

# In this PDF

Batch	Subject	Exam
2022	Theory of Computation (TOC)	Mid Semester, End Semester
	Compiler Design	Mid Semester, End Semester
	Object-Oriented Analysis and Design	Mid Semester, End Semester
	Differential Equations and Transforms	Mid Semester, End Semester
	Data Structures III	Mid Semester, End Semester
	Computer Networks	Mid Semester, End Semester
	Principles of Management	End Semester
	Fundamentals of Economics	End Semester
	Computer Networks	Mid Semester 1, Mid Semester 2, End Semester
2021	Theory of Computation (TOC)	Same as above
	Data Structures III	Same as above
	Differential Equations and Transforms	Same as above
	Compiler Design	Same as above
	Fundamentals of Economics	End Semester
	Risk Management in Cyber Security	End Semester
	Secure Software Engineering	Mid Semester 1, Mid Semester 2, End Semester

Name: Ashinaw Bhagwat

Roll No: 2020BCS0019



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computer Science and Engineering

**MID SEMESTER EXAMINATION- FEBRUARY, 2024**

**ICS 221 Theory of Computation**

Date & Time: 19-02-2024, 9:30 AM - 11:00 AM

Course Instructors: Chakradhar P., Nandini J. W, Sreeja M.U

Max marks: 50

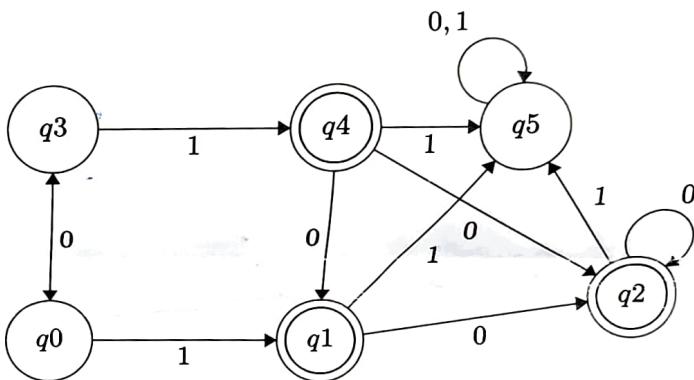
Semester: IV

Batch: 1, 2 & 3

**Answer all Questions.**

**Part A (Each Question carry 4 marks, 5\*4=20 marks)**

- ✓ 1. Design a DFA which accepts all strings over  $\{0, 1\}$  with odd number of 0's and number of 1's divisible by 3.
- ✓ 2. Minimize the FA shown below.

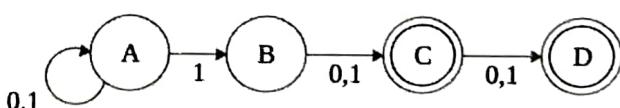


- ✓ 3. Check whether the following languages are regular or not. Justify your answer.

- a.  $\{ww^R : w \in \{a, b\}^*\}$  (2 marks)
- b.  $\{a^n! | n \geq 0\}$  (2 marks)

- ✓ 4. Develop a minimized deterministic finite state automata equivalent for the Regular Expression  $(ab^*c) + (a + bc^*)$

- ✓ 5. Write the regular expression for the following DFA:



**Part B (Each Question carry 10 marks, 3 \* 10 = 30 marks)**

- ✓ 6. Consider a DFA  $M$  with the set of states  $Q$ , alphabet  $\Sigma = \{0, 1\}$ , transition function  $\delta$ , and accepting state  $F$ . Draw the state diagram and transitions for the DFA  $M$  that accepts the language:  $L = \{0^n 1^m | (m + n) \text{ is even}\}$

7. Define  $\epsilon$  - closure of a state? Explain with example. Design an NFA (without  $\epsilon$  - moves) for strings having substring  $bab$ . Convert it into equivalent DFA.  $\Sigma = \{a, b\}$ .
8. a. Construct Moore Machine for the set of all strings of 0's and 1's whose last two symbols are the same. (5 marks)
- b. Construct a mealy machine that uses its state to remember the last symbol read and emits output  $x$  whenever current input matches to previous one and emits  $m$  otherwise. (5 marks)

\*\*\* Best wishes \*\*\*

Roll No: 2022 BCS 0019

Name: Abhinav



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computer Science & Engineering

FIRST MID SEMESTER EXAMINATION- FEBRUARY, 2024

IV Sem ICS 223 Compiler Design

Date: 20.02.2024

Max. Marks: 50

Time: 02:30 - 04:00 PM

Course Instructor: Dr. Koppala Guravaiah /Dr. Selvi C/Dr. Priyadharshini S

Answer all Questions( 5 X 10 = 50M)

1. Answer the following

- (a) How many lexemes, and tokens are present in the following C code? 4M  
int x=360, y=50;  
printf("Hello IIIT Kottayam II Year %d Students\n This exam is for %d marks",&x,y);  
(b) Why is lexical analysis required as a separate phase in compiler design? 3M  
(c) What is a lexical error? Justify your answer with an example. 3M

2. Consider the following code that is fed to Lexical Analyzer:

```
#include <stdio.h>
int Minimum(int x, int y) {
    // This will compare 2 numbers
    if (x < y)
        return x;
    else {
        return y;
    }
}
```

- (a) Describe the tokens created for the above program.  
(b) Describe the non-tokens present in the above program. 5M 5M

3. Answer the following

- (a) Given a parse tree, how do we obtain the string? What do you mean by the derivation of a string? What techniques are there to represent derivation of a string?  
(b) What is the dangling else problem? What Techniques are needed to solve the issue? Explain with examples. 5M 5M

4. Design the predictive parser for the following grammar. Then identify any problem you are getting from the LL(1) parsing? If yes, what are the problems and why are those problems there?

S → AS | b  
A → SA | a 10M

5. Construct the LR parsing table for the grammar below and show that G is suitable for LR(0) parser and parse the string int id,id,id; Where int, float, id are lexemes  
S → TL;  
T → int | float  
L → L, id | id 10M



Roll No: 2022BCS0019

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**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM**  
**Department of Computer Science And Engineering**

**MID SEMESTER EXAMINATION- FEBRUARY, 2024**

**COURSE TITLE: ICS222 OBJECT ORIENTED DESIGN AND ANALYSIS**

**Time: 2:30 PM to 4:00 PM**

**Max. Marks: 50**

**Course Instructors:** Dr. Sujamol S, Dr. Debarati Ganguly,  
Dr. Vineeth Palliyembil

**Batch:2022CSE**

**Common for Batches 1,2 and 3**

**Answer all Questions**

**PART- A [4 x 5 = 20 marks]**

- ✓ 1. What is object-oriented design (OOD), and how does it differ from other approaches to software design?
- ✓ 2. Hofmeister et al. (2000) propose that a software architecture can serve firstly as a design plan for the negotiation of system requirements, and secondly as a means of structuring discussions with clients, developers, and managers. They also suggest that it is an essential tool for complexity management. It hides details and allows the designers to focus on the key system requirements. Justify this statement using two important object oriented principles that may help to reduce complexity of software development.
- ✓ 3. For a healthcare system, propose a set of use cases that illustrate the interactions between a doctor, who sees patients and prescribes medicines and treatments
- ✓ 4. Prepare a class diagram for the dining philosopher problem. There are 5 philosophers and 5 forks around a circular table. Each philosopher has access to 2 forks, one on either side. Each fork is shared by 2 philosophers. Each fork may be either on the table or in use by one philosopher. A philosopher must have 2 forks to eat.
- ✓ 5. Assume that a recent large software system was behind schedule, over budget, or failed to perform as expected. What factors were blamed? How could the failure have been avoided?

**PART- B [10 x 3 = 30 marks]**

- ✓ 6. (a) Briefly explain the conceptual model of the UML.  
(b) What are the different phases of software development life cycle?
- ✓ 7. Assume that a bank, ABC has many branches. In each zone, one branch is designated as the zonal head office that supervises the other branches in that zone. Each branch can have multiple accounts and loans. An account may be either a savings account or a current account. A customer may open both a savings account and a current account. However, a customer must not have more than one savings account or current account. A customer may also procure loans from the bank. Find out the classes, inherited classes and relationships in this system and draw the class diagram for this scenario.

8. a) Prepare a class diagram from the object diagram in Figure 1. Explain your multiplicity decisions. Each point has an x coordinate and a y coordinate. What is the smallest number of points required to construct a polygon? Does it make a difference whether or not a point may be shared between polygons? Your answer should address the fact that points are ordered.

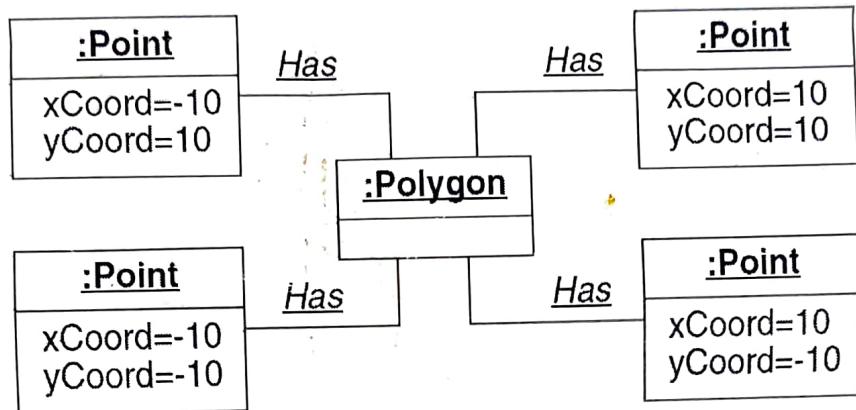


Fig 1: Object diagram for a polygon

- b) Using your class diagram for 8a, prepare an object diagram for two triangles with a common side under the following conditions.
- i. A point belongs to exactly one polygon.
  - ii. A point belongs to one or more polygons.

