. Sprint meeting could be held for 3 consecutive days
d. a and b

9. Which software process model is the most suitable if teams are able to work in parallel to provide a quick implementation of the already designed modules that can be integrated later?

a. Waterfall b. Prototyping c. RAD d. Spiral

10. The concepts user stories, acceptance tests, spike solutions, CRC cards, and refactoring etc. are embedded in which of the following software process?

a. Waterfall b. Extreme Programming c. Spiral d. None of the above

11. Which of the following a role in a scrum team?

a. Sprint Master b. Scrum Master c. Product Master d. Quick Master

12. In scrum, the duration of a sprint review meeting depends on _____

a. Duration of the sprint
b. Duration of the sprint retrospective meeting
c. Duration of the sprint planning meeting
d. None of the above

13. In scrum, which of the following is discussed in a sprint retrospective?

a. What went well in the sprint
b. What could be improved
c. What will the team commit to improve in the next sprint
d. All of the above

14. In scrum, sprint retrospective is scheduled _____

a. Every 2 weeks in a 4-weeks sprint
b. Right after the sprint planning meeting
c. Just before every sprint planning meeting
d. After a sprint and just before another sprint planning meeting

15. Which of the following statements about continuous integration and continuous deployment (CI/CD) are correct?

a. CI/CD automates the build, test, and deployment processes.
b. CI/CD helps in identifying integration issues early.
c. CI/CD fosters collaboration and reduces manual errors.
d. All of the above

CLO 2: Develop a model of requirements for a software system

16. Requirements specification is an important activity in the RE process because:

a. It gives the engineers an opportunity to spend some time in documentation and avoid coding
b. It gives the engineers an opportunity to express what they've understood
c. It gives the engineers an opportunity to get the documented requirements validated
d. b and c only

17. You have to develop a Context Diagram of a golf players' swing analysis system that needs to interact with a few cameras, the golf coaches, directors who manages correctness of the analysis reports generated by the system, a screen that displays reports, and a sensor-based platform that the players stand on. How many bubbles (or processes) will the context diagram of this payroll system have?

a. 0 b. 1 c. 4 d. 5

18. For a System Requirements Specification document to be considered of good quality, all the requirements in it need to be:

a. Testable b. Complete c. Traceable d. All of the above

19. Which of the following is an example of a typical stakeholder for any system?

a. Customer b. User c. Engineering and technical persons d. All of the above

20. Which of the following is the most applicable when behavioral aspects of a software system need to be modeled:

a. State diagram b. Class diagram c. ER diagram d. Use case diagram

21. CRC cards can be used as an input to the process of developing _____ diagram

a. Swimlane diagram b. Class diagram c. State diagram d. Petrinet

22. In a use case diagram, a use case should be modelled using <<include>> only if _____

a. the use case is enhancing functionality of another use case

b. the use case is shared by more than one use cases

c. the use case is invoked by more than one actors

d. none of the above

23. Which of the following requirements model helps in user interface design?

a. use case diagram b. class diagram c. swimlane diagram d. a and c only

24. Which of the following requirements model helps in architecture design?

a. data flow diagram b. class diagram c. state diagram d. a and b only

25. A process in a data flow diagram is considered primitive if _____

a. the process cannot be broken further b. the process can be implemented by a single developer

c. if the process has single input flow and single output flow d. all of the above

26. A collaborator in a CRC card indicates presence of _____ in the corresponding class diagram

a. a data member b. a function c. an association d. none of the above

27. A responsibility in a CRC card may be translated into _____ in the corresponding class diagram.

a. a data member b. a function c. an association d. a and b only

28. The maximum number of states in a state diagram is _____

a. 2^n b. log n c. n^2 d. none of the above

29. Synchronization bars in a petrinet are responsible for _____

a. remembering how many tokens need to be received before the transition is made
b. passing the token to the next place to complete a transition
c. withholding a transition until all tokens have been received
d. all of the above

30. Which of the following is the most suitable to model a situation where happening of multiple events results in performance of multiple actions at once?

