



NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CYCLE TEST 1 – CSPE42 DESIGN THINKING

106120079

Maximum Marks: 20

Date: 08.03.2022

Duration: 1 Hour

Time: 2.30 pm to 3.30 pm

ANSWER ALL THE QUESTIONS

Q.No	QUESTION	MARKS
1.	Why Design Thinking?	2
2.	What is great design according to Richard Buchanan?	2
3.	Draw the Design Thinking process in a single diagram with Questions, Tools and Project Management aids.	2
4.	When to use visualization?	2
5.	List the cluster in value chain analysis.	2
6.	How Journey mapping de-risk your project growth? Explain.	3
7.	Write in detail about getting started with mind mapping.	3
8.	Use the storyboarding elements to tell the story of your journey in this design thinking course starting with the choice of electives.	4



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CYCLE TEST 2 – CSPE42 DESIGN THINKING

Maximum Marks: 20

Date: 06.04.2022

Duration: 1 Hour

Time: 2.30 pm to 3.30 pm

ANSWER ALL THE QUESTIONS

layout

zen
chall
mind

Q.No	QUESTION	MARKS
1.	Mention the zen of Brain storming.	2
2.	Differentiate Assumption Testing and Rapid Prototyping.	5
3.	Draw The Napkin Pitch for Life Plan Visualization.	4
4.	What is the metaphor chili table in concept development? Explain.	3
5.	What is Design Criteria? Draw a sample design criterion.	4
6.	List a set of tests that apply to any new business in any industry.	2

U
U, E, S, d

D
R
A
R

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NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FINAL ASSESSMENT - CSPE42 DESIGN THINKING

Maximum Marks: 30

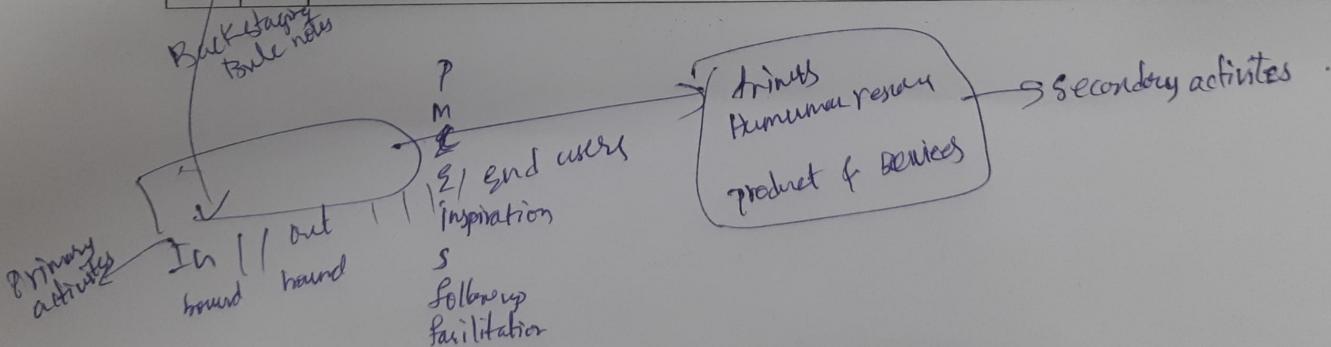
Date: 30.04.2022

Duration: 2 Hour

Time: 2.00 pm to 4.00 pm

ANSWER ALL THE QUESTIONS

Q.No	QUESTION	MARKS
1. a.	What is design according to Tim Brennan? <i>hair pin ball</i>	2
b.	Draw the Porter's value chain.	3
2. a.	Create the detailed mind mapping for the design thinking course.	5
b.	Differentiate between customer co-creation and learning launch.	5
3. a.	Write in detail about getting started with brain storming.	5
b.	Explain in detail about the process of rapid prototyping.	5
4. a.	What is journey map? Create a journey map for your project.	5



NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI –
620015

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
B.Tech (CSE) - Cycle Test 2 – January – May 2022

CSPC41 – Automata and Formal languages

Semester: IV

Max Marks: 20

Curriculum: NITTUGCSE20

Time: 1 hour

Date of Exam: 4th April 2022

1. Convert the following grammar to Chomsky Normal form where S is the start symbol. (4)

$$\begin{aligned}S &\rightarrow EFG \\E &\rightarrow bEc \mid \epsilon \\F &\rightarrow cFd \mid \epsilon \\G &\rightarrow dGb \mid \epsilon\end{aligned}$$

2. Define a Context free grammar for the following language: (2)

1. The set of odd length string S in $\{0,1\}^*$ with middle symbol 1
2. $\{a^i b^j c^k \mid j = i \text{ or } j = k\}$

3. Design a PDA that accepts by final state for the following language. (4)

$\{x \mid x \in \{a,b,c\}^* \text{ and } n_a(x) < n_b(x) \text{ or } n_a(x) < n_c(x)\}$

4. Show that if L is accepted by a PDA in which no symbols are ever removed from the stack then L is Regular. (2)

5. Design a TM that accepts the following language. (4)

$\{x \mid x \in \{a,b,c\}^* \text{ and } n_a(x) = n_b(x) = n_c(x)\}$

W

- #10011# #0
0 11 001 6. Design a Turing machine to reverse a given string. For example, (4)

Input: #w#, $w \in \{a, b\}^*$

Output: # w^R #

$s_1 \rightarrow s$

--- Best Wishes ---

a'

