10+10+13+21.5+24.5 = (79)

0122

National University of Computer and Emerging Sciences, Lahore Campus

Course Name:	Software Engineering	Course Code:	CS 3009
Degree Program:	BS (CS)	Semester:	Spring 2023
Exam Duration:	180 Minutes	Total Marks:	120
Paper Date:	30-May-2023	Weight	40%
Section:	ALL	Page(s):	17
Exam Type:	Final		

Student : Na

Instruction/Notes: [illegible] questions on the question pap[illegible] 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. Photocopies are not allowed.

3. State your assumptions clearly

Question 1 (Marks = 20) [CLO 1]

Part I **7 Marks** (10)

In each of the following MCQs, **circle** the most appropriate **single** option. Unclear answers will not be given any credit.

1) Which of the following statements about software process is false?

a. The process covers all steps from initial idea and requirements to delivery, maintenance, and final retirement.
b. Having a good process guarantees that you will have a good product.
c. Different processes are needed for different kinds of software.
d. The process is the key factor in determining key properties or qualities of the product.
e. The process is a key factor in ensuring conformance to the established practices.

2) Validation is concerned with the following:

a. Are we building the right product?
b. Are we building the product right?
c. Does the product comply with its design?
d. Can the proof of the correctness be formalized?
e. Has the product been completely tested?

3) Which of the following is not related to software development process?

a. Scrum
b. RAD (Rapid Application Development)
c. Prototyping
d. SPAM (Software Process Assessment Model)

4) In software engineering, what does the term "refactoring" refer to?

a. Rewriting the entire codebase from scratch
b. Modifying the software to improve its internal structure without changing its external behavior
c. Testing the software for defects and fixing them
d. Documenting the software requirements and specifications

5) Which of the following is not a software development model?

a. Waterfall
b. Rapid Application Development (RAD)
c. Agile
d. Spiral

(3)

Part II **15 Marks**

Relate the concepts of Column 1 with concepts of Column 3. Write the most appropriate match in 'Correct Match' column. Write alphabet only and not the complete entry. Do not repeat the alphabet.
Note: There are extra mismatched entries in Column 3 that do not relate with any entry of column 1. Each entry in column 1 must have a match from column 3.

Entries	Correct Match	Mismatched Entries
Deliver software in timely manner	N	A. Agile process
Requirements complete and frozen	E	B. Unified Process
Quick plan, quick design, quick review. Lack of focus on internal quality s.a. maintainability	H	C. Intent of software process
Iterative nature of prototyping, systematic aspect of waterfall, evolutionary, risk identification	J	D. Inception, Reception, Collaboration, Transition
Four phases, work on almost all disciplines in each phase, use of UML, mini projects	P	E. Expectation of the Waterfall model
Core product first, scope largely known	B	F. XP
Product backlog, user stories, sprints	B P	G. Maintenance
User stories, test driven development, pair programming, CRC cards	F	H. Agile manifesto
Human resource hungry, short cycle time, parallel development of modules	A	I. Problem with Waterfall Model
Respond to change, focus more on working software	O	J. Spiral Model
Reduced cost of change during software development	C	K. Framework activities
Visualizing workflow, limiting the amount of work in progress (WIP)	L	L. Kanban
A phase in software lifecycle	G	M Umbrella Activities
User available for daily review of work, frequently changing requirements	Q	N. RAD
Long wait before a running software can be seen	B	O. Incremental Model
		P. Scrum
		Q. Select agile process
		R. Prototyping Model

(7)

Question 2 (Marks = 20) [CLO 2] (10)

Part I **10 Marks**

In each of the following MCQs, circle the most appropriate single option. Unclear answers will not be given any credit.