a. class diagram b. swimlane diagram c. use case diagram d. petrinets

CLO 5: Construct reasonable sized software in team setting

Theo Mandel's Golden Rule of UI Design: Place the user in control (MCQs 31 to 34 are about this)

31. The color scheme on all the pages of a website is kept the same.
a. Rule applied b. Rule violated c. Rule is irrelevant d. None of the above

32. The date field in a form shows a calendar for selecting the date, preventing users from typing the date manually.
a. Rule applied b. Rule violated c. Rule is irrelevant d. None of the above

33. The user copies 1GB file from a source folder and pastes it in the destination folder, but he is not shown the status of how many files have been copied and how many are remaining.
a. Rule applied b. Rule violated c. Rule is irrelevant d. None of the above

34. In one part of the app, the trash icon deletes files, but in another, it archives them.
a. Rule applied b. Rule violated c. Rule is irrelevant d. None of the above

Theo Mandel's Golden Rule: Reduce the user's memory load. (MCQs 35 to 38 are about this)

35. The form uses icons with no labels, requiring users to recall what each icon means.
a. Rule applied b. Rule violated c. Rule is irrelevant d. None of the above

36. User is given undo option if he presses send email by mistake
a. Rule applied b. Rule violated c. Rule is irrelevant d. None of the above

37. A form auto-fills the user's address based on postal code.
a. Rule applied b. Rule violated c. Rule is irrelevant d. None of the above

38. An app uses technical jargon and abbreviations without explanations.
a. Rule applied b. Rule violated c. Rule is irrelevant d. None of the above

Theo Mandel's Golden Rule: Make the interface consistent. (MCQs 39 to 40 are about this)

39. The user is given the shortcut combination of Ctrl+Q to save data.
a. Rule applied b. Rule violated c. Rule is irrelevant d. None of the above

40. The "Save" button is located in different positions on different pages.
a. Rule applied b. Rule violated c. Rule is irrelevant d. None of the above

41. Which of the following best describes the purpose of Function Point Analysis (FPA)?
    a. To estimate the runtime performance of a system
    b. To count the number of lines of code in a program
    c. To measure the size of software based on its requirements
    d. To calculate the number of test cases needed

Read the following statement to answer MCQ 42 to 50

The National Traffic Management Authority (NTMA) is initiating a digital transformation project aimed at building a centralized Traffic Violation Management System (TVMS). The goal is to automate violation reporting, fine payments, and driver history tracking across all provinces via a web and mobile platform.

The system is expected to reduce manual workload for officers and improve service efficiency for citizens. The TVMS must interact with the Vehicle Registration System and National Identity Database through two complex external interfaces. Additionally, it must manage 6 internal logical files that are of average complexity related to drivers, vehicles, violations, payments, legal notices, and appeals.

Citizens will primarily perform 5 types of simple inquiries (e.g., checking fines, appeal status), while officers will handle 6 complex inquiries (e.g., generating violation trends, reviewing legal appeals). There are 4 simple inputs, 4 moderately complex inputs, and 3 complex inputs (such as evidence uploads, legal documentation). The system must produce 8 complex outputs and 4 simple outputs, including reports, receipts, and notifications.

The adjustment factor values for the 14 general system characteristics are listed as:
[3 5 4 2 3 3 4 5 3 4 5 4 4 5]

Assume the following:

- Productivity rate: **6 FP/person_month**
- Labor Rate: **$6500 per month**
- 1 FP = **60 SLOC**
- If any value includes decimals (e.g., 512.13), **only consider the whole number part** (e.g., 512) and **ignore the decimal portion** in all calculations. No need to round off values.

