PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

Department of Computer Science and Engineering

BE CSE – G1 & G2

CONTINUOUS ASSESSMENT TEST 3

19Z501 - Theory of Computing

Date: 22.10.2024

Time: 1 Hour 15 minutes. **Maximum Marks: 35**

INSTRUCTIONS:

1. Answer **ALL**questions.
2. Question No. **1**carries 8 marks and question No. **2**carries 27 marks
3. In question No. **1**, subdivision **a** carries total of 8 marks (one mark for each question).
4. In question No. 2, subdivision **a** carries total of 7 marks (one mark for each question), subdivisions**b(i)**and **b(ii)**carries 5 marks each and subdivision **c** carries 10 marks.
5. Course Outcome Table :

Qn. 1	CO 1 to 4

Qn.2	CO5

1. a **(8 x 1 mark = 8 marks)**

i. Which of the following regular expressions represents strings that start with '1', do not have consecutive '0's, and contain at least one '1'?

A. 1(1|0)*

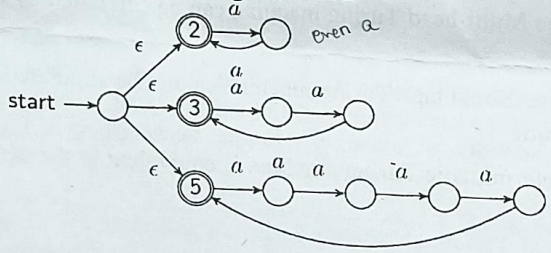
B. 1(10)*1*

C. 1(0|1)*(00)?

D. 1(1|10)*

[CO1 – Remember]

ii. Write the Language for the given NFA.



[CO1 – Understand]

iii. Consider the production rules of grammar G

S->Ab|Bb

A->aA|ϵ

B-> bB|ϵ

Which of the following Language L is generated by grammar G?

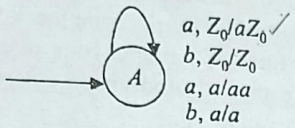
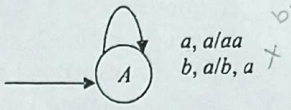
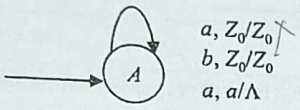
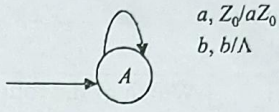
a) $L2=\{a^n b^m | n,m \geq 0\}$

b) $L2=\{a^n a | n \geq 0\} \cup \{b^n b | n \geq 0\}$

c) $L2=\{a^n b^n | n \geq 0\}$

d) $L2=\{a^n a^m | n,m \geq 0\}$

[CO2 – Understand]

iv.	Consider the following grammar: S→AB|BA A→aA|a B→bB|b Is the grammar ambiguous?	**[CO2 – Remember]**
v.	The PDA move that pushes a's into stack and ignore b's is _____ (a)  (b)  (c)  (d) 	**[CO3 – Apply]**
vi.	The Language which is generated by the grammar S→aSa|bSb|a|b over the alphabet {a,b} is the set of _____	**[CO3 – Understand]**
vii.	Which of the following statement(s) on Turing machine variants is (are) false? I. Multi-Tape Multi-head Turing machine can be simulated by a standard Turing machine. II. Multi dimensional tape Turing machine cannot be simulated by one-dimensional Turing machine III. A non-deterministic Turing machine is equivalent to the deterministic Turing machine. A. Only II B. I, II and III C. II and III D. I and III	**[CO4 – Remember]**
viii.	A language is defined to be recursively enumerable if there exists a Turing machine that _____	**[CO4– Remember]**
2.a.		**(7 x 1 mark = 7 marks)**
i)	Given the set of dominos, is it possible to list these dominos (repetitions permitted) so that the string of symbols on top is the same as the string of symbols on the bottom? Write the solution. $(D_1, D_2, D_3, D_4) = \left(\frac{b}{ca}, \frac{a}{ab}, \frac{ca}{a}, \frac{abc}{c} \right)$	**[CO5– apply]**