1) What is the purpose of a use case diagram in software engineering?
   a) To model the dynamic behavior of a system
   b) To depict the structure and organization of software components
   c) To visualize the flow of data within a system
   d) To capture the functional requirements of a system from a user's perspective

2) Which software engineering activity is responsible for identifying, defining, and documenting the software requirements?
   a) Design
   b) Testing
   c) Maintenance
   d) Requirements engineering

3) While refining a Data Flow Diagram (DFD) from higher level to a lower level a process is broken until:
   a. There are some unfulfilled requirements
   b. There is a disagreement in stakeholders
   c. It becomes a primitive process
   d. Input and outputs of both level start matching
   e. All of the above

4) When refining a Data Flow Diagram (DFD) from higher level to a lower level, a process is considered primitive if it:
   a. Has same input and output flow
   b. Has single output flow multiple input flow
   c. Is easy to be implemented by one person
   d. All of the above

5) You have to develop a 0-level Data Flow Diagram (DFD) of a payroll system that needs to interact with an HR subsystem that manages employee information, a Secretary who manages distribution of pay cheques generated by the payroll system, a Finance department that requires reports from the payroll system, and an Attendance subsystem that manages employee timecards. How many bubbles (or processes) will the 0-level DFD of this payroll system have?
   a. 0
   b. 1
   c. 4
   d. 3

6) In a data-flow diagram (DFD),
   a) at level 0, the number of processes are the same as number of verbs given in the problem description.
   b) data flow need not be balanced across consecutive DFD levels.
   c) every bubble must be refined to at least 5 bubbles in the next level.
   d) the external entities are always humans.
   e) The inputs and outputs in successive levels must match when refining the DFD from one level to another

7) The maximum number of processes in a level 1 DFD is:
   a. Zero
   b. 1
   c. 5
   d. 2^8
   e. None of the above

8) What information is provided by functional requirements?

   X1: The constraints on the services or functions offered by the system such as timing constraints.

   X2: How the system should behave in particular situations.

   X3: The constraints on the development process, standards.

   X4: How the system should react to particular inputs.

a) X2, X4
b) X1, X2, X4
c) X4
d) X1, X3
e) X2

9) Which of the following statements is false?

a) Requirements must be testable.
b) Requirements must be concerned with system functionality only.
c) Requirements must be complete.
d) Requirements must be unambiguously stated.
e) Requirements must be consistent.

10) Which of the following would be least appropriate to include in a requirements document?

a. Environment requirements
b. An architectural diagram
c. Design and implementation constraints
d. A description of how the potential users do their work without the proposed system
e. Performance requirements

Part II **7+3 = 10 Marks**

Your team is developing an internet based electronic items ordering system. The system shall allow a customer to ord the electronic items online. An order is a set of one or more electronic items selected from the inventory. An ord when processed can be picked up at the warehouse or delivered to the customer location at a specified time and dat Knowing beforehand the items that customers' demand can help improve the efficiency of the staff. To allo customers order online the system shall display a list of items (retrieved from the inventory) to the customer, receiv order from the customer, record order details including delivery address, delivery date, delivery time, and paymen amount which is due. Once the order is recorded an order id is sent to the customer and the customers will be able to use the order id to inquire/modify the order (i.e. know order status, modify, or cancel the order). After recording of the order the system shall process the delivery of the placed order by selecting a delivery person from the riders' database. Once the order is delivered to the customer the system shall generate order completion notification (containing an order summary) for the customer. The system shall receive payments through credit card; the credit card details shall be provided by the customer to the system when placing an order. The provided details are sent to the payment processing module of the system that shall contact the banking system for the processing of the payment. The customers paying through the credit card receive a digital receipt from the payment processing module. The system shall allow the staff to manage its inventory (adding, modifying, deleting electronic item records etc.). Each customer will be shown the make, model, and price of the items listed. This information is added to the inventory when an item's record is added to the inventory.

To do:

a. Develop a Level-1 DFD for the requirements given above. The diagram must be complete in terms of notation and mentioned requirements.
b. List the primitive and potentially non-primitive processes.

c. Calculate Cost per FP, Total Estimated Cost of project and Estimated Effort. Mention formulae

13 — 1 month
165.20 12.71 months

total = 12.71 × 4500 = 57195 $

Cost per ~~month~~ FP = 346.02

0.5

Question 3 (Marks = 20) [CLO 3]

Part I **10 Marks**

In each of the following MCQs, **circle** the most appropriate **single** option. Unclear answers will not be given any credit.