Using Function Point Analysis (FPA) answer MCQs 42 to 50:

42. What is the value of count total?
    a. 346 b. 249 c. 267 d. 359

43. What is the sum of 14 Value Adjustment Factors?
    a. 50 b. 52 c. 54 d. 56

44. What is the final adjusted Function Point (FP) count for the TVMS?
    a. 296 b. 314 c. 184 d. 491

45. What is the approximate estimated effort (in person-months) to develop the *Traffic Violation Management System (TVMS)*?

a. 25 b. 49 c. 64 d. 29

46. What is the estimated cost per Function Point (FP) in dollars?

a. $1912 b. $1083 c. $1120 d. $1286

47. What is the total estimated development cost (in USD) of the TVMS?

a. $500,431 b. $874,105 c. $320,568 d. $472,984

48. How many Estimated lines of code approximately?

a. 18109 b. 17760 c. 52000 d. 14127

49. If the sum of the 14 Value Adjustment Factors (ΣFi) is 62, what is the final adjusted Function Point (FP) count?

a. 370 b. 316 c. 345 d. 398

50. If the sum of the 14 Value Adjustment Factors (ΣFi) is 62, what are the estimated lines of code?

a. 11,892 b. 23,561 c. 34,141 d. 18,960

CLO4: Design test cases for a software system

51. For a control flow graph (CFG) having cyclomatic complexity 5, what is the minimum number of test cases that ensures basis path coverage?

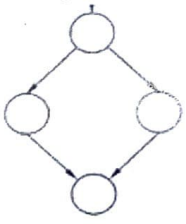
a. 5^0 b. 5^1 c. 5^2 d. 5^3

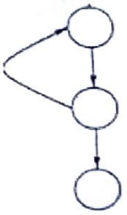
52. Cyclomatic complexity of a CFG is equal to:

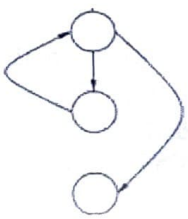
a. Edges – Nodes + 2 b. Nodes – Edges + 2

c. Number of regions in the graph d. a and c only

53. Which of the following CFGs shall have cyclomatic complexity equal to 2?

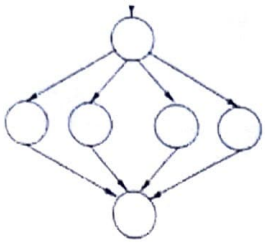
a. 

b. 

c. 

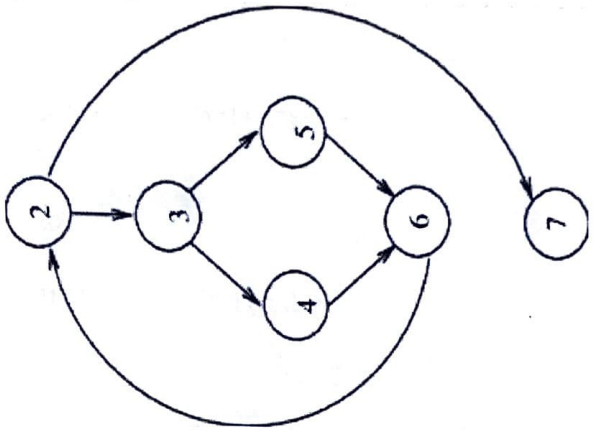
d. All of the above

54. What is the cyclomatic complexity of the following CFG:



a. 8 b. 6 c. 4 d. Cannot be determined

55. Which of the following is a set of basis path for the given CFG? P1, P2, P3 etc. represent a path.



a. P1: 2, 3, 4, 5, 6, 7 P2: 2, 3, 5, 6
b. P1: 2, 3, 4, 6 P2: 2, 3, 5, 6 P3: 2, 7
c. P1: 2, 3, 4, 6, 2, 7 P2: 2, 3, 5, 6, 2, 7
d. P1: 2, 7 P2: 2, 3, 5, 6, 2, 7 P3: 2, 3, 4, 6, 2, 7

56. For the CFG in Q15, What is the minimum number of test cases that ensures statement coverage?

a. 2 b. 3 c. 4 d. 1

57. Which of the following input values shall ensure branch coverage for the following pseudocode:

```
if X = 10 then
   if Y > Z
      X = Y
   else X = Z
   endif
endif
print X, Y, Z
```

a. X=20, Y=10, Z=1 b. X=10, Y=20, Z=5 c. X=10, Y=20, Z=30 d. All of the above combined