ii)	Let S be an NP-complete problem ,Q and R be two other problems not known to be in NP. Q is polynomial time reducible to S and S is polynomial-time reducible to R. Which one of the following statements is true? A. R is NP complete B. R is NP hard C. Q is NP complete D. Q is NP hard **[CO5– Apply]**	
iii)	Which of the following statements correctly distinguishes tractable and intractable problems? A) Tractable problems belong to class P, while intractable problems belong to class NP-complete or NP-hard. B) Intractable problems are always unsolvable, whereas tractable problems are solvable within exponential time. C) Tractable problems are solvable by nondeterministic algorithms, while intractable problems require heuristic approaches. D) Tractable problems can only be solved using brute force, while intractable problems have polynomial-time solutions. **[CO5– Remember]**	
iv)	Which of the following is true regarding space complexity for recursive algorithms? A) The space complexity of a recursive algorithm is determined solely by the size of the input. B) Recursive algorithms always have linear space complexity due to the function call stack. C) Space complexity for a recursive algorithm includes the memory required for the call stack, in addition to the memory used by variables. D) The space complexity of any recursive algorithm is always greater than its time complexity. **[CO5– Remember]**	
v)	L and L' are both Recursively Enumerable , then L is _____ A. Recursively Enumerable B. Recursive C. Recursive and Recursively Enumerable D. None of above **[CO5– Remember]**	
vi)	The _____ denotes the class of decision problems that can be solved by deterministic algorithms in polynomial time. **[CO5– Remember]**	
vii)	A Function is considered primitive recursive if it can be obtained from initial functions and through finite number of _____and_____ **[CO5– Understand]**	
b.		**(2 x 5 marks = 10 marks)**
i)	Apply the concept of a Universal Turing Machine by illustrating its operation, including how it simulates the behavior of any Turing machine. **(Note : Consider Turing machine M that decides whether a given binary string contains an equal number of 0s and 1s)** **[CO5– Apply]**	

ii)	Distinguish between the characteristics of tractable and intractable problems by providing suitable examples for each. **[CO5– Understand]**	
		(1 x 10 marks = 10 marks)
c.		
i)	Apply the process of reducing the Boolean satisfiability problem (SAT) to the Clique problem. Given a Boolean formula F in conjunctive normal form (CNF) with m clauses, describe how to construct a graph G such that F is satisfiable if and only if G contains a clique of size k, where k=m. **[CO5– Apply]**	
	OR	
ii)	Apply the concept of Cook-Levin's theorem to explain its significance in computational complexity. In your explanation, illustrate how the theorem demonstrates that the Boolean satisfiability problem (SAT) is NP-complete and discuss its implications for other problems in NP. **[CO5– Apply]**	

CA Test 3
2019 Regulations

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

Department of Computer Science and Engineering

B.E CSE, SEMESTER V

CONTINUOUS ASSESSMENT TEST 3 Date: 22/10/2024

19Z502 - Microprocessors and Interfacing

Time: 1 Hour 15 minutes. **Maximum Marks: 35**

INSTRUCTIONS:

1. Answer **ALL** questions.
2. Question No. 1 carries 8 Marks and question No. 2 carries 27 Marks
3. In question No. 1, subdivision **a** carries total of 8 marks (one mark for each question).
4. In question No. 2, subdivision **a** carries total of 7 marks (one mark for each question), subdivisions **b(i)** and **b(ii)** carries 5 marks each and subdivision **c** carries 10 marks.
5. Course Outcome Table :

Qn. 1	CO 1,2,3,4	Qn.2	CO5

Group I

1. a **(8 x 1 mark = 8 marks)**

i. Compute the physical address for the Source operand of **MOV AX, [BX]+0400.** The register contents are as follows: CS=0A00, DS=OB00, SI=0100, DI=0200, BX=0300

A) 0B200H **B)** 0B100H **C)** 0B700H **D)** 0B900H

ii. The instruction that will move the value 1234H into the CX register is _____.

iii . Consider a word located at memory address 01231_{16} of an 8086 based microprocessor. How many bus cycles are required to read it from the memory?