1) Which of the following statements is true?

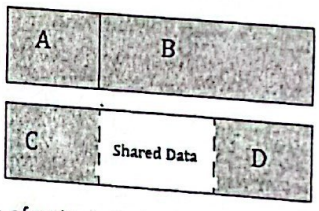
a. A good design methodology should provide a clear division of design from implementation.
b. A good design methodology should not promote a top-down decomposition strategy.
c. A good design methodology should help to minimize future maintenance.
d. A good design methodology should encourage encapsulation.
e. All of the above

2) Which one of the following is NOT a constituent component of software architecture?

a. Set of components that perform required system functions.
b. Set of connectors allowing communications among the components.
c. Constraints describing how the components maybe integrated to form a system.
d. Test plans for testing the architecture.
e. Semantic models that enable the designer to understand the overall system properties by analyzing the known properties of its components.

3) Which of the following statements is most probable from the diagram given below?

a. A, B, C and D are loosely coupled components
b. A and B are more coupled than C and D
c. C and D are more coupled than A and B
d. C and D are more cohesive than A and B



4) If each part of a component is necessary for the execution of a single task, then

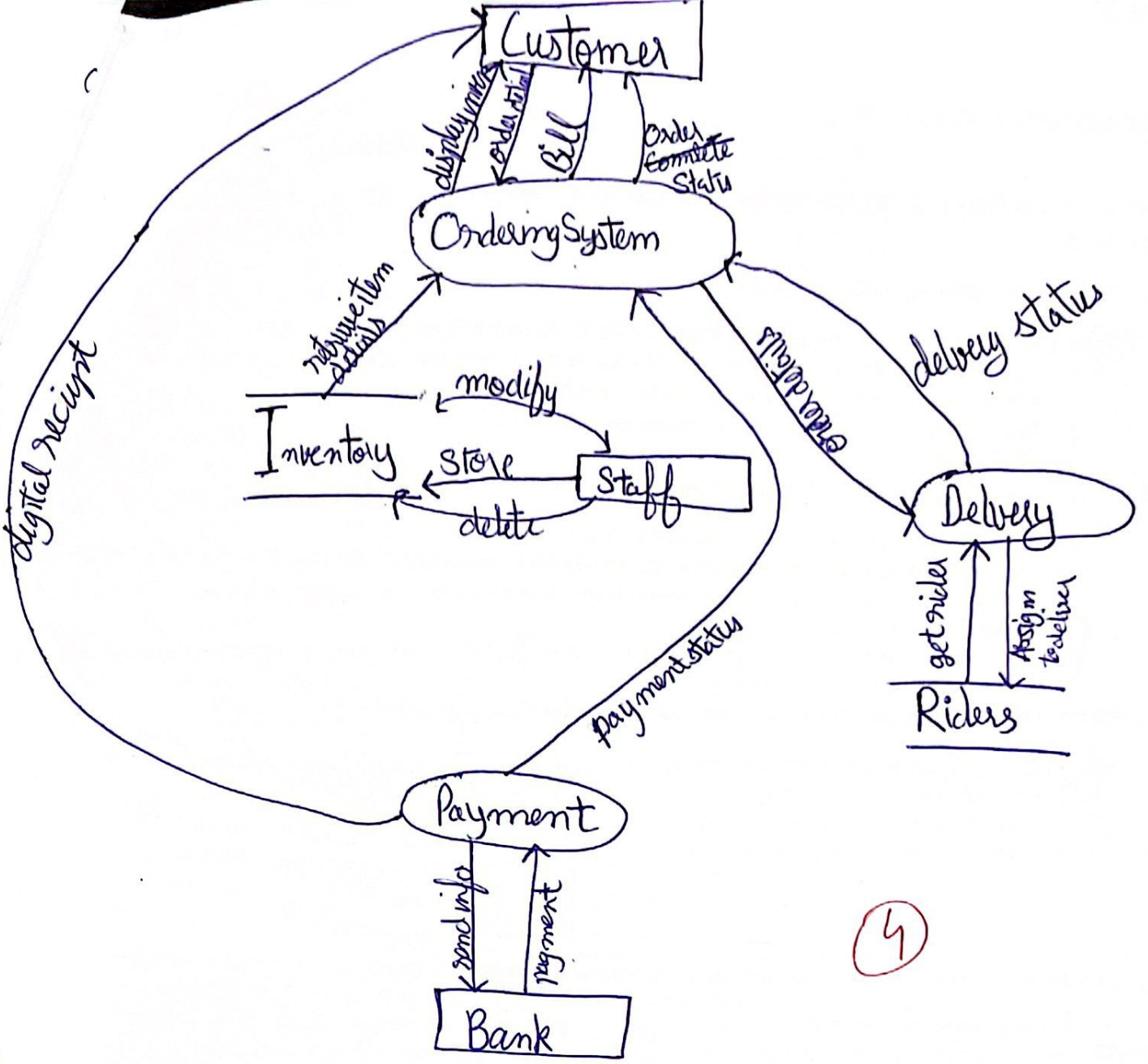
a. the component has layered cohesion.
b. the component has functional cohesion.
c. the component has functional coupling.
d. the parts of the component are not related but simply placed in a single component.
e. the modifications related to this component will be complicated.