$s \rightarrow AB$

$A \rightarrow a/aA / ab/ba / ab$

$B \rightarrow bC/bBC / c/CBC$

$s \rightarrow AB$
 $A \rightarrow ab/aAb /$
 $B \rightarrow c/cBc / bBc$

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI – 620015

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

B.Tech CSE – Semester Examinations – April 2022

106120079

CSPC41 – Formal languages and automata theory

Semester: IV

Max Marks: 80

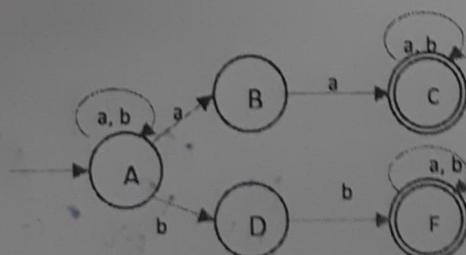
Curriculum: NITTUGCSE20

Time: 3 hours

ANSWER ALL QUESTIONS

1. a. Let M be a Finite automata represented by $(Q, \Sigma, \delta, q, A)$. Show that if every state other than ' q ' from which no element of A can be reached is deleted, then what remains is an NFA recognizing the same language. (4)
b. Prove that every language L is accepted by a NFA if and only if there exists a DFA. (4)
c. Design a DFA for the following languages. (2)
 - i. The set of all strings such that the number of 1's is even and the number of 0's is a multiple of 3.
 - ii. The set of all strings not containing a 110.
d. Using the properties of regular languages, construct a DFA to accept the language over $\{0,1\}^*$ which when interpreted in binary is not a multiple of 6. (6)

2. a. Prove by pumping lemma that $L = \{a^i b^j \mid \text{GCD}(i, j) = 1\}$ is not regular. (2)
b. Convert the following NFA to DFA. (6)



- c. Prove that there exists a ϵ -NFA for every regular expression and represent the following regular expression to ϵ -NFA – $0^* + (1^*0 + 01)^*$ (8)

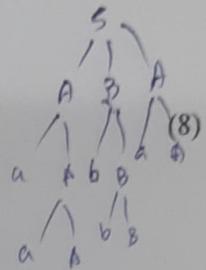
3. a. Prove that the following grammar is ambiguous and construct an unambiguous grammar for the same language. (4)

$S \rightarrow ABA$

$$A \rightarrow aA \mid \varepsilon$$

$$B \rightarrow bB \mid \varepsilon$$

aijat



- b. Find a grammar in GNF equivalent to the following grammar.

S → AB | ε

$$A \rightarrow DE \mid a$$

$$B \rightarrow b \mid \varepsilon$$

$$D \rightarrow b$$

$$E \rightarrow a$$

c. Prove that if L is $L(G)$ for a grammar G , then L' is $L - \{\epsilon\}$ for some grammar G' which is free of ϵ productions and unit production. (4)

4. a. Prove that if L is $N(M_1)$ for some PDA M_1 , then L is $L(M_2)$ for some PDA M_2 . (4)

- b. Design a Turing machine to accept the following language , (6)

$$L = \{ a^n b^m c^n d^m \mid m, n > 0 \}$$

Convert the designed TM to a one-way infinite tape TM.

- c. Design a Turing machine that implements a binary full adder.⁴ (6)

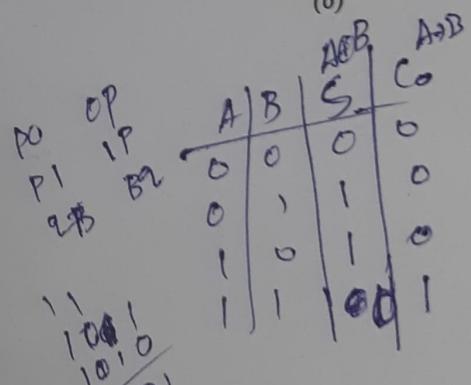
- a. Define L_d and prove that it is not recursively enumerable. (4)

- b. Prove that L_u is recursively enumerable but not recursive. (6)

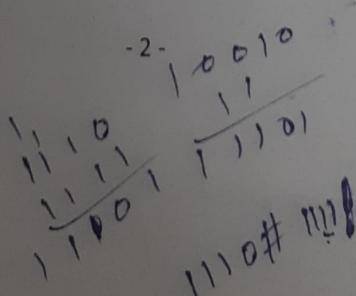
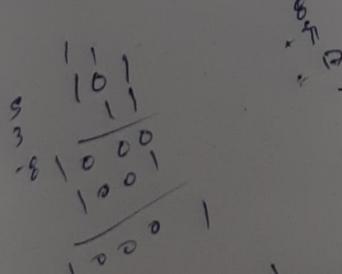
- c. Convert the following Turing machine to a MPCP and show that the conversion is correct by validating with a string. (6)

$(\{p, q, r, s\}, \{0, 1\}, \{0, 1, B\}, \delta, p, B, s)$ where δ is defined as

	0	1	B
p	(p, 0, R)	(p, 1, R)	(q, B, R)
q	(q, 0, R)	(r, 1, R)	-
r	(s, 0, L)	---	---
s	---	---	---