A) 1 **B)** 2 **C)** 3 **D)** 4

iv. Connecting MN/MX to logic 0 selects the _____ mode of operation.

v. The _____ is an LSI peripheral designed to permit easy implementation of parallel I/O in the 8088 and 8086 microcomputer system

A) 82C05A **B)** 82C55A **C)** 82A55C **D)** 82A55A

vi. If PC6 is written to the control register, Mode 0 operation is selected for all three ports with the activation of D_7

vii. Which of the following interrupt requests is/are independent of IF flag?

I. NMI II. TRAP III. Divide by zero

A) I & II **B)** I & III **C)** II & III **D)** I, II & III

viii. What is the range of address reserved for storing the Interrupt vector table?

A) 00000H – 0003EE **B)** 00000H – 0003EF **C)** 00000H – 0003FE **D)** 00000H – 0003FF

2. a **(7 x 1 mark = 7 marks)**

i. Which instruction set architecture is used in Raspberry Pi?

A) X86 B) AVR C) MSP D) ARM

ii. _____ mode in pentium supports segmentation and paging

iii. How many threads can an Intel Core i7 processor with 8 physical cores handle, assuming HyperThreading is enabled?

A) 16 threads B) 12 threads C) 8 threads D) 24 threads

iv. Which technology allows Intel Core i5 processors to dynamically increase their clock speed when needed?

A) Smart Cache B) Turbo boost C) QuickPath Interconnect D) Hyper-Threading

v) Which of the following is NOT a feature of the Arduino Uno?

A) Built-in PWM capability B) Analog-to-digital conversion
C) External memory support D) Digital I/O pins

vi) Arduino Uno uses a _____ bit architecture and Raspberry Pi uses a _____ bit architecture

vii) Which of the following is TRUE for Raspberry Pi ?

A) It supports only digital signals B) It lacks an ADC
C) It has a built-in Ethernet D) It comes with an built-in hard drive

2.b. **(2 x 5 marks = 10 marks)**

i. Explain the changes in Pentium processor to improve its performance compared its predecessors ?

ii. Compare the features of i3,i5 and i7 (hardware and software) ?

2.c. **(1 x 10 marks = 10 marks)**

i. Discuss the architecture of Arduino Uno development board based on its features and show how it interfaces with external peripheral devices with examples ?

(OR)

ii. Draw the hardware architecture diagram of ARM processor, its benefits as RISC processor and mention the salient features of ARM Bus and Memory Architecture.

222203

CA Test 3

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

Department of Computer Science and Engineering

CSE & 05

CONTINUOUS ASSESSMENT TEST 3 Date: 23-10-2024

19Z503- ARTIFICIAL INTELIGENCE

Time: 1 Hour 15 minutes. **Maximum Marks: 35**

INSTRUCTIONS:

1. Answer **ALL** questions.
2. Question No. 1 carries 8 Marks and question No. 2 carries 27 Marks
3. In question No. 1, subdivision **a** carries total of 8 marks (one mark for each question).
4. In question No. 2, subdivision **a** carries total of 7 marks (one mark for each question), subdivisions **b(i)**and **b(ii)** carries 5 marks each and subdivision **c** carries 10 marks.
5. Course Outcome Table :

Qn. 1	CO 1 to 4

Qn.2	CO5

Group I

1. a **(8 x 1 mark = 8 marks)**

- **Write the alphabet of your choice answer for the questions i, iii, v&vii in the CA test answer book mentioning the question number and subdivision number.**
- **Write the answer for the Fill in the blanks questions ii, iv, vi&viii in the CA test answer book mentioning the question number and subdivision number.**

i. In a utility-based agent, utility refers to: **L1**

A) The random choices made by the agent
B) The agent's ability to learn from mistakes
C) The measure of the agent's happiness or satisfaction
D) The actions performed by the agent in a deterministic environment

ii Static environment does not change while the agent is deliberating **L2**

iii. In AO* search, the "AND" part of an AND-OR graph represents: **L1**

A) Alternative paths to the goal **B)** Multiple subproblems that need to be solved together
C) A single node with multiple costs **D)** A choice of different actions

iv. Uniform cost search is a variant of Uniformed search algorithm **L2**

v. Which inference rule allows logical agents to derive conclusions from premises such as "if P then Q" and "P" to infer "Q"? **L2**