5) Which of the following help determine and achieve modularity in software?

a) Application points, function points
b) Uses-graph, activity graphs
c) Coupling, cohesion
d) Milestones, deliverables
e) WBS, critical path

6) When performing structured design (i.e. mapping data flow into architecture), one of the tasks of the designer is to determine the _____ flow of data:

a) Activity flow
b) Transaction flow
c) Normal flow
d) Alternate flow
e) None of the mentioned



(4)

Primitive :- Payment, ~~Delivery~~

Non - Primitive :- Delivery, Ordering System.

Part IV 5+3+2=10 Marks

A company wants to launch a new software product. They have identified the task, the duration for each task and predecessor for each task. Below is the Task list.

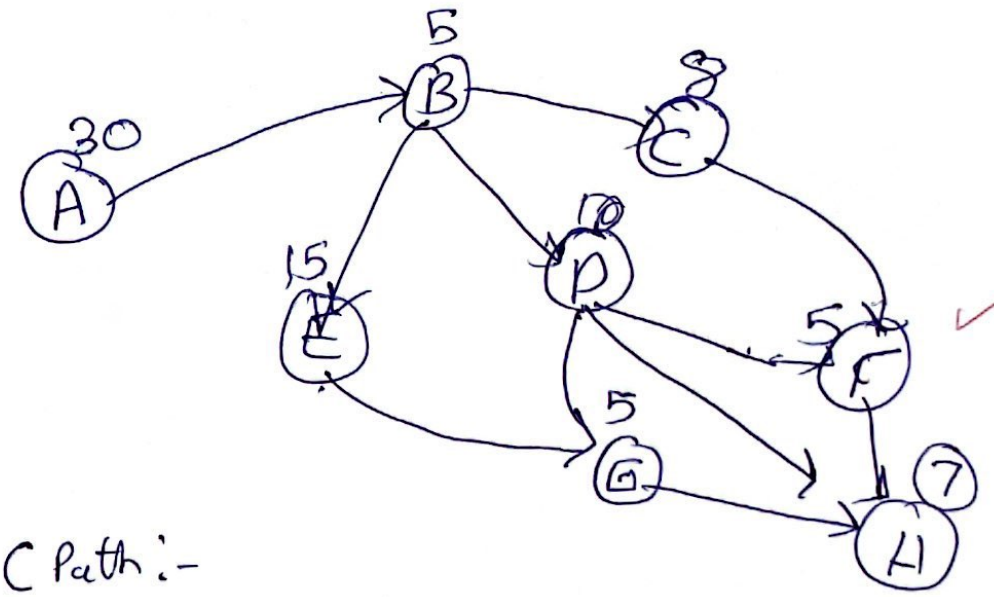
Task Id	Task Name	Duration (Days)	Predecessor Task
A	Design new product	30	-
B	Obtain approvals	5	A
C	Identify manufacturing specification	8	B
D	Create Advertisements	10	B
E	Conduct training sessions	15	B
F	Final product testing	5	C, D
G	Production	5	D, E
H	Shipping	7	F, D, G