----- Best Wishes -----



A Ⓛ B

AB 300

$$x \rightarrow D$$

$$y \rightarrow Y$$

$x \# y$
 $1101 \# 1010 \#$
• -01 |

106120099

**NATIONAL INSTITUTE OF TECHNOLOGY,
TIRUCHIRAPPALLI
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
CYCLE TEST-1**

Subject Code/ Name: CSPC43/ Operating Systems
Date:
23/ 04/ 2018

Marks: 50

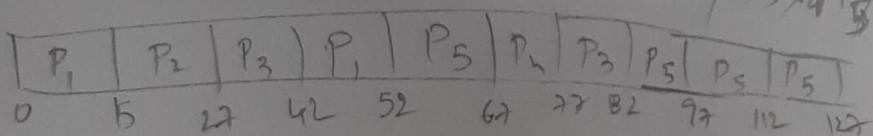
Time: 2:30 pm – 3:30 pm

Answer all the Questions

1. What is dual-mode operation? Why is it needed? (2)
2. List out the characteristics of mobile operating systems. (3)
3. For the following set of processes, find the average waiting time, and turnaround time while applying the RR algorithm. Assume that the quantum time is 15 ms. Draw charts and show the calculations. (5)

Process Number	Burst (ms)	Arrival (ms)
P1	25	0
P2	12	10
P3	20	15
P4	10	25
P5	60	20

4. Design a program using ordinary pipes in which one process sends a string message to a second process, and the second process reverses the case of each character in the message and sends it back to the first process. For example, if the first process sends the message ‘Hi There’, the second process will return ‘hI tHERE’ (3)
5. Consider two processes, P1 and P2, where $p1 = 50$, $t1 = 25$, $p2 = 75$, and $t2 = 30$. Can these two processes be scheduled using rate-monotonic Scheduling? Illustrate your answer neatly using a Gantt chart. (4)
6. What is Coarse grained multithreading? (1)
7. Discuss briefly about the Linux’s process scheduler. (2)



NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
END SEMESTER EXAMINATION- APRIL/MAY 2022

Subject Code/ Name: CSPC43/ Operating Systems
Marks: 50

Date: 27/ 04/ 2022
Time: 10:00 am – 12:30 pm

Answer all the questions

1.

- a. List out the various definitions of the operating system. (2)
- b. Distinguish between symmetric and asymmetric multiprocessing. (3)
- c. Explain the dual-mode operation in Operating systems. (2)
- d. Design a program using ordinary pipes in which one process sends a string message to a second process, and the second process reverses the case of each character in the message and sends it back to the first process. For example, if the first process sends the message ‘Hi There’, the second process will return ‘hI tHERE’. (3)

2.

- a. For the following set of processes, with the help of Gantt charts calculate the average turnaround and waiting time, using the Preemptive priority scheduling algorithm. The lowest number indicates the highest priority. (4)

Process	Arrival	Burst	Priority
P1	0	4	1
P2	1	5	3
P3	3	2	0
P4	9	1	1
P5	12	5	2

- b. Discuss about thread cancellation. (3)
- c. Define Amdahl’s law. Give an example. (3)

3.

- a. What is a Race condition? Give a simple example. (2)
- b. Describe in detail how the readers-writer’s problem can be solved using semaphores. (4)

c. Consider the following snapshot of the system.

Process	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	0	0	1	2	0	0	1	2	2	1	0	0
P1	2	0	0	0	2	7	5	0				
P2	0	0	3	4	6	6	5	6				
P3	2	3	5	4	4	3	5	6				
P4	0	3	3	2	0	6	5	2				

$$\begin{array}{r}
 475 \\
 49(8)9 \\
 128 \\
 146 \\
 504 \\
 8834 \\
 356 \\
 188 \\
 608 \\
 311 \\
 93 \\
 151 \\
 \hline
 9917
 \end{array}$$

- i) Is the system in the safe state?
 ii) If a request from p3 arrives for (0,1,0,0) can that request be safely granted immediately?
 Which process, if any, are or may be deadlocked if this whole request is granted immediately?

4.

 - Explain the difference between internal fragmentation and external fragmentation. Which one occurs in paging systems? Which one occurs in systems using pure segmentation? (3)
 - A computer provides each process with 65,536 bytes of address space divided into pages of 4096 bytes. A particular program has a text size of 32,768 bytes, a data size of 16,386 bytes, and a stack size of 15,870 bytes. Will this program fit in the address space? If the page size were 512 bytes, would it fit? Remember that a page may not contain parts of two different segments. (4)
 - Discuss about dynamic linking. (3)

5. a. For the following sequence of memory references, show how the Second Chance Page replacement works. Assume that there are four frames in the main memory and that all of them are empty initially. Also, list the number of page faults. (4)

- b. Suppose that a disk drive has 5,000 cylinders, numbered 0 to 4,999. The drive is currently serving a request at cylinder 2,150, and the previous request was at cylinder 1,805. The queue of pending requests, in FIFO order, is:

2,069, 1,212, 2,296, 2,800, 544, 1,618, 356, 1,523, 4,965, 3681,

- Starting from the current head position, show and calculate the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for the C-SCAN disk-scheduling algorithms? (4)

c. What is Constant Linear Velocity and Constant Angular Velocity? (2)

c. What is Constant Linea

$$\begin{array}{r} \cancel{3} \\ \times 4 \\ \hline \cancel{5} \times 6 \\ 2 \cancel{4} 9 \cancel{6} \\ \hline \cancel{4} \end{array}$$

$$= \frac{1}{2}$$

$$\begin{array}{r} 4965 \\ 3681 \hline 1284 \end{array}$$

Anguilla 7
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1000
352
1688

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1212
5448
6688
2296
21

~~2 600
2 46
504~~

RV
2069
16/8
45+

16/18
15/23
95

600
46



Class Test on

Design and Analysis of Algorithms

Marks: 25

Subject Code-CSPC42

Time: 1hr

Instruction: Answer all questions.