A) Conjunction **B)** Modustollens
C) Modusponens **D)** Resolution

vi A Leaping network is a graphical model used to represent the probabilistic relationships among a set of variables. **L1**

vii. What is a reward signal? **L1**

A) The total number of actions taken by the agent
B) A scalar value received by the agent after taking an action in a specific state
C) A list of all possible actions
D) The estimated future reward of an action taken

viii. The term _____ refers to a condition where two actions cannot be executed at the same time due to resource conflicts in a planning graph L1

2. a (7x 1 mark = 7 marks)

Write the alphabet of your choice answer in the CA test answer book mentioning question number and subdivision number.

i.What is syntactic analysis in NLP primarily concerned with? L1

A) Understanding the meaning of words
B) Analyzing the structure of sentences
C) Extracting information from texts
D) Generating natural language responses

ii. Which of the following is a popular language model developed by OpenAI? L2

A) BERT B) ELMo
C) LSTM D) GPT

iii. Which type of grammar is most closely associated with generating hierarchical structures in sentences? L1

A) Context-Free Grammar
B) Regular Grammar
C) Context-Sensitive Grammar
D) Phrase Structure Grammar

iv. What is the primary purpose of smoothing techniques in language modeling? L2

A) To reduce the computational cost
B) To handle zero probabilities for unseen events
C) To increase the size of the training dataset
D) To enhance the model's interpretability

Write the answer for the Fill in the blanks questions in the CA test answer book mentioning question number and subdivision number.

v. _____ is a popular metric used to evaluate the performance of language models by measuring how well a model predicts test data. L1

vi. _____ is a type of machine learning where models are trained to understand language using vast amounts of text data without labeled examples. L1

vii. An _____ grammar is an extension of a formal grammar that includes additional information or features to enhance its expressive power. L1

b. (2 x 5 marks = 10 marks)

i. Discuss how the n-gram model can be used for classifying a new email message text as a genuine email or spam. L4

ii. Describe the process of generating parse trees from a given phrase structure grammar L4

c. **(1 x 10 marks = 10 marks)**

L5

i. Consider the problem of changing a flat tire. The goal is to have a good spare tire properly mounted onto the car's axle, where the initial state has a flat tire on the axle and a good spare tire in the trunk. The exact description of the problem is given below:

$$Init(Tire(Flat) \land Tire(Spare) \land At(Flat, Axle) \land At(Spare, Trunk))$$
$$Goal(At(Spare, Axle))$$
$$Action(Remove(obj, loc),$$
$$\quad \text{PRECOND: } At(obj, loc)$$
$$\quad \text{EFFECT: } \neg At(obj, loc) \land At(obj, Ground))$$
$$Action(PutOn(t, Axle),$$
$$\quad \text{PRECOND: } Tire(t) \land At(t, Ground) \land \neg At(Flat, Axle)$$
$$\quad \text{EFFECT: } \neg At(t, Ground) \land At(t, Axle))$$
$$Action(LeaveOvernight,$$
$$\quad \text{PRECOND:}$$
$$\quad \text{EFFECT: } \neg At(Spare, Ground) \land \neg At(Spare, Axle) \land \neg At(Spare, Trunk)$$
$$\qquad \land \neg At(Flat, Ground) \land \neg At(Flat, Axle) \land \neg At(Flat, Trunk))$$

- Write the Graph-Plan algorithm
- Use the Graph-Plan algorithm to build a planning graph for the spare tire problem.
- Highlight mutex conditions and their causes in the constructed planning graph.

(OR)

ii. Explain how the CYK algorithm processes a specific input string "ab" using the given CFG.