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Name:

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INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computational Science and Humanities

## MID SEMESTER EXAMINATION- FEBRUARY, 2024

## IMA 221 DIFFERENTIAL EQUATIONS AND TRANSFORMS

Date &amp; Time: 20-02-2024, 09:30 AM - 11:00 AM

Course Instructor: Dr. Murugan D/ Dr. Riyasudheen TK/ Dr. Suriyapriya K Max mark: 50 Batch: I, II, III

Answer all Questions

~~Q1.~~ Find the Fourier series of the periodic function

$$f(x) = \begin{cases} -k & \text{for } x \in (-\pi, 0) \\ k & \text{for } x \in (0, \pi) \end{cases}$$

where  $k$  is any non-zero constant and  $f(x + 2\pi) = f(x)$ . Hence evaluate  $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{2n-1}$ . [8]

~~Q2.~~ Find the Fourier half range sine series and half range cosine series of  $f(x) = x(\pi-x)$  in  $0 \leq x \leq \pi$ . Hence evaluate  $\sum_{n=1}^{\infty} \frac{1}{n^2}$ .

~~Q3.~~ Find the Fourier transform of the function [10]

$$f(x) = \begin{cases} 1 - |x| & \text{for } |x| < 1 \\ 0 & \text{for } |x| > 1 \end{cases}$$

and using Parseval's identity, find the value of  $\int_0^{\infty} \frac{\sin^4 t}{t^4} dt$ . [8]

~~Q4.~~ Find the Fourier cosine and sine transforms of  $f(x) = e^{-5x}$ . Hence evaluate  $\int_0^{\infty} \frac{\cos \lambda x}{5^2 + \lambda^2} d\lambda$ . [8]

~~Q5.~~ Obtain  $Z^{-1} \left( \frac{4z^2 - 2z}{z^3 - 5z^2 + 8z - 4} \right)$ . [6]

~~Q6.~~ (a) Find the Z-transform of the discrete signal,  $x[n] = \frac{n^2}{3^n}$ .  
 (b) Using Z-transforms, solve the difference equation

$$y_{n+2} - 2y_{n+1} + y_n = 2^n,$$

with  $y_0 = 2, y_1 = 1$ .

[4+6]

Name: 2022 BCS 0019

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INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computer Science and Engineering

MID SEMESTER EXAMINATION- FEBRUARY, 2024

ICS 225 Data Structures III

Date & Time: 19-02-2024, 2:30 PM - 4:00 PM

Course Instructors: Nandini J W, Lakshmi N. S, M. Gopal

Max mark: 50

Semester: IV

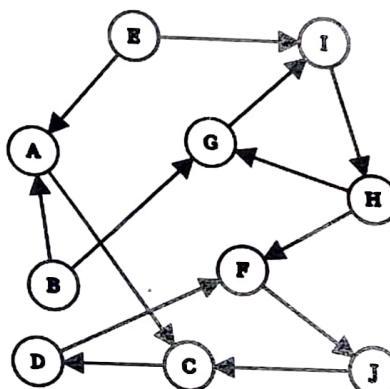
Batch: 1, 2 & 3

Answer all Questions.

(Calculators are allowed but sharing of calculators during the exam is not permitted.)

Part A (Each Question carry 6 marks,  $4*6=24$  marks)

1. Run Tarjan's algorithm to identify the strongly connected components on the following directed graph  
G. Whenever there is a choice of vertices to explore, always pick the one that is alphabetically first.



Now, answer the following questions.

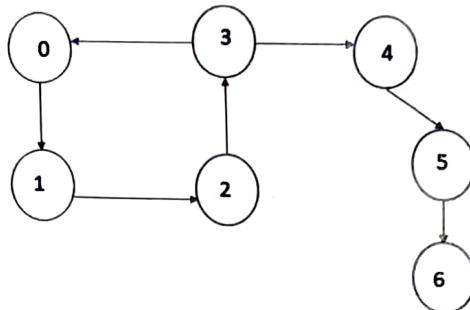
- a) In what order are the strongly connected components found? (4marks)  
b) How many strongly connected components were identified? (2 marks)

2. A person is going for check-in at the airport. The luggage bag capacity allowed is 7 kg. He is having valuables of weight 2kg, 3kg and 4kg worth \$20, \$33 and \$50 respectively. He has to carry maximum worth while ensuring that the luggage capacity does not exceed the limit. Guide him to find a solution in which he can fill the bag by either taking each valuable or not taking it. He is not allowed to take partial quantity of a valuable.
3. Give an algorithm to convert a binary tree to double threaded binary threaded tree with appropriate node representation. Incorporate inorder traversal to print the order of traversal in double threaded binary tree.
4. Imagine you are developing a file management system where directories and files are organized in a hierarchical structure. The file system is represented using a binary tree say  $B$ , where each node represents a directory, and leaf nodes represent files. Now, you need to implement a feature to check whether a given subtree is present in the main file system tree.

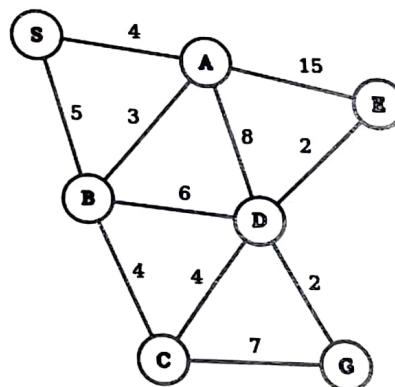
Specifically, your task is to write an algorithm that determines whether an input binary tree say  $B'$  is a sub-tree of the main file system tree  $B$ . The running time of the algorithm should be linear to number of nodes in the file system directory structure.

Part B (Each Question carry 13 marks,  $3*13=26$  marks)

5. Benny appeared in a Magic labyrinth. Labyrinth consists of rooms and doors. Doors are unidirectional, they can be used only in one direction. When passing through the door, the master of the labyrinth gives Benny a coin. Benny can move through the doors as much as she wants. Suggest an algorithm linear in number of nodes and edges, for Benny to achieve maximum coins. The magic labyrinth can be visualized as below, the nodes represent rooms and edges represent doors:



6. Meena works for a delivery company, and is responsible for optimizing the route for the delivery person. The delivery person needs to deliver packages from Warehouse to a specific customer's location. The goal is to find the shortest path for the delivery person to minimize travel time. Consider the following as the network diagram of the delivery company. Design a branch and bound algorithm to compute the shortest path from source S to destination G, assuming the network of delivery company as given below:



Specify the branching condition, bounding condition and draw the state space tree.



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**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM**  
**Department of Computer Science and Engineering**

**MID SEMESTER EXAMINATION - FEBRUARY, 2024**

**COURSE TITLE: ICS 224 COMPUTER NETWORKS**

**Date & Time: 21/02/2024, 9.30 AM – 11 AM**

**Max. Marks: 50**

**Course Instructor: Dr. Goutam Mali**

**Sem: IV**

**Batch: I**

**Answer all Questions**

**Part A:**

**(6 × 5 = 30)**

- ✓ 1. A channel has a bit rate of 20 Kbps and one way propagation delay of 50 msec. The channel uses stop and wait protocol. The transmission time of the acknowledgement frame is negligible. To get a channel efficiency of at least 20%, what would be the minimum frame size?

**(5)**

- ✓ 2. To send a frame from one host to another, there are protocols such as PPP and HDLC.

- a. Write down the working principle of HDLC protocol.  
b. Point out three important differences between PPP and HDLC.

**(3 + 2 = 5)**

✓ 3.

- a. Describe the working principle of differential Manchester encoding.  
b. Determine the corresponding differential Manchester encoding for the following bit sequence: 1101 1100 0100 0110 1100.

**(2 + 3 = 5)**

✓ 4.

- Prove that the maximum efficiency of the slotted ALOHA is  $1/e$  [Show all the steps in detail].

**(5)**

✓ 5.

- With the CSMA/CD protocol, the adapter waits after a collision. For  $K = 50$ , how long does the adapter wait until returning to Step 2 (i.e., the adapter senses that the channel is idle) for a 10 Mbps broadcast channel?

**(5)**

✓ 6.

- Suppose a router receives an IP packet of 1470 bytes including IP header, and has to fragment the packet and forward the fragments across some networks with an MTU of 316 bytes including IP header. If the size of the IP header is 20 bytes (i.e., there are no options), compute the values of different fields (such as offset, flag, and other important ones) in the IP headers for all of the fragments which traverse all the networks. Draw the fragmented packets with those different fields.

**(5)**

( $2 \times 10 = 20$ )

**Part B:**

- ✓ 7. Suppose we want to transmit the message 1011 0010 0100 1011 and protect it from errors using the CRC-8 polynomial  $x^8 + x^2 + x + 1$ .
- a. Determine the message that should be transmitted.
  - b. Suppose the leftmost bit of the message is inverted due to noise on the transmission link. What is the result of the receiver's CRC calculation? How does the receiver know that an error has occurred?

( $6 + 4 = 10$ )

- ✗ 8. Consider a scenario where a frame is lost. Frames 0, 1, 2, and 3 are sent. However, during transit frame 2 is lost. The sender receives no acknowledgment for frames 2 and 3. The timer finally expires. So, show how Go-Back-N ARQ can resolve this problem so that the receiver receives all the packets successfully at its end. Draw figure(s) and illustrate.