1. Find the relation between the number of algorithms and number of problems. [3]
2. a. Describe RAM model.
b. What is the prerequisite of Binary Search algorithm?
c. Implement this algorithm on RAM model.
d. For this algorithm find the actual time and space complexity. [3+1+5+2]
3. Let $f(n)$ and $g(n)$ be two non-negative functions.
Prove that $\max(f(n), g(n)) = \Theta(f(n)+g(n))$ [4]
4. Prove that $f(n) = \Theta(n)$ if and only if $f(n) = O(n)$ and $f(n) = \Omega(n)$. [3]
5. Solve the following recurrence relation:

$$T(n) = T(n/10) + T(9n/10) + cn \quad \text{when } n > 1 \\ = c \quad \text{otherwise}$$

$$T\left(\frac{n}{10}\right) = T\left(\frac{n}{10^2}\right) + T\left(\frac{9n}{10^2}\right) + cn$$

$$T\left(\frac{9n}{10}\right) = T\left(\frac{9n}{10^2}\right) + T\left(\left(\frac{9}{10}\right)^2 n\right) + cn\left(\frac{9n}{10}\right)$$

$T(n)$

$\boxed{K} \boxed{n} \boxed{\dots} \boxed{1}$

$$T\left(\frac{n}{10}\right) + T\left(\frac{9n}{10}\right) - cn$$

$$T\left(\frac{n}{10^2}\right) + T\left(\frac{9n}{10^2}\right) + T\left(\left(\frac{9}{10}\right)^2 n\right) - c\left(\frac{n}{10} + \frac{9n}{10}\right)$$

$$- cn\left(\frac{1}{10^2} + \frac{9}{10^2} + \frac{9^2}{10^3} + \frac{9^2}{10^2}\right) = cn\left(\frac{(1+9)^2}{10^2}\right)$$

\boxed{K}

$\boxed{-1}$

$\log_{10} \boxed{-1}$



106120079

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Department Of Computer Science And Engineering

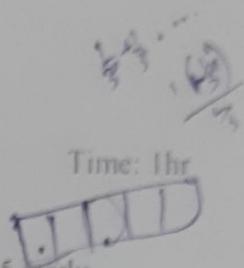
Second Class Test

Design and Analysis of Algorithms

Marks: 25

Course Code: CSPC42

Time: 1hr



Instructions to the Students: Answer all questions. Each question is of 5 marks.

1. Take a hypothetical situation where the data are unsorted and probability of searching the i^{th} record is $p_i = 1/3^i$ ($1 \leq i \leq n-1$). Write an algorithm to search the record corresponding to a given key. Find the expected time complexity of that algorithm for this given data.
2. Given an array of elements, suppose your sorting technique finds the proper location of an element in a sorted subarray and inserts it into that location. For this, the algorithm compares that element with every element of the sorted sub-array starting with the first element of the sub-array. Now, if the given array of elements is in ascending order, find the time complexity to sort the array in that order.

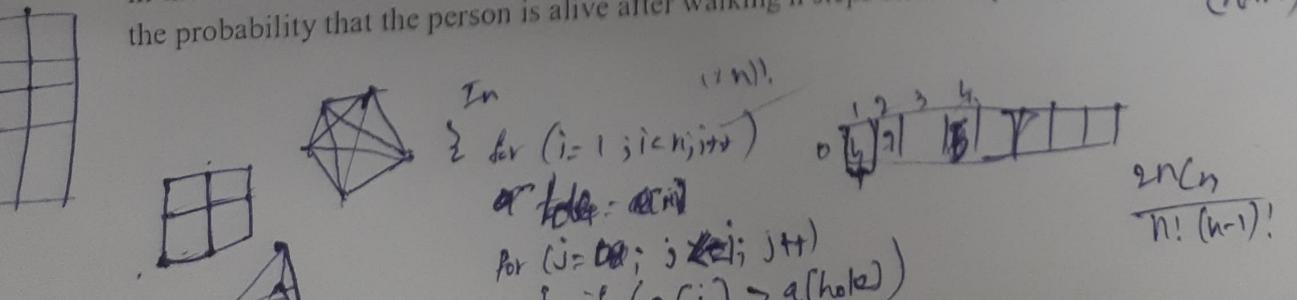
or

You are given a collection of records in descending order. Write a comparison-based sorting algorithm that provides the best solution for sorting. Give reasons in support of your argument. Find the time complexity to sort the array.

- (-/-) 3. Write an algorithm to find the strongly connected component of a connected graph.

4. Consider a hash table with 9 slots. The hash function is $h(k) = k \pmod 9$. The collisions are resolved by chaining. Show the insertion of the following keys in order 5, 28, 19, 15, 20, 33, 12, 17, 10. Also find the maximum, minimum and average chain lengths in the hash table.