1. $S \rightarrow AB$
2. $A \rightarrow a$
3. $B \rightarrow b$

CA Test 3
2019 Regulations

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

Department of COMPUTER SCIENCE & ENGINEERING

BE-COMPUTER SCIENCE & ENGINEERING

CONTINUOUS ASSESSMENT TEST 3 Date: 23.10.2024

19Z504 – COMPUTER NETWORKS

Time: 1 Hour 15 minutes. **Maximum Marks: 35**

INSTRUCTIONS:

1. Answer **ALL** questions.
2. Question No. 1 carries 8 Marks and question No. 2 carries 27 Marks
3. In question No. 1, subdivision **a** carries total of 8 marks (one mark for each question).
4. In question No. 2, subdivision **a** carries total of 7 marks (one mark for each question), subdivisions **b(i)** and **b(ii)** carries 5 marks each and subdivision **c** carries 10 marks.
5. Course Outcome Table :

Qn. 1	CO 1 - 4

Qn. 2	CO5

1.a	(8 x 1 mark = 8 marks)	BTL
i)	In the OSI model, when data is transmitted from device A to device B, the header from A's layer 5 is read by B's _____ layer. A)physical B)transport C)session D)presentation	L1
ii)	A bridge has access to the _____ address of a station on the same network. A) logical B) physical C) port D)Both port & logical	L2
iii)	Which of the given wireless technologies used in IoT, consumes the least amount of power? A) Zigbee B) Bluetooth C) Wi-Fi D) GSM/CDMA	L2
iv)	In the go-back-N protocol, the send window size is _____ and the receive window size is _____, where n is related to the number of bits in the sequence. number. A) 1, 1 B) 1, n C) n, 1 D) n, n	L2
v)	When not all fragments of a message have been received within the designated amount of time, a _____ error message is sent. A) Source-quench B) Time-exceeded C) Parameter-problem D) Time-stamp-request	L2
vi)	The _____ routing uses the Dijkstra algorithm to build a routing table. A)Distance Vector B) Link state C) path vector D) route vector	L2
vii)	Suppose two hosts use a TCP connection to transfer a large file. Which of the following statements is/are False with respect to the TCP connection? S1: If the sequence number of a segment is m, then the sequence number of the subsequent segment is always m+1. S2: If the estimated round trip time at any given point of time is t sec, the value of the retransmission timeout is always set to greater than or equal to t sec. S3: The size of the advertised window never changes during the course of the TCP connection. A) S1 only B) S1 &S2 only C) S1 & S3 D) S2 &S3	L3
viii)	On a TCP connection, current congestion window size is Congestion Window = 2KB. The window size advertised by the receiver is Advertise Window = 3 KB. The current window size at the sender is _____	L4

	A) 1024 bytes B) 2048 bytes C) 4096 bytes D) 6144 bytes	
2.a	**(7 x 1 mark = 7 marks)**	L2
i)	Consider different activities related to email: m1: Send an email from a mail client to a mail server m2: Download an email from mailbox server to a mail client m3: Checking email in a web browser Which is the application level protocol used in each activity? A) m1: HTTP m2: SMTP m3: POP C) m1: SMTP m2: FTP m3: HTTP B) m1: SMTP m2: POP m3: HTTP D) m1: POP m2: SMTP m3: IMAP	
ii)	Which of the following protocol is used by email server to maintain a central repository that can be accessed from any machine? A) POP3 B) IMAP C) SMTP D) SNMP	L1
iii)	Consider the following statements and choose the correct option S1: Domain Name System (DNS) is Networking support protocol which uses User Data Protocol (UDP) as transport protocol. S2: HTTP may use different TCP connection for different objects of a webpage if non-persistent connections are used. A) S1: True ; S2 :True B) S1: True ; S2 :False C) S1: False ; S2 :True D) S1: False ; S2 :False	L4
iv)	Identify the correct order in which the following actions take place in an interaction between a web browser and a web server. 1. The web browser requests a webpage using HTTP. 2. The web browser establishes a TCP connection with the web server. 3. The web server sends the requested webpage using HTTP. 4. The web browser resolves the domain name using DNS. A) 4,2,1,3 B) 1,2,3,4 C) 4,1,2,3 D) 2,4,1,3	L3
v)	DHCP uses the services of _____. A) UDP B) TCP C) IP D) SCTP	L1
vi)	QUIC protocol that creates a stateful interaction between a client and server (True/ False)	L1
vii)	During an FTP session data connection may be opened _____ (once/ as many times as needed)	L2
2. b	**(2 x 5 marks = 10 marks)**	
i)	i. Consider an HTTP client that wants to retrieve a Web document at a given URL. The IP address of the HTTP server is initially unknown. What transport and application- layer protocols besides HTTP are needed in this scenario? ii. Consider the resolution of the domain name www.example.in by a DNS resolver. Assume that no resource records are cached anywhere across the DNS servers and that iterative query mechanism is used in the resolution. How many DNS query-response pairs involved in completely resolving the domain name?	L3 L5
ii)	What is the need of DHCP in computer networks? Illustrate its sequence of steps with sketch.	L2
2.c	**(1 x 10 marks = 10 marks)**	
	Suppose Alice, with a Web-based e-mail account (such Gmail), sends a message to Bob, who accesses his mail from his mail server. Discuss how the message gets from Alice's host to Bob's host. Be sure to list the series of application-layer protocols that are used to move the message between the two hosts.	L5