(10)

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Name:

Abhinav Bhagmat



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM  
Department of Computer Science and Engineering

Roll No: 2022BCS0019

END SEMESTER EXAMINATION- APRIL, 2024

ICS 221 Theory of Computation

Date & Time: 29-04-2024, 9:30 AM - 12:30 AM

Max marks: 100  
Semester: IV  
Batch: 1, 2 & 3

Course Instructors: Chakradhar P., Nandini J. W, Sreeja M.U

**Answer all Questions.**

Part A (Each Question carry 10 marks, 10\*7=70 marks)

1. Construct NFA without  $\epsilon$ -transition from the following NFA:  $M = (\{q_0, q_1, q_2\}, \{a, b, c\}, \delta, q_0, \{q_2\})$  and  $\delta(q_0, a) = \{q_0\}, \delta(q_0, b) = \{q_1\}, \delta(q_0, c) = \{q_2\}, \delta(q_1, \epsilon) = \{q_0\}, \delta(q_1, a) = \{q_1\}, \delta(q_1, b) = \{q_2\}, \delta(q_2, \epsilon) = \{q_1\}, \delta(q_2, a) = \{q_2\}, \delta(q_2, c) = \{q_0\}$  ✓
2. Design a Turing Machine for the language checking balanced parenthesis. Example: ((())()) ✓
3. Write the Context free grammar for odd and even palindromes over  $\sigma = \{a, b\}$ . ✓
4. Explain Chomsky Normal Form. Convert the following CFG to CNF.  
 $S \rightarrow ABa$   
 $A \rightarrow aab$   
 $B \rightarrow Ac$  ✓
5. Design a Push down automata(PDA) for  $a^n b^{2n+1}$ . Write the instantaneous description for one accepted string, and rejected string. ✓
6. Construct a Mealy Machine accepting two's complement (two's complement is given by one's complement + 1) of any binary input (last carry bit neglected) read as LSB to MSB. ✓
7. For languages  $A$  and  $B$ , let the perfect shuffle of  $A$  and  $B$  be the language  $\{w | w = a_1b_1\dots a_kb_k, \text{ where } a_1\dots a_k \in A \text{ and } b_1\dots b_k \in B, \text{ each } a_i, b_i \in \Sigma^*\}$ . Show that the class of regular languages is closed under a perfect shuffle. ?

Part B (Each Question carry 15 marks, 15\*2=30 marks)

8. Draw the transition diagram (Finite state automaton) for the following languages:  
a.  $\{a^n\} \cup \{b\}$  where  $n \geq 1$ .  
b.  $01^* + 10^*$ .  
c. The set of strings of 0's and 1's such that there are two 0's separated by a number of positions that is multiple of 4. Note that 0(zero) is an allowable multiple of 4.  
d. The set of strings over alphabet  $\{0, 1, \dots, 9\}$  such that the final digit has not appeared before.  
e. The set of all strings such that the 5th symbol from the left end is 0 over alphabet  $\{0, 1\}$ .  
9. Show that if  $P = NP$ , there exists a polynomial time algorithm that takes as input an undirected graph and finds the maximum clique in the graph. A clique of a graph  $G$  is a complete subgraph  $G_c$ . That is every vertex in  $G_c$  has an edge to every other vertex in  $G_c$ . And the clique of largest possible size in  $G$  is referred to as a maximum clique of  $G$ . *dafug!!?* 9

Roll No: 2022BCS0019

Name: Abhinav Bhagwat



# INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

## Department of Computer Science and Engineering

END SEMESTER EXAMINATION - EVEN 2023-'24  
APRIL 2024

COURSE TITLE: ICS222 OBJECT ORIENTED ANALYSIS AND DESIGN

Date & Time: 24/04/2024 & 9.30 AM to 12.30 PM

Max. Marks: 100

Course Instructors: Dr. Sujamol S, Dr. Debarati Ganguly,

Batch: 2022CSE

Dr. Vineeth Palliyembil

### Answer all Questions

#### PART- A [6 x 5 = 30 marks]

1. Recall a past system that you created. Briefly describe it. What obstacles did you encounter in the design? What software engineering methodology, if any, did you use? What were your reasons for choosing or not choosing a methodology? ✓
2. Write a short note on RUP. ✓
3. Prepare an object diagram for an imaginary round trip you took last weekend to London. Include at least one instance of each class. Fortunately, direct flights on a hypersonic plane were available. A friend went with you but decided to stay a while and is still there. Captain Johnson was your pilot on both flights. You had a different seat each way, but you noticed it was on the same plane because of a distinctive dent in the tail section. Students should indicate unknown values with a "?". ✓
4. What are the functional and non-functional requirements of the information system, and how will they be verified and validated? ✓
5. Compare aggregation and composition with suitable examples for both. ✓
6. Prepare an activity diagram for computing a restaurant bill. There should be a charge for each delivered item. The total amount should be subject to tax and a service charge of 18% for groups of six or more. For smaller groups, there should be a blank entry for a gratuity according to the customer's discretion. Any coupons or gift certificates submitted by the customer should be subtracted. ✓

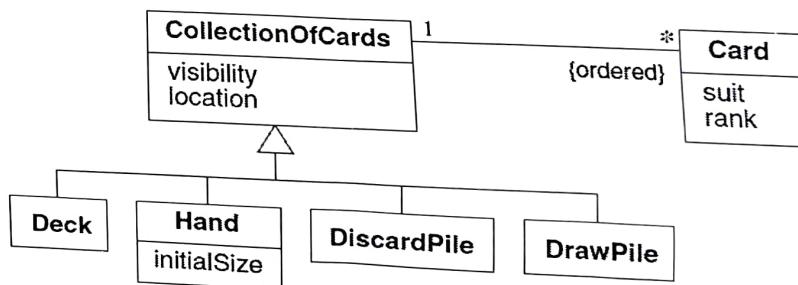
#### PART- B [4 x 10 = 40 marks]

7. Prepare a class diagram for a graphical document editor that supports grouping. Assume that a document consists of several sheets. Each sheet contains drawing objects, including text, geometrical objects, and groups. A group is simply a set of drawing objects, possibly including other groups. A drawing object can be a direct member of at most one group. Geometrical objects include circles, ellipses, rectangles, lines, and squares. ✓
8. Consider an online airline reservation system. You may want to check airline websites to give your ideas.
  - a. List two actors. Explain the relevance of each actor. (2 marks)
  - b. One use case is to make a flight reservation. List four additional use cases at a comparable level of abstraction. Summarize the purpose of each use case with a sentence. (4 marks) ✓
  - c. Prepare a use case diagram for an online airline reservation system (4 marks) ✓

- ✓ 9. Illustrate UML Deployment and Component diagram with an example.
- ✓ 10. Based on your experience with ATM, prepare a sequence diagram for ATM cash withdrawal.

### PART- C |2 x 15 = 30 marks|

- ✗ 11. While exploring an old castle you and your friend discovered a bookcase that you suspected to be the entrance of a secret passageway. While you examined the bookcase, your friend removed a candle from its holder, only to discover the candle holder was the entrance control. The bookcase rotated a half turn pushing you along separating you from your friend. Your friend put the candle back. This time the bookcase rotated a full turn still leaving you behind it. Your friend took the candle out. The bookcase started to rotate a full turn again, but this time you stopped it just shy of a full turn by blocking it with your body. Your friend handed you the candle and together you managed to force the bookcase back a half turn but this left your friend behind it and you in front of it. You put the candle back. As the bookcase began to rotate, you took out the candle and the bookcase stopped after a quarter turn. You and your friend then entered to explore further. Prepare a state diagram for the control of the bookcase that is consistent with the previous scenario. What should you have done at first to gain entry with the least fuss?
- ✓ 12. a) What is the difference between OOAD and SDLC? (5 marks)
- ✓ b) Following figure is a portion of a class diagram for a computer program for playing several types of card games. Deck, hand, discard pile, and draw pile are collections of cards. The initial size of a hand depends on the type of game. Each card has a suit and rank. Add the following operations to the diagram: display, shuffle, deal, initialize, sort, topOfPile, bottomOfPile, insert, draw, and discard. Some operations may appear in more than one class. For each class in which an operation appears, describe the arguments to the operation and what the operation should do to an instance of that class (10 marks)



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Roll No:.....  
Name:.....  
2022BCS0019  
abhinav bhagwat

## INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

### Department of Computer Science & Engineering END SEMESTER EXAMINATION- APRIL, 2024

ICS 223 Compiler Design

Date: 22.04.2024

Max. Marks: 100

Batch: I, II, III

Time: 09:30 AM - 12:30 PM

Course Instructor: Dr. Koppala Guravaiah/Dr. Selvi C/Dr. Priyadarshini S

Semester: IV

Answer all Questions

1. a. Generate machine code (containing register descriptors and address descriptors) for the following sequence assuming that a, b, c, and W are in memory locations:

$$W := (a-b)+(a-c)+(a-c)$$

[10M]

- b. Optimize the code given below by eliminating common subexpressions, performing reduction in strength on induction variables, and eliminating all the induction variables.

$$dp = 0$$

$$i = 0$$

L:  $t1 = i * 8$

$$t2 = A[t1]$$

$$t3 = i * 8$$

$$t4 = B[t3]$$

$$t5 = t2 * t4$$

$$dp = dp + t5$$

$$i = i + 1$$

if  $i < n$  goto L

[10M]

2. Translate the executable statements of the below C program into following three address code formats: a) Abstract syntax tree b) Quadruples c) Triples d) Indirect triples

main()

{

    int i, a[10];

    i=1;

    while( $i \leq 10$ ) {

        a[i]=0; i= i+1; }

}

[20M]

3. Consider the following grammar,

$E \rightarrow E + T \mid T$

$T \rightarrow T * F \mid F$

$F \rightarrow (E) \mid a$

Construct S-attributed grammar with semantic rules and check whether given grammar will accept the string 'a\*a+a' with the help of constructed L-attributed grammar.