5. A man lands in an unknown island to search for treasures. He reaches a door and opens it only to find himself landing inside a square matrix grid. He has to find the entrance which might be in any side of the matrix. If he can find and walk through it, he can go to the next room. The person can take moves one step at a time in any direction (right, left, top, down) in the matrix. However, he dies if somehow, he steps outside the matrix. Now, calculate the probability that the person is alive after walking n steps on this square grid. $\rightarrow (n \times n)$





NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI
Department Of Computer Science And Engineering

END SEMESTER EXAMINATION

Design and Analysis of Algorithms

106120079

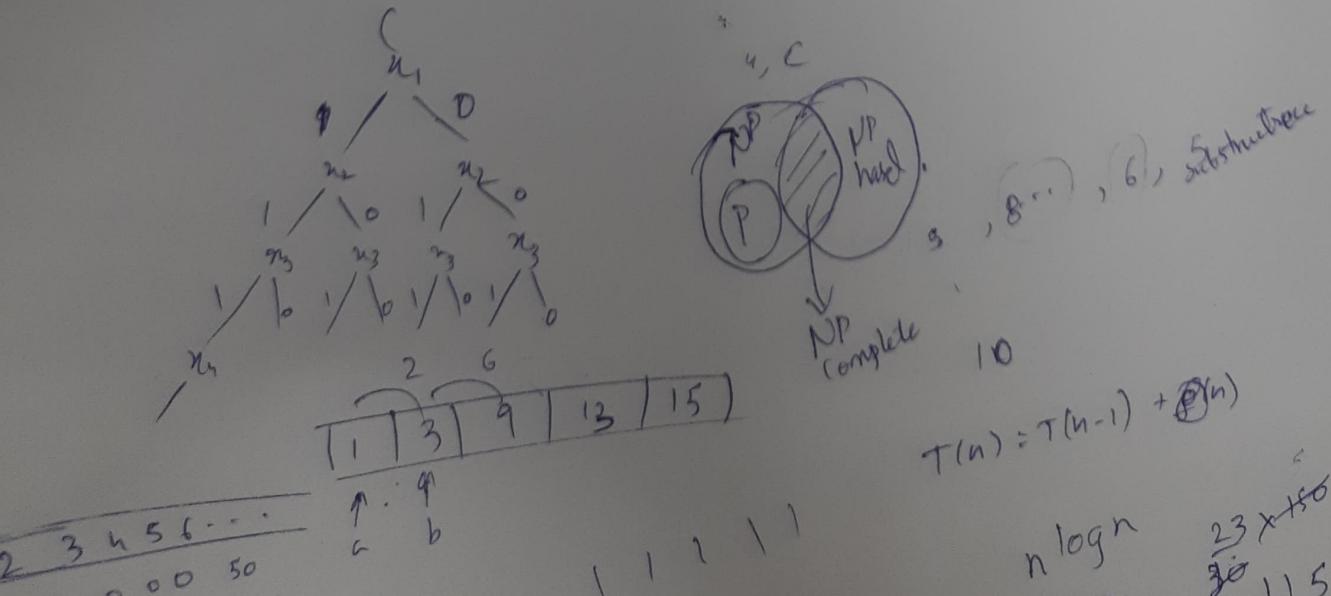
Marks: 30

Course Code: CSPC42

Time: 2hrs

Instructions to the Students: Answer all questions.

1. a. Find the theoretical lower bound of general-purpose comparison-based sorting techniques.
b. Can we get any better solution than this? Justify your answer.
c. Why upper bound of a problem is not relevant? [4+2+1]
2. a. Define P, NP, NP Complete and NP Hard problems.
b. Why NP Complete problems are considered to be the most difficult computational problems to solve? [4+1]
3. a. Suppose we have an $O(n)$ time algorithm that finds median of an unsorted array. Now consider a QuickSort implementation where we first find median using the above algorithm, then use median as pivot. What will be the worst-case time complexity of this modified QuickSort? Show the recurrence relation and derive it.
b. Suppose, you are given a problem which can be solved using both dynamic programming and greedy algorithm. Then, which approach will you choose and why? [4+2]
4. Consider a sorted array of n numbers. Write an algorithm that takes a positive integer k as input and finds a pair a and b such that $|a-b|=k$ in $O(n)$ time. Show why its time complexity will be $O(n)$. [3+2]
5. a. Consider a set of 4 items of weight 10, 12, 15, 30 (kgs) with values 50, 100, 90, 150 respectively. Using 0-1 knapsack problem, find how these items can be put in a knapsack of capacity 50 such that the total value of the knapsack is maximum.
b. Compare with the solution if fractional knapsack is considered. [4+3]



CYCLE TEST I
COURSE CODE: HS1R13
COURSE TITLE: INDUSTRIAL ECONOMICS AND FOREIGN TRADE
DEPARTMENT: COMPUTER SCIENCE AND ENGINEERING
SECTION A

Date: 04/03/2022

Duration: 10.00 to 11.00. A.M

Max. Marks: 20

PART A
ANSWER ALL QUESTIONS
 $(5 \times 2 = 10)$

1. Define the term Marginal Rate of Technical Substitution.
2. Explain the concept of Law of Diminishing marginal utility with an example.
3. Differentiate between change in demand and shift in demand.
4. Consider the market for apple juice. In this market, the supply curve is given by $QS = 10PJ - 5PA$ and the demand curve is given by $QD = 100 - 15PJ + 10PT$, where J denotes apple juice, A denotes apples, and T denotes tea.
 - a) Assume that PA is fixed at \$1 and $PT = 5$. Calculate the equilibrium price and quantity in the apple juice market.
 - b) Suppose that a poor harvest season raises the price of apples to $PA = 2$. Find the new equilibrium price and quantity of apple juice. Draw a graph to illustrate your answer

(2 marks)

(2 marks)

PART B

*(1 variable input (2*5=10) 1 variable output)*

5. Explain the Law of Variable proportions and its implications on the short run production function.
6. Explain the concept of price elasticity its types. (3 marks)

Use the information give in table below to answer the following questions.