With the help of the above table,

1. Create the CPM Network (also known as Activity on Node graph or PERT chart)

2. Identify the critical path

3. Explicitly state the minimum duration for the project



(5)

C Path :-

A → B → E → G → H (3)

30 + 5 + 15 + 5 + 7 = 62 days. (2)

b. What is the minimum number of test cases in the complete test suite if we are performing Equivalence Class based Testing. How did you reach this number?

need to ~~middle~~ anywhere in the equivalence and at the boundaries. And each time on Invalid regions.

c. Design/write test cases to perform EC based testing (using the equivalence classes identified in part a). Use the appropriate test structure. Add more rows/columns if required.

Test Case Id	Purpose	Input		Expected Output
		Age	Claim	Increase/Error Message
1	Test invalid classes	3-1	0	Invalid Age
2		3	-3	Invalid Claim
3		72	0	Invalid Age
4		73	-100	Invalid Age & Claim
5	Test valid classes	30	0	25
6		31	0	50
7		30	3	75
8		31	3	100
9		30	5	200
10		31	5	400
11				
12				
13				
14				

Question 5 (Marks = 30) [CLO 5]

Part I

4 Marks

1) 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)?

a) Context diagram
b) Function points
c) Block diagram
d) Lines of Code
e) COCOMO
f) b and d only
g) b, d, and e only ← g

2) Which of the following can help software engineers in software management activities?

1.5

Part III 5+3+3=11 Marks

Fast National University wants to create a new student portal in which they are mainly focused on providing functionalities similar to FLEX. The system should contain basic functionalities for the content management system. After initial analysis, it is determined that the system will have five External inputs with one having Average complexity, one with high complexity, and the other three having low complexity. There will be six external outputs from which five have low complexity while the remaining have high complexity.

Students will be able to carry out a total of six external queries of which five have low complexity and one has high complexity. As the system interacts with HEC's system for verification of degree and student information, there is one high complexity External interface file. Also, the system will have four internal logical files with one having low complexity, two have average complexity and one with high complexity.

Suppose all the value adjustments factors are given a score of 4. Average productivity is 13 FP/pm and labor rate is $ 4500 per month.

a. Calculate Unadjusted Function Points (aka Count Total).

Information Domain Value	Count	Weighting Factors			Total
		Simple	Average	Complex	
External Inputs	5	3	4	6	13
External Outputs	6	4	5	7	27
External Inquiries	6	3	4	6	21
Internal Logical Files	4	7	10	15	F 42
External Interface Files	1	5	7	10	15
Total Unadjusted Function Points (or count total) =					118

4

b. Calculate Adjusted Function Points (or Function Points). Mention the formula to calculate FP

Total

$F = 118 \times [0.65 + 0.01 \times \Sigma(F_i)]$

$= 118 \times (0.65 + 0.01 \times 95)$

165.20

3

b. Calculate Cyclomatic Complexity of the code using the Control Flow Graph (CFG). State the formula and show complete working

$CC = Edge - Nodes + 2$

$= 12 - 10 + 2$

$= 4 = Cyclomatic\ Complexity.$

(2)

c. Identify and list all the basis paths (aka independent paths)

(1) $1 \to 2 \to 3 \to 8 \to 9 \to 10$

(2) $1 \to 2 \to 4 \to 5 \to 6 \to 8 \to 9 \to 10$

(3) $1 \to 2 \to 4 \to 5 \to 7 \to 8 \to 9 \to 10$

(4) $1 \to 10$

(3)

d. Design test cases for the set of basis paths of part c. Add more rows, if required.