CA Test 3
2019 Regulations

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

Department of Computer Science and Engineering

BE CSE Semester 5

CONTINUOUS ASSESSMENT TEST 3 Date: 24/10/2024

19Z505 - Object Oriented Analysis and Design

Time: 1 Hour 15 minutes. **Maximum Marks: 35**

INSTRUCTIONS:

1. Answer **ALL** questions.
2. Question No. 1 carries 8 Marks and question No. 2 carries 27 Marks
3. In question No. 1, subdivision **a** carries total of 8 marks (one mark for each question).
4. In question No. 2, subdivision **a** carries total of 7 marks (one mark for each question), subdivisions **b(i)** and **b(ii)** carries 5 marks each and subdivision **c** carries 10 marks.
5. Course Outcome Table :

Qn. 1	CO 1 to 4

Qn.2	CO 5

Group I

1. a **(8 x 1 mark = 8 marks)**

- Write the alphabet of your choice answer for the questions i, iii, v & vii in the CA test answer book mentioning the question number and subdivision number.
- Write the answer for the Fill in the blanks questions ii, iv, vi & viii in the CA test answer book mentioning the question number and subdivision number.

i. Which one of the following is an example of a generic software product ?
A) Microsoft PowerPoint Software B) Samsung Washing Machine Software
C) PSG Attendance Entry Software D) Indian Railway Ticket Booking Software

ii. If a post-condition is violated, this means that a _____ object has not carried out its part of the contract associated with an abstraction.

iii. Which one of the following represents a process or thread in UML?
A) Executable Component B) Runnable Interface C) Thread class D) Active class

iv. _____ states how the world has changed because of the execution of the use case.

v. Which diagram models the life cycle of a single object?
A) State machine B) Sequence C) Object D) Timing

vi. Typically, a message in a collaboration diagram represents a client invoking _____ on a supplier object.

vii. Which of the following is true about object diagrams?
A) They are used to show the dynamic interaction of objects during execution
B) They represent the static structure of the system
C) They are a snapshot of the instances of classes at a specific point in time
D) They show the deployment of software components on hardware nodes

viii. A class with a filled diamond at one end of an association line indicates a Composite relationship, where the class at the diamond end controls the lifecycle of the other class.

2. a **(7 x 1 mark = 7 marks)**

Write the alphabet of your choice answer in the CA test answer book mentioning question number and subdivision number.

i. What is the primary reason to model nodes in a deployment diagram using stereotypes such as <<device>> and <<execution environment>>?

A) To differentiate between hardware and software elements deployed on the system
B) To establish the ownership of artifacts between different developers
C) To simplify the understanding of relationships between classes
D) To define the sequence of interactions between objects

ii. What relationship is primarily used between components in a component diagram?

A) Inheritance B) Usage Dependency C) Association D) Deployment

iii. Which of the following is NOT an artifact type?