[20M]

4. "If there is no SR-conflict in CLR(1) then definitely there will be no SR-conflict in LALR(1)". Prove the correctness of the above statement by taking an appropriate example grammar and constructing the DFA and parse tables.

[20M]

5. a. Explain the steps present in converting a program into executable code? [10M]  
b. Write a Lex program to identify the tokens in a C Program? [10M]

\*\*\* ALL THE BEST \*\*\*

Name: Abhinav Bhagwat



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM  
Department of Computer Science and Engineering

Roll No: 2022BCS0019

END SEMESTER EXAMINATION- APRIL, 2024

ICS 225 Data Structures III

Date & Time: 19-04-2024, 9:30 AM - 12:30 PM

Course Instructors: Nandini J. W, Lakshmi N. S, Krishnendhu S. P

Max marks: 100  
Semester: IV  
Batch: 1, 2 & 3

Answer all Questions.

**Part A** (Each Question carry 10 marks,  $10 \times 7 = 70$  marks)

1. Let the directed graph  $G$  has  $|V|$  vertices and  $|E|$  edges. Target is to identify the components of  $G$  that has a path from every vertex to every other vertex in that component. Give an algorithm to identify such components without reversing the graph edges.
2. Design an appropriate algorithm to insert key in double threaded binary tree in following cases:
  - (i) Insert in an empty threaded binary tree (5 marks)
  - (ii) Insert as a left/ right child in threaded binary tree (5 marks)
3. Perform the following sequence of operations on a Splay Tree data structure initially empty:
  - (i) Insert the elements ~~10, 5, 15, 8, 7, 12~~, and 20 into the Splay Tree in the given order. (6 marks)
  - (ii) Perform a search operation for the element 7. (2 marks)
  - (iii) Perform a search operation for the element 15. (2 marks)
- After each operation, illustrate the resulting Splay Tree by showing the structure and any necessary rotations.
4. Imagine you are a logistics manager tasked with optimizing the loading of cargo onto delivery trucks for a courier company. Each delivery truck has a maximum weight capacity, and you need to determine the most profitable combination of packages to load onto each truck while maximizing the total value of delivered goods. The weight and value of each package vary, and you must ensure that the total weight of packages loaded onto each truck does not exceed its weight capacity. The details are as given below:  
Number of delivery trucks: 3  
Maximum weight capacity of each truck:

- Truck 1: 1000 kg
- Truck 2: 1500 kg
- Truck 3: 2000 kg

Number of available packages: 5

Details of each package (weight, value):

- Package 1: 500 kg, \$ 1000
- Package 2: 700 kg, \$1500
- Package 3: 300 kg, \$800
- Package 4: 200 kg, \$500
- Package 5: 600 kg, \$1200

Using branch and bound technique, identify the optimal combination of packages to load onto each delivery truck, maximizing the total value of goods delivered. Provide a detailed breakdown for each truck, listing the selected packages along with their respective total weight and total value.

- ✓ 5. You are leading a software development team tasked with building a new e-commerce platform. The project involves various tasks, each with its own dependencies. Here are the specific tasks:

- Task1: Requirement Gathering
- Task2: System Design
- Task3: Database Design
- Task4: Frontend Development
- Task5: Backend Development
- Task6: API Integration
- Task7: User Authentication
- Task8: Payment Gateway Integration
- Task9: Testing and Quality Assurance
- Task10: Deployment

Now, let's define the dependencies between these tasks:  
System Design depends on Requirement Gathering.  
Database Design depends on System Design.  
Frontend Development depends on Database Design.  
Backend Development depends on Database Design.  
API Integration depends on Backend Development.  
Frontend Development depends on User Authentication.  
User Authentication depends on Backend Development.  
Payment Gateway Integration depends on Backend Development.  
Testing and Quality Assurance depends on API Integration and User Authentication.  
Deployment depends on Testing and Quality Assurance.  
Construct a graph to illustrate the given dependencies. Using topological sorting, determine the order in which these tasks should be executed to ensure all dependencies are met and the project progresses efficiently.

- ✓ 6. A directed graph  $G$  is semi-connected if, for every pair of vertices  $u$  and  $v$ , either  $u$  is reachable from  $v$  or  $v$  is reachable from  $u$  (or both). Describe and analyze the most efficient algorithm to determine whether an arbitrary directed graph is semi-connected.

- ✓ 7. Problem : Verifying matrix multiplication. A randomized algorithm for the given problem is as follows:

**Randomized algorithm:**

**input:**  $n \times n$  matrices  $A, B, C$  over  $\mathbb{F}$

**output:** YES, if  $AB = C$ .

NO, otherwise.

1. Pick a random  $n \times 1$  vector  $r$ . (elements of  $r$  can take values 0 or 1)
2. Return the answer of the equality  $ABr = Cr$ .

The following theorem is derived based on the randomized algorithm given above.

**Theorem:**

If  $AB = C$  then the algorithm will always say YES.

If  $AB \neq C$  then the algorithm will say YES with probability at most  $1/2$

Based on these given data, prove that the probability  $A * B \neq C$  and the algorithm output a YES is less than or equal to  $1/2$ . Note that  $\mathbb{F}$  stands for field of real numbers.

## Part B (Each Question carry 15 marks. $15 * 2 = 30$ marks)

One of the oldest algorithms for exploring arbitrary connected graphs was proposed by Gaston Tarry in 1895, as a systematic procedure for solving mazes. The input to Tarry's algorithm is an undirected graph  $G$ ; however, for ease of presentation, we formally split each undirected edge  $uv$  into two directed edges  $uv$  and  $vu$ . (In an actual implementation, this split is trivial; the algorithm simply uses the given adjacency list for  $G$  as though  $G$  were directed.)

We informally say that Tarry's algorithm "visits" vertex  $v$  every time it marks  $v$ , and it "traverses" edge  $vw$  when it colors that edge red and recursively calls  $\text{RecTarry}(w)$ . Unlike our earlier graph traversal algorithm, Tarry's algorithm can mark the same vertex multiple times.

**TARRY( $G$ ):**

```
unmark all vertices of  $G$ 
color all edges of  $G$  white
 $s \leftarrow$  any vertex in  $G$ 
RECTARRY( $s$ )
```

**RECTARRY( $v$ ):**

```
mark  $v$                                  $\langle\langle$  "visit  $v$ "  $\rangle\rangle$ 
if there is a white arc  $v \rightarrow w$ 
    if  $w$  is unmarked
        color  $w \rightarrow v$  green
        color  $v \rightarrow w$  red
        RECTARRY( $w$ )      }  $\langle\langle$  "traverse  $v \rightarrow w$ "  $\rangle\rangle$ 
    else if there is a green arc  $v \rightarrow w$ 
        color  $v \rightarrow w$  red
        RECTARRY( $w$ )      }  $\langle\langle$  "traverse  $v \rightarrow w$ "  $\rangle\rangle$ 
```

- (i) Describe how to implement Tarry's algorithm so that it runs in  $O(V + E)$  time. (10 marks)  
(ii) Prove that no directed edge in  $G$  is traversed more than once. (5 marks)

9 You have a collection of  $n$  lock-boxes and  $m$  gold keys. Each key unlocks at most one box. However, each box might be unlocked by one key, by multiple keys, or by no keys at all. There are only two ways to open each box once it is locked: Unlock it properly (which requires having one matching key in your hand), or smash it to bits with a hammer. Your baby brother, who loves playing with shiny objects, has somehow managed to lock all your keys inside the boxes! Luckily, your home security system recorded everything, so you know exactly which keys (if any) are inside each box. You need to get all the keys back out of the boxes, because they are made of gold. Clearly you have to smash at least one box.

- (i) Your baby brother has found the hammer and is eagerly eyeing one of the boxes. Describe and analyze an algorithm to determine if it is possible to retrieve all the keys without smashing any box except the one your brother has chosen. (10 marks)  
(ii) Describe and analyze an algorithm to compute the minimum number of boxes that must be smashed to retrieve all the keys. (5 marks)

Name: 2022BCS0019



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM  
Department of Computational Science and Humanities

Roll No:

Abhirav

END SEMESTER EXAMINATION - EVEN 2023-'24

APRIL 2024

IMA 221 DIFFERENTIAL EQUATIONS AND TRANSFORMS

Date & Time: 15-04-2024, 09:30 AM - 12:30 PM

Max marks: 100

Course Instructor: Dr. Murugan D/ Dr. Riyasudheen TK/ Dr. Suriyapriya K Batch: 2022

Answer all Questions

1. (a) Let  $a_k$ 's and  $b_k$ 's are the Fourier cosine and sine coefficients respectively corresponding to a piece-wise continuous signal  $f(x) = \cos x, -L \leq x \leq L$ , then find  $\lim_{k \rightarrow \infty} (a_k + b_k)$ . [8]  
(b) Find the half range cosine series of  $f(x) = x - x^2$  in the interval  $(0, \pi)$ . Hence, find the sum of the series  $1 + \frac{1}{2^4} + \frac{1}{3^4} + \dots$  [10]
2. Find the Fourier series for the periodic function  $f(t) = |\sin t|$ , given in the interval  $(-\pi, \pi)$ . Also, find the sum of the series  $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{4n^2 - 1}$ . [10]
3. Find the Fourier transform of

$$f(x) = \begin{cases} a - |x| & \text{for } |x| < a \\ 0 & \text{for } |x| > a \end{cases}$$

and using Parseval's identity show that  $\int_0^\infty \left(\frac{\sin t}{t}\right)^4 dt = \frac{\pi}{3}$  [8]

4. Solve the following difference equation using Z-transforms.

$$y_{n+2} + 4y_{n+1} + 3y_n = 2^n ; y_0 = 0, y_1 = 1.$$

5. Solve  $\frac{d^2y}{dt^2} + 4y = \sin^2 2t$  using the method of variation of parameters. [10]

6. Solve  $x^2 \frac{d^2y}{dx^2} - 3x \frac{dy}{dx} + 5y = x^2 + \sin(\log x)$  [8]

7. Solve  $(z^2 - 2yz - y^2)p + (xy + zx)q = xy - zx$  where  $p = \frac{\partial z}{\partial x}, q = \frac{\partial z}{\partial y}$ . [8]

8. If  $P(x, y)$  is a particular integral of the partial differential equation  $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial x \partial y} - 6 \frac{\partial^2 z}{\partial y^2} = x^2 y + e^{3x+y} + \cos(3x + y)$  then find  $P(1, -3)$ . [10]

9. Let  $z = z(x, y)$  be a solution of  $\frac{\partial z}{\partial x} \frac{\partial z}{\partial y} = 1$  passing through  $(0, 0, 0)$ . Find the value of  $z(0, 1)$ . [8]

10. Determine the solution of the one dimensional heat equation  $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$  subject to the boundary conditions  $u(0, t) = 0, u(l, t) = 0$  ( $t > 0$ ) and the initial condition

$$u(x, 0) = \begin{cases} x & \text{for } 0 \leq x \leq l/2 \\ l - x & \text{for } l/2 \leq x \leq l \end{cases}$$

$l$  being the length of the rod.