Id	x	number	Expected Output	Basis Path
①	44	+41 +ve	"Positive" "Done"	1→2→3→8→9→10
②	44	-41 -ve	"Negative" "Done"	1→2→4→5→6→8→9→10
③	44	0	"Zero" "Done"	1→2→4→5→7→8→9→10
④	51	99/key	"Done"	1→10

(4)

Part III 6+1+6= 13 Marks

Consider the computational problem **healthInsuranceRenewal**:

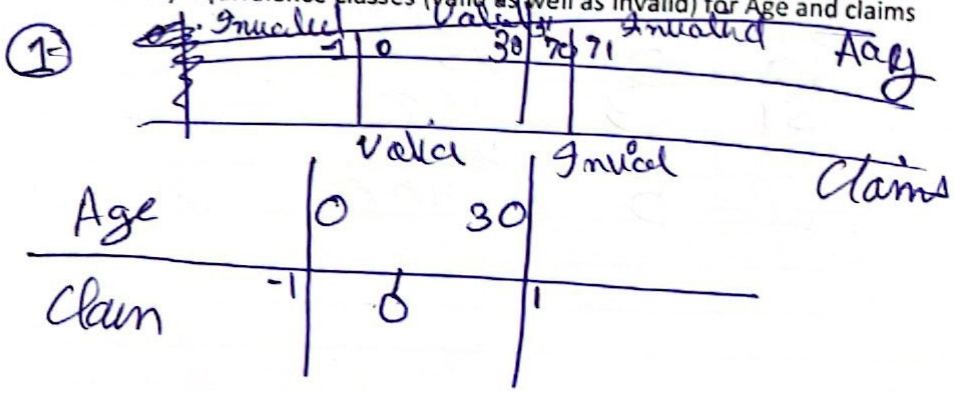
Input: integers 0<=Age<=70, 0<=claims<=10

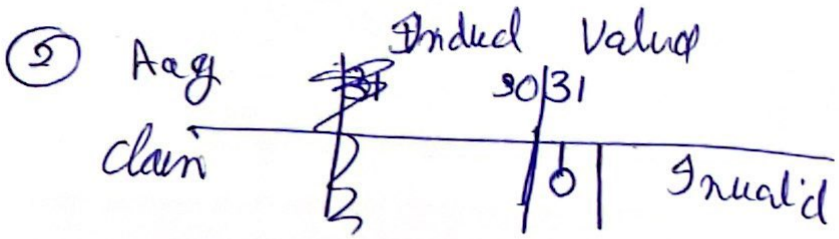
Output: integer Increase, where the value for Increase are computed according to the following policy:

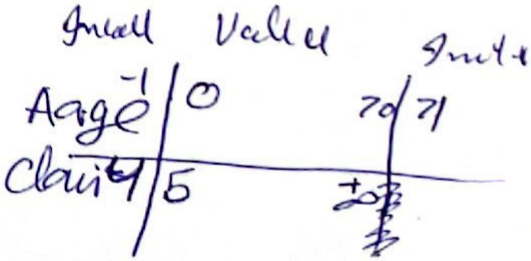
1) If the person is 30 years old or younger and has zero claims they will receive a GBP 25 increase in their insurance premium.
2) If the person is 31 years old or older and they have zero claims they will receive GBP 50 increase in their insurance premium,
3) If the person has 1 to 4 claims and they are
   a. 30 or younger, they will receive a GBP 75 increase
   b. 31 or older, they will receive a GBP 100 increase
4) If the person has 5 or more claims and they are:
   a. 30 or younger, they will receive a GBP 200 increase
   b. 31 or older, they will receive a GBP 400 increase.

Answer the following questions for above scenario:

a. Identify Equivalence classes (valid as well as invalid) for Age and claims







Sprint 3: The team committed [illegible]ries (including those not completed in sprint 2) an
user stories.