A) Execution File B) Configuration file C) Library file D) State

iv In a package diagram, which type of relationship is used to indicate that one package depends on another?

A) Aggregation B) Composition C) Dependency D) Generalization

Write the answer for the Fill in the blanks questions in the CA test answer book mentioning question number and subdivision number.

v. A component is an _____ unit within a system.

vi. _____ patterns serve as a blueprint for how different classes and objects are combined to form larger structures.

vii. In deployment diagram a _____ usually represent a piece of hardware in the system.

b. **(2 x 5 marks = 10 marks)**

i. Draw UML Deployment Diagram for Book Club Web Application. It should be an instance level deployment diagram with the following components like device node – any Server, execution environment nodes: JSP Server, any servlet container and artifacts of your own choice. Use a protocol like TCP/IP for communication between Client side and Server side. **L4**

ii.List out the elements of package diagram and also identify the dependencies of packages in online shopping system. **L3**

c. **(1 x 10 marks = 10 marks)**

Sketch an UML Component Diagram for the below description: Scenario consists of 3 main subsystems namely: Web store, Warehouse and Accounting. Web store in turn consists of components namely: Search Engine, Shopping Cart and Authentication. Accounting also has some in built components like Orders and Customers. Ports are used for communication between any two components that interacts. 7 interfaces are used to enrich the scenario namely Product Search, Online Shopping, User Session, Search Inventory, Manage Orders, Manage Customers, Manage Inventory. **L6**

(OR)

ii. Create the geometrical shapes square, triangle and circle. Add necessary attributes and a function to calculate area. Apply decorator pattern to change the border colour of the shape. **L5**

CA Test 3

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

Department of CSE

BE CSE V SEM

CONTINUOUS ASSESSMENT TEST 3 Date: 24.10.2024

19Z002 - ADVANCED DATA STRUCTURES

Time: 1 Hour 15 minutes. **Maximum Marks: 35**

INSTRUCTIONS:

1. Answer **ALL** questions.
2. Question No. 1 carries 8 Marks and question No. 2 carries 27 Marks
3. In question No. 1, subdivision **a** carries total of 8 marks (one mark for each question).
4. In question No. 2, subdivision **a** carries total of 7 marks (one mark for each question), subdivisions **b(i)** and **b(ii)** carries 5 marks each and subdivision **c** carries 10 marks.
5. _____ Data book / _____ table(s) may be permitted.
6. Course Outcome Table :

Qn. 1	CO 1 to 4

Qn.2	CO5

Group I

1. a **(8 x 1 mark = 8 marks)**

- Write the alphabet of your choice answer for the questions i, iii, v & vii in the CA test answer book mentioning the question number and subdivision number.
- Write the answer for the Fill in the blanks questions ii, iv, vi & viii in the CA test answer book mentioning the question number and subdivision number.

i. Van Emde Boas tree on u integers between 0 and u − 1 supports successor queries in
A) O(log u) **B)** O(u) **C)** O(lg lg u) **D)** O(lg u lg lg u) **L1**

ii. In the potential method for amortized analysis, the potential energy should never go _____ **L1**

iii. Which of the following statements about leftist heaps is **NOT** true?
A) A leftist heap is a type of priority queue that maintains a complete binary tree structure.
B) The "rank" of a node in a leftist heap is determined by the shortest distance to a node with no children.
C) Merging two leftist heaps can be performed in O(log n) time.
D) In a leftist heap, the smallest element is always found at the root node. **L2**

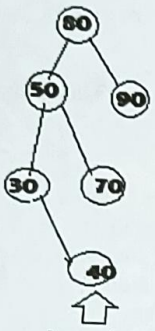
iv. The amortized time complexity for the decrease-key operation in a Fibonacci heap is _____ **L1**