[10]

Roll No: 2022BCS0019

Name: Abhinav Bhagwat



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, KOTTAYAM  
Department of Computer Science and Engineering

END SEMESTER EXAMINATION - APRIL, 2024  
COURSE TITLE: ICS 224 – Computer Networks

Time: 17/04/2024, 9.30 AM – 12.30 PM

Course Instructors: Dr. Goutam, Dr. Balasubramanian, Dr. Deepak Sem.: IV

Marks: 100  
Batch: I, II & III

**Instructions:**

- Exchange of the Calculator is strictly prohibited during the examination.
- Include the detailed steps for the problem-oriented questions. Formula and Substitution Steps are Mandatory.

**Answer all Questions**

1. Illustrate the TCP/IP layer with a suitable diagram. Explain any of the four layers in detail. [10 M]

2. Answer the following.

a. Apply a parity check mechanism that prevents single bit error and burst error for the following data-words: 1000101 1111000 1100100 1100111. Odd parity check is considered at the sender and receiver side. [5 M]

b. A sender uses the stop and wait ARQ protocol for reliable transmission of frames. Frames are of size 2000 bytes and the transmission rate at the sender is 40 Kbps. Size of an acknowledgement is 200 bytes and the transmission rate at the receiver is 4 Kbps. The one-way propagation delay is 100 msec. Assuming no frame is lost, find the sender throughput in bytes/sec. [5 M]

Hints: Throughput is calculated by  $\text{efficiency} \times \text{transmission rate}$

3. Present the role and scope of the following in the context of DNS: [5 M]

- a. DNS name server.
- b. DNS Resolver.

4. Describe the following protocols in detail. [5 M]

- a. SMTP
- b. HTTP

5. Assume that TCP handshaking is performed to transfer an image of size 1000 bytes from a client (C) to a server (S). If the Initial Sequence numbers at the client is 1000 and at the server it is 2000, present the handshaking signalling involved during connection, data transfer and termination if the data is transmitted as below: [5 M]

- Segment 1 of the data transfer phase from C to S has 500 bytes
- Segment 2 of the data transfer phase from S to C has 100 bytes
- Segment 3 of the data transfer phase from C to S has 400 bytes
- During the termination phase the last 100 bytes of the image is transmitted in the Segment 4 from C to S.

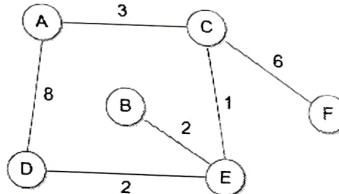
[10 M]

6.

- a. Describe why congestion happens in the network and how can it be addressed (explain any two methods).
- b. UDP and TCP use 1s complement for their checksums. Suppose you have the following three 8-bit bytes: 01010011, 01100110, 01110100.
- i. What is the 1s complement of the sum of these 8-bit bytes? (Note that although UDP and TCP use 16-bit words in computing the checksum, for this problem you are being asked to consider 8-bit sums.) Show the detailed steps. [1M]
- ii. Justify the reason for using the 1's complement of the sum? [2M]
- With the 1s complement form for the sum, how does the receiver detect errors? Is it possible for a 1-bit error to go undetected? [2 M]

7.

- a. Compare and contrast link-state and distance-vector routing algorithms.
- b. For the given network, Find information related to the destination, cost, and next hop stored in nodes A and E using Distance Vector Routing protocol. Show the initial and final states of nodes A and E. [4 M] [6 M]



8. We have the following IP addresses- 250.240.128.0/20. We want to give half of the addresses to Company C, a quarter to Company D, and the rest to Company E. Determine the range of IP addresses and the corresponding subnet masks allocated to the companies C, D, and E.

9. Suppose a router receives an IP packet of 1500 bytes including IP header, and has to fragment the packet and forward the fragments across a network with an MTU of 340 bytes including IP header. Here, the MTU refers to the size of the largest packet that can be carried in a link-layer frame. If the size of the IP header is 20 bytes (i.e., there are no options), compute the values of different fields (such as **offset**, **flag**, **and data-bytes**) in the IP headers for all of the fragments that traverse each network. [10 M]

10.

Answer the following.

- a. Suppose a router has built up the following routing table shown below. The router can deliver packets directly over interfaces 0 and 1, or it can forward packets to routers R2, R3, or R4. Describe what a router does with a packet addressed to each of the following destinations:

- i. 128.96.40.12  
ii. 192.4.153.90

[5 M]

Subnet Number	Subnet Mask	Next Hop
128.96.39.0	255.255.255.128	Interface 0
128.96.39.128	255.255.255.128	Interface 1
128.96.40.0	255.255.255.128	R2
192.4.153.0	255.255.255.192	R3
(Default)		R4

- b. Why is CIDR needed? Describe CIDR with an example. [5 M]



**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM**  
**Department of Computational Science & Humanities**

**END SEMESTER EXAMINATION- EVEN 2023-24**

**APRIL 2024**

**COURSE TITLE: IHS222-Principles of Management**

**Time: 9.30 AM-12.30PM**

**Max. Marks: 100**

**Course Instructor: Dr. Mathew C D**

**Batch: 2022 Batch. 1, 2 and 3**

**Answer all Questions – Each Question carries 10 marks**

**Question 1:** Mr. Rajeev is a middle level manager. He keeps all his subordinates under a lot of discipline. His employees however complain of wastage of time and efforts as they feel that nothing is being assigned in a proper way and a proper place, also no proper schedule is made for working. Which principle of management is violated here? How it could be corrected.

**Question 2:** Comment on the following statement: "If you try to control everything, you may end up by controlling nothing".

**Question 3:** "Management is a trinity of art, science and profession" In the light of this statement explain the nature of management".

**Question 4:** ABC Software Company is having the following employee strength

- Project Manager for UPI-1
- Project Manager for Net Banking-1
- Project Manager for ERP-1
- Chief UPI Consultant-1
- Chief Net Banking Consultant-1
- Chief ERP Consultant-1
- Chief Operating Officer-1
- 2 developers 1 designer and 1 tester for each project. Conceive and draw a suitable organisational structure.

**Question 5:** What are the functions of a Manager? Is mere knowledge of management enough to become a successful manager? Briefly explain various managerial skills?

**Question 6:** How does organizing leads to coordination and specialization of work? Explain the statement. "Authority can be delegated but accountability cannot".

**Question 7:** What is the importance of having a concise business strategy for achieving success in a business? Explain the purpose of a strategy and identify its key elements. Provide an example, in your own words, of a business strategy for a company that you are familiar with, frequent, or use.?

**Question 8:** The Chief Executive of a large manufacturing enterprise is upset over frequent clashes and continuing conflicts between the production department and personnel department. The enterprise is organised on line and staff pattern. What can be the possible causes of this conflict and what steps can be taken to reduce and overcome it?

**Question 9:** Rahul Steel and General Industries Ltd. decides to diversify its activities and undertake production of automobiles. The Chief executive seeks your advice on whether to group the activities by product or by function. What advice would you tender and why?

**Question 10:** "Beneath the cloak of formal relationships in every institution, there exists a more complex system of social relationships called the informal organisation". (Keith Davis). Explain this statement and state why the informal groups come into existence.

Roll No: 2023BCS0019  
Name: Ashinaw Bhagwat



**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM**  
**Department of Computational Science and Humanities**

**END SEMESTER EXAMINATION - EVEN 2023-'24**  
**APRIL 2024**

**COURSE TITLE: WIS 221- Fundamentals of Economics**

**Time: 3 Hour**

**Course Instructor: Dr. Remya Mohan**

**Max. Marks: 100**  
**Batch: 2022**

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**Answer all questions**

**Part A – Each question carries 10 marks**

**$6 \times 10 = 60$  Marks**

- 1. Differentiate between microeconomics and macroeconomics.
- 2. Compare different market structures.
- 3. Briefly explain short-run production function.
- 4. Explain the fundamental concepts in managerial economics.
- 5. Explain different types of price elasticity.
- 6. Differentiate between balance of payment and balance of trade.

**Part B – Each question carries 20 marks**

**$2 \times 20 = 40$  marks**

- 7. Define law of demand and discuss its exceptions.
- 8. Discuss the monetary policy measures to control inflation.