Sprint 4: The team committed 8 user stories (including those not completed in sprint 3) and
user stories.

To do: Find project velocity to help the team provide a good estimate of work to be committed
your working.

Velocity = $\frac{\sum \text{user stories} \times \text{points}}{n}$

= [illegible] +

1 = 42 × 4 Total Stories Completed

2 = = 18

3 =

4 =

5 =

Velocity = $\frac{18 \times 6}{4}$ = 27 is the velocity

✓

(5)

Question 4 (Marks = 30) [CLO 4]

21.5

012

Part I — 2 Marks

1) Which one of the following is an attribute of a good software test?

   a. Has a high probability of finding an error
   b. Is not redundant
   c. Is capable of uncovering a whole class of errors
   d. Is neither too simple nor too complex
   e. Proves that the program does not have any errors
   f. All except e

2) Beta testing

   a. is a level of testing also known as acceptance testing
   b. is the same as integration testing
   c. requires that the system is given for real use to a number of potential users to detect errors
   d. is repeatedly done until the system is error free
   e. is carried out by the development organization

2

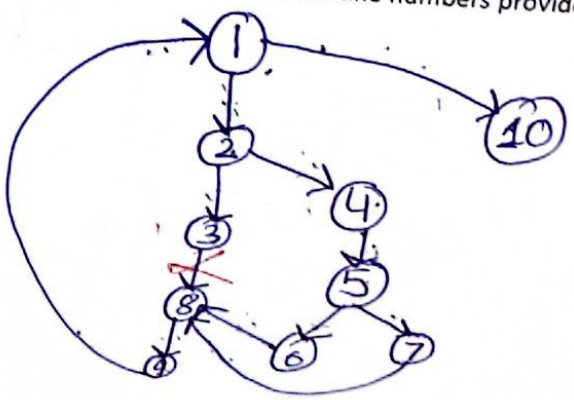
Part II — 5+2+4+4=15 Marks

Consider the following code segment and answer the following questions:

13.5

Line #	code
1	while (x < 50) {
2	if (number > 0) {
3	println ("Positive Number"); }//end if number>0
4	else {
5	if (number < 0) {
6	println ("Negative Number"); }//end if number<0
7	else { println ("Zero"); }//end else i.e. number == 0
8	}
9	x++;}//end while
10	println ("Done");

a. Draw a Control flow Graph for the given code. Use the line numbers provided above