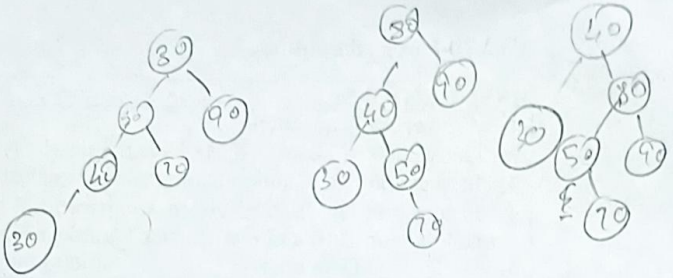
v. Let i be the interval to be searched with high[i] and low[i] representing high and low endpoints of the interval respectively, and let x be a node in interval tree, we can say that there is no overlap in left sub tree if _____

A) Max[left[x]]>low[i]
B) Max[left[x]]>=high[i]
C) Max[left[x]]<low[i]
D) Max[left[x]]<=high[i]

L1

vi The resultant tree after inserting node 40 in the following splay tree is _____





L2

vii. Which of the following statements about point quad trees is **NOT** true?

A) A point quad tree is a data structure used to partition a two-dimensional space into four quadrants.

B) Point quad trees are primarily used for storing line segments rather than individual points.

C) The insertion operation in a point quad tree involves recursively dividing the space into quadrants until a suitable leaf node is found.

D) Point quad trees can efficiently support range searching and nearest neighbor queries.

L1

viii. The KD Tree formed after inserting the points (0.7, 0.2), (0.5, 0.4), (0.2, 0.3), (0.4, 0.7), (0.9, 0.6) is _____

L2

2. a **(7 x 1 mark = 7 marks)**

Write the alphabet of your choice answer in the CA test answer book mentioning question number and subdivision number.

i. Randomized algorithms which always terminate in given time bound, but output the correct answer with at least some (high) probability are called

A) Las Vegas algorithms **B)** Monte Carlo algorithms
C) Sorting algorithm **D)** Greedy algorithm

L1

ii. The expected value if we roll a single die is

A) 3.5 **B)** 6 **C)** 1 **D)** 0.167

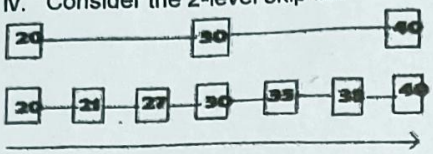
L2

iii. When is the following congruence true? $a^p \bmod p \equiv a \bmod p$

L1

A) a and p must both be prime numbers. **B)** a must be a prime number.
C) a must be a composite number while p must be a prime number.
D) p must be a prime number.

iv. Consider the 2-level skip list **L2**



How to access 38?

A) Travel 20-30-35-38 **B)** Travel 20-30-40-38

C) Travel 20-38 **D)** Travel 20-40-38

Write the answer for the Fill in the blanks questions in the CA test answer book mentioning question number and subdivision number.

v. An algorithm is random if its behavior is determined not only by its input but also by values produced by a random-number generator. **L1**

vi. The _____ of a random variable X is just its average value over S, where each elementary event e is weighted according to its probability. **L1**

vii. In hiring problem, the total cost of hiring m persons out of the *n candidates, if Ci is the* cost of interviewing and Ch is the cost of hiring is Cih **L2**

b. **(2 x 5 marks = 10 marks)**

i. Build a treap by inserting following nodes representing (Key, priority) in sequence. (1, 400), (2,700), (2,200), (5,650), (6,500), (7,600), (8, 100). In the resultant heap insert (9,399). **L5**

ii. Analyze any three methods of primality testing with example **L4**

c. **(1 x 10 marks = 10 marks)**

i. Consider the Birthday Paradox: "How many people must there be in a room before there is a 50% chance that two of them were born on the same day of the year?" Solve the Birthday Paradox question using Indicator Random Variables. **L6**

$$x+ \quad {}^{n}C_{0}\, x^{n-0} y^{0} + {}^{n}C_{1}\, x^{n-1} y^{1} + {}^{n}C_{2}\, x^{n-2} y^{2} +$$

$${}^{n}C_{3}\, x^{n-3} y^{3} + {}^{n}C_{4}\, x^{n-4} y^{4} +$$

$${}^{n}C_{5}\, x^{n-5} y^{5}$$