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## In this pdf

- (1) Computer Networks { Mid I,2, End - Sem }
- (2) Theory of Computation { " }  
" "
- (3) Data Structures II { " }  
" "
- (4) Differential Equations { " }  
and Transforms  
" "
- (5) Compiler Design { " }  
" "
- (6) Fundamentals of Economics { End - Sem }
- (7) Risk management in Cyber security { End - sem }  
" "
- (8) Secure Software Engineering { Mid I, II, End - Sem }

Roll No: 2021BCY0035.....

Name: KUNDAL RAJNUR.....



**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM**  
**Department of Computer Science and Engineering**

FIRST MID SEMESTER EXAMINATION- APR, 2023

COURSE TITLE: ICS 224 COMPUTER NETWORKS

Date & Time: 20/04/2023, 2:30 PM – 4:00 PM

Max. Marks: 50

Course Instructor: Dr. Goutam Mali

Batch: I

**Answer all Questions**

**Part A:**

(10 × 1 = 10)

1. Error detection at the data link layer is achieved by \_\_\_\_\_.
2. The data link layer takes the packets from \_\_\_\_\_ and encapsulates them into frames for transmission.  
a) Network layer   b) Physical layer   c) Transport layer   d) Application layer.
3. In \_\_\_\_\_ protocols, we use \_\_\_\_\_.  
a) Byte-oriented; bit stuffing   b) Character-oriented; bit stuffing  
c) Bit-oriented; bit stuffing   d) None.
4. High-level Data Link Control (HDLC) is a \_\_\_\_\_ protocol for communication over point-to-point and multipoint links.  
a) Bit-oriented   b) Byte-oriented   c) Character-oriented   d) None.
5. In \_\_\_\_\_, the sender sends one frame, stops until it receives confirmation from the receiver, and then sends the next frame.  
a) Stop and wait protocol   b) Simplest protocol  
c) Sliding window protocol   d) High level Data Link Control Protocol (HDLC).
6. \_\_\_\_\_ is the process of adding one extra 0 whenever five consecutive 1s follow a 0 in the data, so that the receiver does not mistake the pattern 0111110 for a flag.  
a) Byte Stuffing   b) Unstuffing   c) Bit Stuffing   d) Stuffing.
7. In sliding window protocol total 6 packets are needed to send. If every 3rd packet is lost, the number of transmissions needed by the sender is \_\_\_\_\_.
8. Which of the following tasks is not done by data link layer?  
a) Framing   b) Error control   c) Flow control   d) Channel coding.
9. Which layer is not present in TCP/IP model?  
a) Application layer   b) Internet layer   c) Transport layer   d) Presentation layer.
10. List two objectives of the data link layer.

**Part B:** $(4 \times 5 = 20)$ 

11.

- a. In stop and wait protocol, how can the sender know that the receiver has not received the message successfully?
- b. Cite with examples some major disadvantage(s) which stop and wait protocol suffers from.  $(3 + 2 = 5)$

12. A channel has a bit rate of 16 Kbps and one way propagation delay of 60 msec. The channel uses stop and wait protocol. The transmission time of the acknowledgement frame is negligible. To get a channel efficiency of at least 40%, what would be the minimum frame size?  $(5)$

13. To send a frame from one host to another, there are protocols such as PPP and HDLC.

- a. Write down the working principle of PPP protocol.
- b. Point out three important differences between PPP and HDLC.  $(3 + 2 = 5)$

14.

- a. Describe the working principle of differential Manchester encoding.
- b. Determine the corresponding differential Manchester encoding for the following bit sequence: 10110011011100010001.  $(2 + 3 = 5)$

**Part C:** $2 \times 10 = 20$ 

15. Suppose we want to transmit the message 1011 0010 0100 1011 and protect it from errors using the CRC-8 polynomial  $x^8 + x^2 + x + 1$ .

- a. Determine the message that should be transmitted.
- b. Suppose the leftmost bit of the message is inverted due to noise on the transmission link. What is the result of the receiver's CRC calculation? How does the receiver know that an error has occurred?  $(6 + 4 = 10)$

16.

- a. Why is the name Go-Back-N ARQ?
- b. Consider a scenario where a frame is lost. Frames 0, 1, 2, and 3 are sent. However, during transit frame 2 is lost. The sender receives no acknowledgment for frames 2 and 3. The timer finally expires. So, show how Go-Back-N ARQ can resolve this problem so that the receiver receives all the packets successfully at its end. Draw figure(s) and illustrate.  $(2 + 8 = 10)$

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Roll No:.....

Name:.....



**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM**  
**Department of Computer Science and Engineering**

**SECOND MID SEMESTER EXAMINATION- MAY, 2023**  
**COURSE TITLE: ICS 224 COMPUTER NETWORKS**

Date & Time: 27/05/2023 (2.30 PM – 4 PM)

Max. Marks: 50

Course Instructor: Dr. Goutam Mali

Batch: I

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**Answer all Questions**

**Part A:**

( $5 \times 2 = 10$ )

1. Describe with example why packet fragmentation is needed.
2. Given an IP address 201.116.78.64 and the subnet mask 255.255.255.224, what is the subnet address?
3. We have the following IP addresses- 250.240.128.0/20. We want to give half of the addresses to Company C, and a quarter to Company D, while keeping the rest with itself. Which is a valid allocation of addresses to C and D?
4. How many bits are allocated for network id (NID) and host id (HID) in the IP address 194.120.1.10?
5. For a LAN, given the host address-172.16.2.160, and the subnet mask- 255.255.255.192, what would be the corresponding broadcast address?

**Part B:**

( $4 \times 10 = 40$ )

6.
  - a. With the CSMA/CD protocol, the adapter waits after a collision. For K = 50, how long does the adapter wait until returning to Step 2 (i.e., the adapter senses that the channel is idle) for a 10 Mbps broadcast channel?
  - b. A switch's primary job is to receive incoming packets on one of its links and to transmit them on some other link. This function is referred to as switching or forwarding. Name the different approaches of switching, and discuss each of them in detail with diagrams.
- [5+5]
7.
  - a. Describe slotted ALOHA in detail.
  - b. Prove that the maximum efficiency of the slotted ALOHA is  $1/e$  [Show all the steps in detail].
- [5+5]

P.T.O.

8. Suppose a router receives an IP packet of 1450 bytes, and has to fragment the packet and forward the fragments across some networks with an MTU of 316 bytes. If the size of the IP header is 20 bytes (i.e., there are no options), compute the values of different fields (such as offset, flag, and other important ones) in the IP headers for all of the fragments which traverse all the networks. Draw the fragmented packets with those different fields.

[10]

9.

- Why is subnetting needed?
- Suppose a router has built up the following routing table shown below. The router can deliver packets directly over interfaces 0 and 1, or it can forward packets to routers R2, R3, or R4. Describe what a router does with a packet addressed to each of the following destinations:
  - 128.96.40.12
  - 192.4.153.90

<b>Subnet Number</b>	<b>Subnet Mask</b>	<b>Next Hop</b>
128.96.39.0	255.255.255.128	Interface 0
128.96.39.128	255.255.255.128	Interface 1
128.96.40.0	255.255.255.128	R2
192.4.153.0	255.255.255.192	R3
(Default)		R4

- Why is CIDR needed?
- Describe CIDR with an example.

[2+4+2+2]

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# INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

**END SEMESTER EXAMINATION- JUNE, 2023**

**COURSE TITLE: ICS 224 Computer Networks**

**Time: 9.30 AM – 12.30 PM**

**Course Instructor: Dr. Goutam/ Dr. Bhanu Chander**

**Max. Marks: 100**

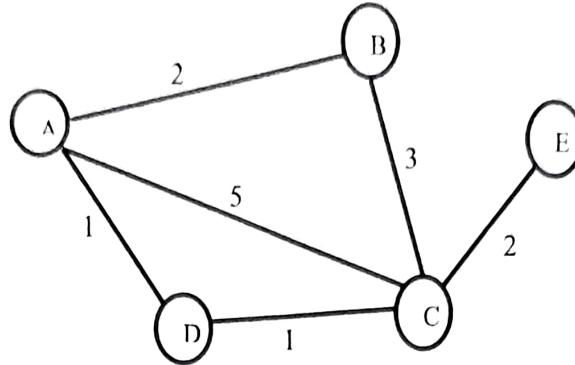
**Sem: IV**

### **Answer all Questions**

**Note:** Answer all the questions. The answers should be precise and to-the-point. There are no separate marks for justification only.

1. With airline transportation system as example, briefly explain what's the need of OSI layering. Mention each layer's functionalities point-wise. **[5 + 5 = 10 Marks]**
2. State whether the following statements are TRUE or FALSE. Write a justification (within maximum 50 words) against your answer. **Note:** Marks will only be given if both the TRUE/FALSE assignment as well as the justification are correct - there is no separate marks for justification only.
  - (a) single autonomous system can run two different routing protocols (like RIP and OSPF) simultaneously. **1**
  - (b) Assume two nodes A and B are connected via switched Ethernet. A want to send data to B. A first sends a ARP request asking for the MAC address of B. and receives the corresponding ARP reply from B. Just after this, B wants to send data to A. Now, B needs to send another ARP request asking for the MAC address of A. **?**
  - (c) Host A is sending a large file to host B over a TCP connection. Assume host B has no data to send to host A. Host B will not send acknowledgments to host A because host B cannot piggyback the acknowledgments on data. **?**
  - (d) The size of the *TCP RcvWindow* never changes throughout the duration of the connection.
  - (e) Suppose host A is sending a large file to host B over a TCP connection. The number of unacknowledged bytes that A sends cannot exceed the size of the advertised receiver buffer.**[10 Marks]**
3. Consider a new student (He/She) of the 2023 batch who joined IIIT Kottayam, and came with a new laptop. He/She wants to use the internet service of IIIT Kottayam, so which protocol he/she has to use (allow) to access the internet services of IIIT Kottayam. *Mention the name of the protocol, and clearly explain each step of the protocol with a neat diagram.* **[10 Marks]**
4. (a) How does slow start work to increase the size of congestion window? Why is this name (slow start)?
  - (b) *Clearly explain which protocols and how it will work* in the following scenarios (1) Assume we are downloading a very large text file from the Internet (2) Assume we are watching a real-time stream video on our computer.**[(2+2)+ 6 = 10 Marks]**
5. (a) How are the TCP segments made from original message?
  - (b) With diagrams describe Connection Establishment and Data Transfer phases of TCP which make it a connection-oriented.**[2 + 8 = 10 Marks]**

6. Write the algorithm of Distance Vector Routing protocol. Find information related to the destination, cost, and next hop stored at nodes D and B, and put in tables. The number on each edge indicates cost between a pair of nodes. Show the initial and final states (the values stored at nodes).