Commodity	Short run	Long run
Tobacco products	-0.46	-1.89
Jewellery and Watches	-0.41	-0.67
Beer	-1.72	-2.17
Wine	-0.88	-1.17
Household natural gas(U.S)	-1.40	-2.10
Electricity(household-U.S)	-0.13	-1.89
Gasoline (Canada)	-0.15	-0.58

- 150-151/162
93-108
- a) Is the demand for electricity elastic or inelastic in the short run? In the long run? (1 mark)
 - b) How much would the quantity demanded of electricity change as a result of a 10% increase in its price in the short run? In the long run? (1 mark)

CYCLE TEST II
COURSE CODE: HS1R13

COURSE TITLE: INDUSTRIAL ECONOMICS AND FOREIGN TRADE
DEPARTMENT: COMPUTER SCIENCE AND ENGINEERING

Date: 05/04/2022

Max. Marks: 20

Duration: 2.30 to 3.30 P.M

PART A
ANSWER ALL QUESTIONS
 $(5*2= 10)$

1. Define the term deadweight loss under monopoly market structure.
2. Explain the relationship between Average costs and marginal costs.
3. A profit maximizing monopoly firm with a demand curve $P=50-Q$ is perfect price discriminator. Determine the level of output and profit, If it has marginal costs of Rs.10/unit and fixed costs of Rs.30.
4. Given the following payoff matrix, determine
 - whether Firm A has a dominant strategy
 - whether Firm B has a dominant strategy

		Firm B	
		Low Price	High Price
Firm A	Low Price	2,2	1,5
	High Price	1,5	3,3

5. Differentiate between the terms shut down and exit.

PART B
 $(2*5=10)$

6. Define monopolistic competition. Derive the long run equilibrium under monopolistic competition market structure.
7. a. Explain the features and short run equilibrium under perfect competition market structure. (3 marks)
 - A perfectly competitive firm faces $P=\text{Rs. } 4$ and $TC = Q^3 - 7Q^2 + 12Q + 5$. Find the best level of output of the firm. Also find the profit of the firm at this level of output. (2 marks)

$$Q^3 - 7Q^2 + 12Q + 5 = 0$$

10612007

COURSE TITLE: INDUSTRIAL ECONOMICS AND FOREIGN TRADE
COURSE CODE: HSIR13
BRANCH: COMPUTER SCIENCE AND ENGINEERING
END SEMESTER EXAMINATION

DATE: 25/04/2022

MAX. MARKS: 30

TIME: 10.00 A.M. to 12.00 P.M.

PART A
(5*2=10)
Answer all questions

1. Differentiate between Isocost and budget line.
2. For which of the following goods is a price increase likely to lead to a substantial income (as well as substitution) effect?
 - a. salt
 - b. housing
 - c. theatre tickets
 - d. food
3. Define Hecksher - Ohlin theorem.
4. A hypothetical firm data is given as under;
 - i) $P = 10 - 0.3Q$
 - ii) $TC = 6 + 4Q + 0.7Q^2$

Calculate profit maximising output and price.
5. Define the term consumer surplus.

PART B
(4*5=20)
Answer any four

6. Explain the qualitative methods of demand forecasting.
7. Describe the price leadership as an example of collusive model under oligopoly market.
8. Explain the derivation of consumer equilibrium using Indifference curves and budget line.
9. Discuss the comparative advantage theory of international trade.
10. Explain the derivation of equilibrium under monopoly. Assume a monopolist has $MC = 20$ and no fixed costs. The monopolist faces a demand curve of $P = 100 - 4Q$. Calculate the deadweight loss.

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI-15
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
II YEAR B.TECH , CYCLE TEST 1
CSPE43 ADVANCED DATA STRUCTURES AND ALGORITHMS

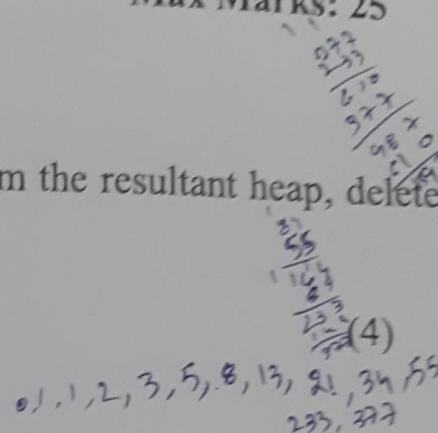
DATE: 09-03-2022

Duration: 1 Hr 30 Mins

Max Marks: 25

1. Insert the following elements into the max-min heap. From the resultant heap, delete the elements one by one in the order: 100, 70 and 40.