58. How many nodes will be there in the CFG for the pseudocode of Q17?

a. 7 b. 2 c. 9 d. 4

59. How many edges will be there in the CFG for the pseudocode of Q17 if we draw a node for each line of code?

a. 6 b. 7 c. 8 d. None of the above

60. What is the minimum number of test cases required to ensure basis path coverage for the pseudocode given in Q17?

a. 6 b. 5 c. 4 d. 3

Read the following statement to answer MCQ 61 to 70. These MCQs carry 2 marks each

LESCO has installed electricity meters (for domestic use) with the ability to record peak hour usage and off-peak hour usage of electricity. Electricity rate is low during off peak hours. LESCO provides details of the peak hours in years 2015 and 2016 as below:

a. March 1 to May 30 — 10 PM to 6 PM (next day)
b. May 31 to August 31 — 11 PM to 7 PM (next day)
c. September 1 to November 30 — 10 PM to 6 PM (next day)
d. December 1 to February 29 — 9 PM to 5 PM (next day)

The meters have embedded software that keeps count of the units using a local clock. A unit consumed at 6 PM in 'case a' will be considered a unit consumed in peak hours. Electricity rate for the 4 cases above are as follows:

a. PKR 7 per unit in off-peak hours and PKR 9 per unit in peak hours.
b. PKR 8 per unit in off-peak hours and PKR 10 per unit in peak hours.
c. PKR 6.5 per unit in off-peak hours and PKR 8.5 per unit in peak hours.
d. PKR 6 per unit in off-peak hours and PKR 8.5 per unit in peak hours.

Meter readers send the number of units consumed in peak and off-peak hours to LESCO office where a Desk Clerk enters the data in the computerized billing system through a graphical user interface and asks the system to generate a bill. The computerized system at LESCO also performs bill related calculations using the above information. The generated bill shows the units consumed and the total price of the electricity. Assume that there is 10% tax on total price of electricity. Assume that there is no additional surcharge if late payment is made.

61. There are _____ input variables that are used to calculate the number of units consumed.

a. 1 b. 2 c. 3 d. 4

62. Possible valid range equivalence class for the variable Day is:

a. EC 1: March 1 <= Day <= May 30 b. EC 2: May 31 <= Day <= August 31

c. EC 3: September 1 <= Day <= November 30 d. All of the above

63. Possible invalid range equivalence class for the variable Time is:

a. EC 5: 5PM < Time <= 6 PM b. EC 6: 6PM < Time <= 7 PM
c. EC 7: 7PM < Time <= 9 PM d. None of the above

64. Which of the following is/are representative value(s) for EC1 and EC5 together?

a. May 31, 6 PM b. April 01, 5:30 PM c. May 30, 5 PM d. b and c only

65. Which of the following are on-boundary values for EC6?

a. 6:01PM, 7PM b. 6PM, 7:01PM c. 6PM, 7PM d. None of the above

66. If we perform Boundary Value Analysis with robustness, which of the following is the set of representative values for EC7?

a. 7PM, 7:01PM, 8PM, 8:59PM, 9PM
b. 7PM, 8PM,9PM
c. 7PM, 9 PM
d. 6:59PM, 7PM, 7:01PM, 8PM, 8:59PM, 9PM, 9:01PM

67. If we have developed 5 invalid range equivalence classes for both input variables combined, what is the minimum number of test cases required to test the invalid equivalence classes:

a. 1 b. 3 c. 5 d. 10

68. If job of the on-meter embedded software is to determine if a unit is consumed in a peak hour or an off-peak hour, then which of the following shall have expected output 'Peak Hour'?

a. March 30, 7PM b. February 29, 4PM c. August 31, 6PM d. b and c only

69. In order to test the computerized billing system, the number of units consumed and peak-hour/off-peak-hour information is sent to the billing system. The expected output of the billing system is expressed in two variables Price of Electricity, Bill including Tax. Which of the input values shall give output 900, 990?

a. March 30, 9PM and 100 units
b. March 30, 11PM and 100 units
c. March 30, 8PM and 100 units
d. a and c only

70. As mentioned in the previous question the expected output of the billing system is expressed in two variables Price of Electricity, Bill including Tax. Which of the input values shall give output 600, 660?

a. February 28, 6 PM and 100 units
b. February 28, 10 PM and 100 units
c. February 28, 8 PM and 100 units
d. a and c only