[4+6 = 10 Marks]

7. (a) An organization is granted a block of addresses with the beginning address 14.24.74.0/24. The organization needs to have 3 subblocks of addresses to use in its three subnets as shown below: (1) One subblock of 120 addresses, (2) One subblock of 60 addresses, (3) One subblock of 10 addresses.

- (b) Suppose a router receives a 1500-byte IPv4 packet with a 20-byte IP header, IP ID x, MF = 1, and DF=0. It needs to forward it out a link with a 1000-byte MTU. What should the IP ID, length, offset, and flags (i.e., MF and DF) fields of the header of the 2nd fragment? [6 + 4 = 10 Marks]

8. Explain the hierarchical structure of Domain Name System (DNS). Explain how the resource records are used by DNS to perform host name to IP address resolution with illustrative example. [10 marks]

9. A router with IP address 125.45.23.12 and Ethernet physical address 23:45:AB:4F:67:CD has received a packet for a host destination with IP address 125.11.78.10 and Ethernet physical address AA:BB:A2:4F:67:CD.

- (a) Show the entries in the ARP request packet sent by the router. Assume no subnetting.  
 (b) Show the entries in the ARP packet sent in response to part (a).  
 (c) Encapsulate the packet made in part (a) in a data link frame. Fill in all the fields.  
 (d) Encapsulate the packet part (b) in a data link frame. Fill in all the fields

[10 Marks]

10. Dr. Bhanu starts to write an electronic mail to CR of batch 2022. With the given scenario show the pictorial representation of how each protocol of email works. [10 Marks]

Or

- Suppose we want to transmit the message 1001 1011 1101 1011 and protect it from errors using the CRC-8 polynomial  $x^8 + x^2 + x + 1$ .

- a. Determine the message that should be transmitted.  
 b. Suppose the leftmost bit of the message is inverted due to noise on the transmission link. What is the result of the receiver's CRC calculation? How does the receiver know that an error has occurred?

[6+4 = 10 Marks]

*"I will feel if you fail the exam, but do not forget what I taught in the class"*



Name: Kunal Rajput.....  
**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM**  
**Department of Computer Science and Engineering**

FIRST MID SEMESTER EXAMINATION- APR, 2023  
COURSE TITLE: ICS221, Theory of Computation

Max. Marks: 50  
Batch: I & II

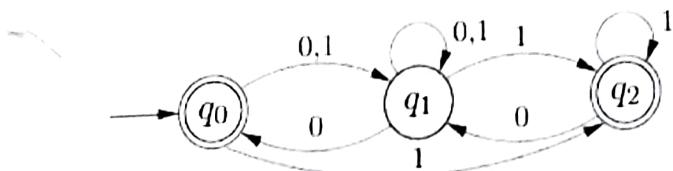
Time: 2.30 PM- 4.00 PM

Course Instructor: Dr Divya, Dr Cinu

**Answer all Questions**

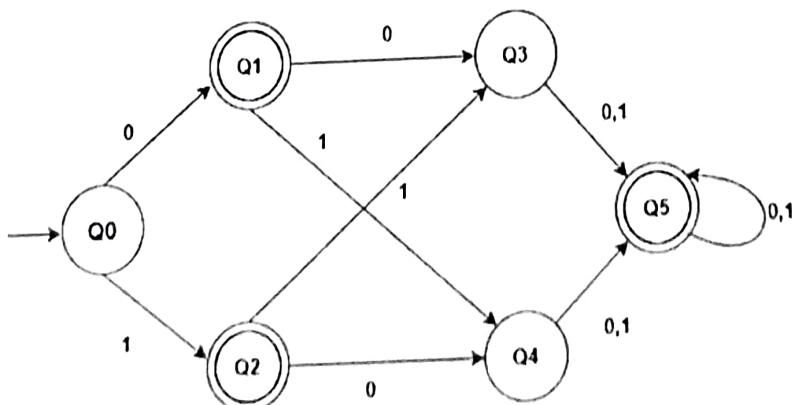
**PART A ( 5 x 4 = 20 Marks)**

1. Construct a DFA that accepts all the binary numbers whose equivalent decimal number is divisible by 4.
2. Construct an NFA that accepts all binary strings that contain at least two 0's and at most one 1.
3. Construct a Mealy machine to determine the residue mod 3 of a binary number.
4. Construct a Moore machine which takes set of all string over {a, b} as input and count number of substring 'ab'.
5. For the following NFA N, construct a DFA M such that  $L(M) = L(N)$ . Illustrate the steps of the algorithm.  $N = (\Sigma = \{0,1\}, Q = \{q_0, q_1, q_2\}, q_0, F = \{q_0, q_2\}, [\delta(q_0, 0) = \{q_1\}; \delta(q_0, 1) = \{q_1, q_2\}; \delta(q_1, 0) = \{q_0, q_1\}; \delta(q_1, 1) = \{q_1, q_2\}; \delta(q_2, 0) = \{q_1\}; \delta(q_2, 1) = \{q_2\}])$



**PART B (2 x 15 = 30 Marks)**

6. Minimize the following DFA



7. Let us take three categories of people who are all going to sit based on the given order in a theatre.
- i. Any number of children can sit together.
  - ii. A child followed by her mother can sit together. This can be repeated any number of times.
  - iii. A child followed by her mother followed by her father can also sit together. This can be repeated any number of times.
  - iv. The theatre should not be empty

Derive the language and design a finite automaton for that accepts the only valid seating pattern.

\*\*\*\*\*



# INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

SECOND MID TERM EXAMINATION- MAY, 2023

COURSE TITLE: ICS221 Theory of Computation

Time: 09:00-10:30 am

Max. Marks: 50

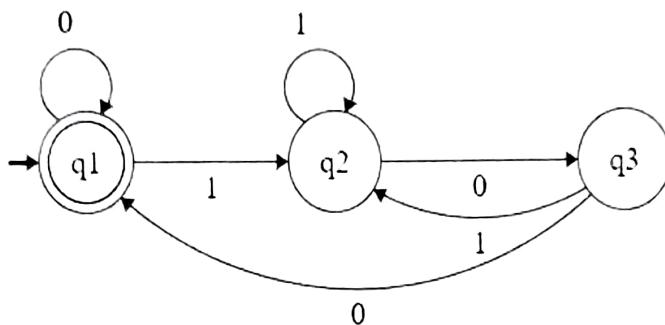
Course Instructor: Dr Divya, Dr Cinu

Batch: I & II

**Answer all Questions**

**PART A (20 marks)**

1. Construct regular expression corresponding to the language recognized by the given automata:



(5 marks)

2. Convert following CFG to Chomsky Normal Form

$$G = (\{B, M, S, E\}, \{+, \times, 0, 1, (, )\}, P, S)$$

where P consists of

$$B \rightarrow 1 \mid B0 \mid B1$$

$$M \rightarrow E \mid M \times E$$

$$S \rightarrow M \mid S + M$$

$$E \rightarrow B \mid (S)$$

(5 marks)

3. Convert the following regular expression to Epsilon-NFA

$$(a + ba + bb)(a + b)^*$$

(5 marks)

4. Prove that if  $L$  is regular,  $L^{rev}$  is regular.  
(5 marks)

**PART B (30 marks)**

5. In a mango juice manufacturing company, a robotic machine is used to pack mangoes in boxes. Each box should contain both yellow and green mangoes. The machine first places the yellow mangoes and then by the green ones. The machine is not programmed to place the mangoes in any other order. It seals the box, only if the number of yellow mangoes is greater than the green ones. Else the box is rejected by the machine.
- Define the **context-free language** for the above scenario.  
(2 marks)
  - Design a **pushdown automaton** that accepts strings in  $L$   
(10 marks)
  - Justify the automaton designed in (b) accepts the strings in  $L$ .  
(3 marks)
6. Show that the language  $L$  is context free by specifying a **context free grammar** that generates it. Be precise in the specification of the grammar, by providing explicitly all its elements.
- $L = \{uawb \mid u, w \in \{a, b\}^*, \text{with } |u| = |w|\}$
  - $L = \{a^m b^n \mid m, n \geq 0, m \neq n\}$   
(8 marks)
7. Using pumping lemma for regular sets, prove that the following language is not regular
- $$L = \{0^m 1^n 0^{m+n} \mid m \geq 1 \text{ and } n \geq 1\}$$
- (7 marks)

\*\*\*\*\*



# INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

## Department of Computer Science & Engineering

Time: 9:30 AM to 12:30 PM (3 hrs)

Course Instructor: Dr Divya, Dr Cinu

END SEMESTER EXAMINATION- JUNE, 2023

COURSE TITLE: ICS221 Theory of Computation

Max. Marks: 100

Batch: 2021 (CSE, CY)