1,4,-5,6,7,9,3,40,20,70 100



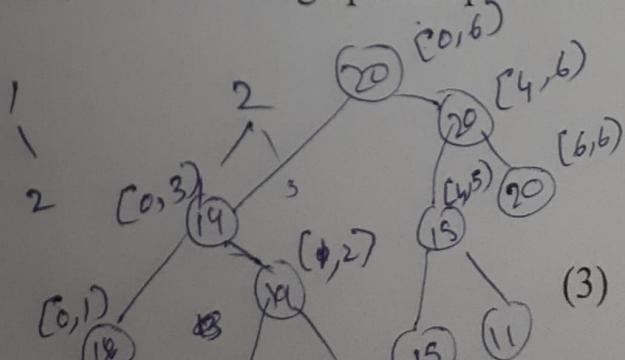
2. Insert the first 15 Fibonacci numbers starting from 2 into the Fibonacci heap and apply Extract min key operation for 5 times. After that, insert the next 5 Fibonacci numbers in the resultant heap and again apply Extract-min key operation for one more time. (4)
3. Insert the numbers from 1 to 10 into the splay tree. From the resultant tree, search for the following elements in order: 5,11,7,1. (4)

4. Insert the following elements B+ Tree of order 3

1,4,7,10,17,21,31,25,42,20,43,48 and from the resultant tree, delete the following elements in order: 10,21,31,20. (4)

5. Segment Tree (ST) with lazy propagation is constructed to address max query for the given array A[0,6] = {18,17,13,19,15,11,20}. Apply the following update operations for incrementing the corresponding values :

- (i) Range update (0 3) by 3
- (ii) Range update (0,3) by 1
- (iii) Range update (0 0) by 2

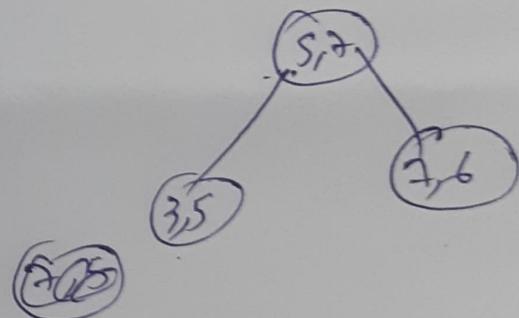
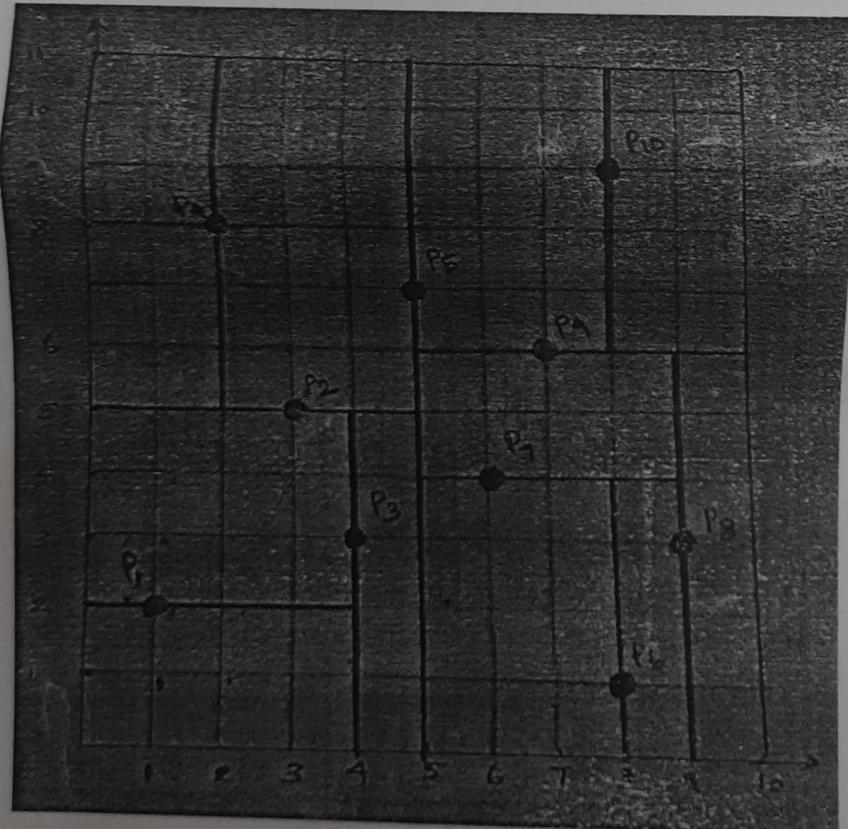


6. A B-tree of order 4 is built from scratch by 10 successive insertions. What is the maximum number of node splitting operations that may take place? (2)

7. To address the sum query, the prefix sum array is given below for an array A of size 4 X 5. Predict the original array. (Row and Column indices are started from 0). (2)

$$\begin{pmatrix} 1 & 3 & 10 & 19 & 26 \\ 5 & 12 & 27 & 39 & 51 \\ 8 & 17 & 43 & 59 & 77 \\ 14 & 23 & 56 & 84 & 107 \end{pmatrix}$$

8. Predict the exact ordering of the data points from the following graph. For these data points, draw the unbalanced 2D tree and balanced 2D tree. (2)



NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI-15
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
II YEAR B.TECH , CYCLE TEST 2
CSPE43 ADVANCED DATA STRUCTURES AND ALGORITHMS

DATE: 07-04-2022

Duration: 1 Hr 30 Mins
Circle OR tick the correct choice

Max Marks: 25

23

Roll No:

1	0	6	1	2	0	0	7	9
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1. For the given data, an optimal BST is constructed. What are the keys in level 1? (Root node is in level 0).