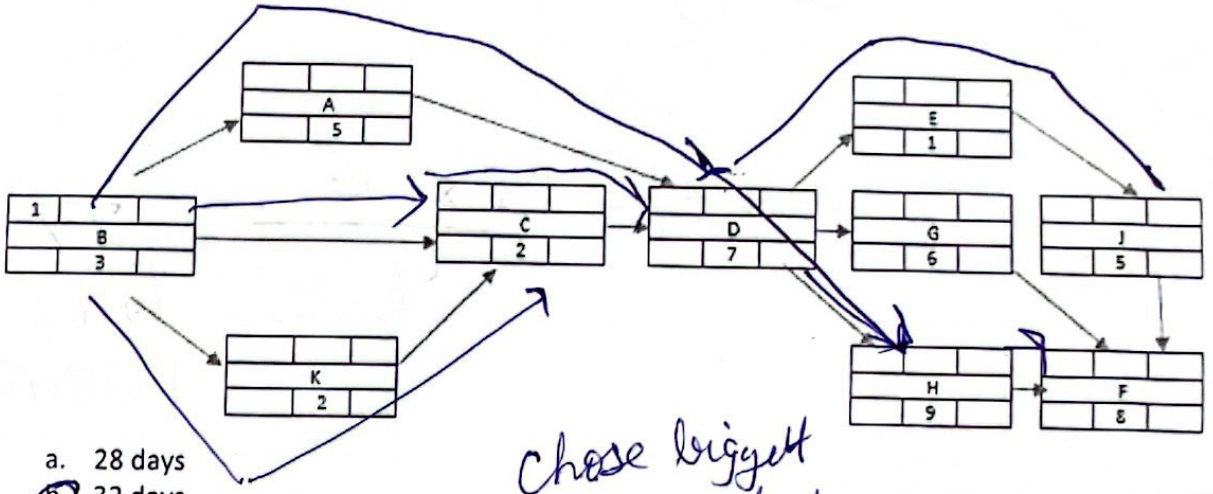
4.5

a) Gantt Chart
b) PERT Chart
c) WBS
d) Milestones
e) All of the mentioned

3) An organization is working on a large information system and a new module needs to be developed in the information system. The organization estimates that the new module shall have 10000 Lines of code in it. Their productivity in this project so far has been 200 lines of code per person week. The estimated effort required to develop this new module is:

a. 50 LOC per person weeks
b. 50 person weeks
c. 500000 person months
d. Cannot calculate with the given information
e. None of the mentioned

4) Consider the following activity on node graph where names of the activities are A, B, C, D, and so on. The duration of each activity is also mentioned in each node (5 days for A, 3 days for B, 8 days for F, and so on). The start day of the project is day 1 as shown in top left cell of Activity B node. What is the minimum time required to complete this project?



a. 28 days
b. 32 days
c. 26 days
d. None of the mentioned

Part II — 5 Marks

A team of software engineers is working on a project being developed using scrum. At the start of each spring they select a few user stories to work on. Assume that each user story is of 6 story points. Their selected and completed user stories in the first sprints are as follows:

Sprint 1: The team committed to complete 7 user stories (i.e. 42 story points). However, the team could complete 4 of the 7 user stories.

Sprint 2: The team committed 6 user stories (including those not completed in sprint 1) and completed 5 of the 6 user stories.

7) When performing structured design (i.e. mapping data flow into architecture), the input to the design process is a(n):
   a) Activity diagram
   b) ER diagram
   c) Data flow diagram
   d) Sequence diagram
   e) None of the mentioned

8) During engineering of software, we sometimes focus on understanding the important aspects of design and ignore the details for a certain time. Which principle of software design do we follow if we do so?
   a) Generality
   b) Modularity
   c) Incremental Development
   d) Abstraction

9) Which of the following helps measure the number of dependencies a module has on other modules?
   a. Cohesion
   b. Coupling
   c. Complexity
   d. Maintainability Index

10) Which software engineering activity involves transforming user requirements into a software architecture?
   a. Design
   b. Testing
   c. Analysis
   d. Maintenance

Part II **10 Marks**

One of the hospitals in the city plan to develop a Hospital Management System (HMS) to maintain the day –to-day state of admission/discharge of patients, list of available doctors, reports generation, attendance (including check-in and checkout) of staff, availability of beds in wards, availability of private rooms etc. The staff can be medical (s.a. doctors, nurses etc.) as well as non-medical (s.a. clerks, cashiers, receptionists, accountants etc.). Hospital allows administrator to view all the details of the hospital record. The admin can get details of any patient, doctor, ward, room, and staff. System shall store personal details and time/reason of visit, doctor visited for all patients who consult a doctor in hospital. The system shall keep complete history (previous visits, doctors consulted, medication, test report results, room/bed availed etc.) for all patients including outdoor patients as well as the indoor patients. The patients that do not get admitted but visit a doctor only are called outdoor patients and the patients that get admitted are called indoor patients. The patients can take appointment, through the HMS, from doctors online as per their availability. Each doctor will be assigned two specific days of the week for outdoor patients. System will also maintain lab records.

Following are some other objectives of the HNS:
1. To computerize all details regarding patient details & hospital details.
2. To schedule the appointment of patients with doctors to make it convenient for both.
3. To schedule the services of specialized doctors properly so that facilities provided by hospital are fully utilized in effective and efficient manner.
4. To keep the medical store's medicines inventory updated in case of issue and return of medicine
5. To handle records of the test reports prepared in the pathology lab of the hospital.

Provide functional decomposition of the HMS.