(4)

Key	10	20	30	40
P	0.1875	0.1875	0.0625	0.0625
Q	0.125	0.1875	0.0625	0.0625

- (a) 10, 30 (b) 20,40 (c) 30, Null (d) Null, 30

2. Using Rabin-Karp Algorithm, the pattern P (CDDC) is matched with the text string S (ABCDCCDDCCDCDDCABEFG). The hash function is $(3*d^3 + 4*d^2 + 4*d^1 + 3*d^0) \%q$, where d is 10 and q is 13. Consider the corresponding rolling hash function for calculating hash values for substrings in S. How many spurious hits are occurred in the entire matching process? **(4)**

- (a) 1 (b) 2 (c) 3 (d) 0

3. Consider the weights and values of items listed below. Note that there is only one unit of each item.

Item number	Weight (in Kgs)	Value (in Rupees)
1	10	60
2	7	28
3	4	20
4	2	24

The task is to pick a subset of these items such that their total weight is no more than 11 Kgs and their total value is maximized. Moreover, no item may be split. The total value of items picked by an optimal algorithm is denoted by V_{opt} . A greedy algorithm sorts the items by their value-to-weight ratios in descending order and

packs them greedily, starting from the first item in the ordered list. The total value of items picked by the greedy algorithm is denoted by V_{greedy} . What is the value of $V_{\text{opt}} - V_{\text{greedy}}$? (3)

- (a) 16 (b) 8 (c) 44 (d) 60

4. What is the optimal parenthesization of matrix chain product using dynamic programming for the given matrices A1 (5X10), A2 (10X3), A3 (3X12), A4 (12X5), A5 (5X50) and A6 (50X6)? (4)

- (a) $((A_1 \times A_2)((A_3 \times A_4)(A_5 \times A_6)))$ (c) $((A_1 \times A_2)(A_3 \times A_4)) \times (A_5 \times A_6)$
(b) $((A_1 \times (A_2 \times A_3))(A_4 \times A_5)) \times A_6$ (d) $((A_1 \times A_2)(A_3 \times (A_4 \times A_5))) \times A_6$

5. The text string (ABAAA~~ABA~~AAABBA~~AAA~~ABA) and the pattern (AAAB) are given. Assume that the preprocessing step is done. Using KMP algorithm, the pattern is matched with the text string. How many times both the variables i and j are moved ahead by one character? (4)

- (a) 14 (b) 16 (c) 17 (d) 15

6. The test string (trusttoothbrushes) and pattern(tooth) are given for pattern matching using Boyer Moore algorithm. How many times the pattern is shifted by 2 characters while doing the matching process? (2)

- (a) 3 (b) 1 (c) 2 (d) 0

7. Total number of possible Binary Search Trees with 5 different keys are ----- (2)

- (a) 14 (b) 42 (c) 82 (d) 132

8. Consider four matrices A, B, C and D with dimension 2X3, 3X4, 4X3 and 3X2 respectively. The number of scalar multiplication required for the 2nd optimal parenthesization ordering is ----- (2)

- (a) 60 (b) 66 (c) 64 (d) 62

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI-15
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
II YEAR B.TECH , SEMESTER EXAMINATION
CSPE43 ADVANCED DATA STRUCTURES AND ALGORITHMS

DATE: 29-04-2022

Duration: 2 Hrs

Max Marks: 30

16 4 2 1
(0 1 1 1)

1. (a) Create two binomial heaps H and H1 with the following elements (Heap H: B, L, N, O, M, I, A, L, H, E, A, P) and (Heap H1: E, X, A, M, I, N, A, T, I, O, N). After constructing these two heaps, do the merging of these heaps. (3)
1. (b) Construct a Min HBLT with the following elements: L, E, F, T, I, S, T, H, E, A and P. From the resultant tree, remove the smallest element. (3)
2. (a) Differentiate B-tree from B+ tree with suitable examples. (2)
2. (b) What is the maximum number of keys that a B+ tree of order 3 and of height 3 have? (2)
3. (a) Give the memory representation of the segment tree for input array {1, 3, 5, 7, 9, 11}. (2)
(b) With the suitable example, illustrate the procedure for finding the minimum element in the third dimension of KD tree. (3)
4. (a) Derive the recurrence relation for the matrix chain multiplication problem. (3)

(2) 3.



(b) Assume 4 elements (a₁, a₂, a₃, a₄) and their values as (do, if, int, while). Let p (1.....4) = (3, 3, 1, 1) and q (0.....4) = (2, 3, 1, 1, 1). By constructing an optimal binary search tree, find the cost of the resultant optimal tree. (3)

(c) Using backtracking approach, find the chromatic number of the graph represented by the following adjacency matrix? (3)

0	1	1	0	1	0
1	0	1	1	0	1
1	1	0	1	1	0
0	1	1	0	0	1
1	0	1	0	0	1
0	1	0	1	1	0

5. (a) How does the preprocessing step avoid the unnecessary comparisons while tracing the pattern *ababd* in the string *ababcabcababababd* using KMP algorithm. (3)

(b) How many comparisons are made while tracing the pattern *abcdef* in the string *aababcabcdabcdeabcdef* using Robin Karp algorithm? (3)