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### Answer all Questions

#### PART A

1. Give a binary encoding of the given TM:

$$M = \{\{q_1, q_2\}, \{0,1\}, \{0,1,B\}, \{\delta(q_1, 0) = (q_2, 0, R), \delta(q_1, 1)$$

$$= (q_2, 1, R), \delta(q_1, B) = (q_2, B, L)\}, B, \{q_2\}\}$$

(5 marks)

2. Show that the language L is context free by specifying a context free grammar that generates it. Be precise in the specification of the grammar, by providing explicitly all its elements.

$$L = \{a^n b^m c^{2(n+m)} \mid n \geq 0, m \geq 0\}$$

(5 marks)

3. Construct an NFA that accepts all binary strings having occurrences of 0 multiples of two apart. (5 marks)
4. Explain Church-Turing thesis. Differentiate between Turing-decidable and Turing-recognizable languages. (5 marks)
5. Prove that the following language is not regular using pumping lemma.

$$L = \{a^{k^2} \mid k \geq 0\}$$

(5 marks)

#### Part-B

6. A state government has a website for knowing the Driving License details. The site has a specific page to know your driving license status. Driving Licence number can be entered in any of the following formats:

**DL-1420110012345 OR DL 1420110012345**

Total number of input characters should be exactly 16 (including space - can be represented by using "\$" symbol or '-'). The format is SS-RYYYYYNNNNNN where

- SS - Two character State Code (like RJ for Rajasthan, TN for Tamil Nadu etc)
- RR - Two digit RTO Code
- YYYY - 4-digit Year of Issue
- Rest of the numbers are to be given in 7 digits

(A) Design a finite-state automata to accept the valid driving license numbers.

(10 marks)

(B) Write regular grammar for the language. Be precise in the specification of the grammar, by providing explicitly all its elements. (5 marks)

7. (A) Design a Turing Machine that transforms a string containing only **a**'s, **b**'s and **c**'s by replacing each letter following '**b**' with '**c**'. For example, the string '**acca**' would remain unchanged while '**abacba**' would change to '**abcccbc**'. (10 marks)
- (B) Give a description of the Universal Turing Machine. (5 marks)

8. Discuss any 3 variants of Turing Machine. (15 marks)

9. (A) Construct regular expression for the following language: (3 marks)

*the set of strings over the alphabet {**a**, **b**, **c**} that contain the substring '**aa**' starting at an odd position and the substring '**bb**' starting at an even position*

(B) Construct NFA accepting the language. (8 marks)

(C) Also, find the equivalent regular grammar G. Be precise in the specification of the grammar, by providing explicitly all its elements. (4 marks)

10. (A) Construct a Pushdown Automata that accepts the set of all strings of properly nested parentheses. (8 marks)

(B) Write the equivalent Context Free Grammar. Be precise in the specification of the grammar, by providing explicitly all its elements. (4 marks)

(C) Convert the CFG to Chomsky Normal Form (3 marks)

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Roll No.: 2021BCY0035.....

Name: Kunal Rajaur.....



Indian Institute of  
Information Technology  
Kottayam

## INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

### Department of Computer Science and Engineering

FIRST MID SEM EXAMINATION - APRIL, 2023

COURSE TITLE: ICS 225 Data Structures III

Time: 2:30 PM - 4:00 PM

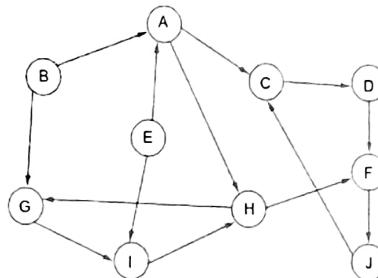
Course Instructor: Manu Madhavan and Mirza Ghalib

Max.Marks:50

Batch: I and II

#### Answer all Questions

1. Does there exist a graph with the degree sequence  $D = [1, 2, 3, 3, 3, 4]$ ? If answer to the previous question is yes, then draw the graph and show step by step execution of Depth First Search (DFS) algorithm on it. Whereas if there no such graph with given degree sequence, then explain why it is so? [10 mar]
2. Strongly Connected Components (SCCs) can be thought of as self-contained cycles within a directed graph where every vertex in a given cycle can reach every other vertex in the same cycle. Design an efficient algorithm to find SCCs in a directed graph. Analyze the time complexity of your algorithms, and argue it's correctness. Further, show step by step execution of your algorithm on the following graph:



[Note: whenever there is a choice of vertices to explore, always pick the one that is alphabetically first.] [10 ma]

3. Consider an undirected social network graph  $G(V, E)$  where the nodes represent people and the lines between nodes, called edges, represent social connections between them, such as friendship or working together in a company. A cluster in an undirected social network graph  $G(V, E)$  is a subgraph in which each pair of nodes is connected with each other via a path. Give an efficient algorithm to find the size of the largest cluster in a given undirected social network graph  $G(V, E)$ . Analyze the time complexity of your algorithms, and argue it's correctness. [10 mar]
4. If the vertex-set of an undirected graph  $G$  can be split into two disjoint sets,  $V_1$  and  $V_2$ , in such a way that each edge in the graph joins a vertex in  $V_1$  to a vertex in  $V_2$ , and there are no edges in  $G$  that connect two vertices in  $V_1$  or two vertices in  $V_2$ , then the graph  $G$  is called a bipartite graph. Give an efficient algorithm to check if an undirected graph is bipartite. Analyze the time complexity of your algorithms, and argue it's correctness. [10 mar]

5. We are given a directed graph  $G(V, E)$  on which each edge  $(u, v)$  has an associated value  $r(u, v)$ , which is a real number in the range  $[0, 1]$  that represents the reliability of a communication channel from vertex  $u$  to vertex  $v$ . We interpret  $r(u, v)$  as the probability that the channel from  $u$  to  $v$  will not fail, and we assume that these probabilities are independent. Give an efficient algorithm to find the most reliable path between two given vertices. Analyze the time complexity of your algorithms, and argue its correctness. [10 mark]

\*\*\*\*\*Good Luck\*\*\*\*\*

Roll No.: 2021BCE0035.....

Name: Kunal Rajour.....



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computer Science and Engineering

SECOND MID SEM EXAMINATION - MAY, 2023

COURSE TITLE: ISC 225 Data Structures III

Time: 9:30 AM - 11:00 AM

Max.Marks:50

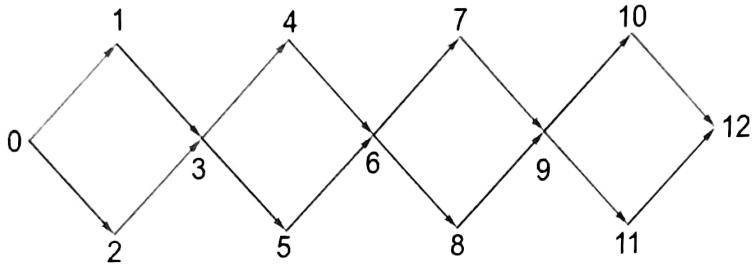
Course Instructor: Manu Madhavan and Mirza Ghalib

Batch: 2021

Answer all Questions

PART-A [10 Marks]

1. How many topological sorts of the following directed acyclic graph are there? [2 mark]



2. Create a max-heap starting from the following elements 2, 1, 4, 6, 5, 3, 7 in this particular order, and write the final order of the elements in an array representation of the heap. [2 mark]
3. How many nodes of height  $h$  are there in a Binary heap of  $n$  nodes? [2 mark]
4. How many non-leaf nodes are there in a complete binary tree with  $2n + 1$  nodes? [2 mark]
5. When preorder traversing a binary search tree resulted in 1 2 3 4 5 6 7 8 9, What will be the inorder and postorder traversal? [2 mark]

PART-B [40 Marks]

6. Given a set of  $n$  distinct integers, we want to find the  $k$  largest elements ( $k$  is a constant) in sorted order. Give a  $c \cdot (n + k \log n)$  algorithm to achieve this task where  $c$  is a positive constant. [10 marks]

7. Given an input integer  $n$ , write a pseudocode to insert  $n$  numbers into a Double Threaded Binary Search Tree(DTBST). You can modify the insertion algorithm of Binary Search Tree (BST) to build thread at the time of insertion. Further, write pseudocode for the following traversals using  $\mathcal{O}(1)$  space:

- Inorder Traversal
- Preorder Traversal
- Postorder Traversal

Finally, analyse the time and space complexity of your algorithm, and argue it's correctness. [10 mark]

8. Mr. Bean has come up with a new idea to find topological ordering of a directed acyclic graph. His strategy is as follows:

1. Pick a random unvisited node, do a Depth First Search (DFS) exploring only unvisited nodes.
2. On the recursive callback of the DFS, add the current node to the topological ordering in reverse order.
3. Repeat 1 and 2 until all the nodes are visited.

Find out whether Mr. Bean's algorithm will always result in the correct topological ordering of a directed acyclic graph. Justify your answer. If the algorithm works correctly, write pseudocode with underlying data structures and analyze time and space complexity of the algorithm. [10 mark]

9. IIIT Kottayam wants to maintain a database of all it's present students only, where the unique key of each student is the roll number. The purpose of maintaining this database is to search for the information of a student as fast as possible. Moreover, the institute wants to update the database fast whenever a new student joins (insert operation) or whenever a student leaves (delete operation) the institute. For delete operation, assume that the location of the entry to be deleted has been given to you. For insert and search operations, assume that you are only given the roll number.

- a. Describe a data structure which enables IIIT Kottayam to search for a student in  $\Theta(\log n)$  worst-case time, insert in  $\Theta(n)$  worst-case time, and delete in  $\Theta(n)$  worst-case time, if there are  $n$  entries in the database. [5 Marks]
- b. Describe a data structure which enables IIIT Kottayam to search for a student in  $\Theta(n)$  worst-case time, insert in  $\Theta(\log n)$  worst-case time, and delete in  $\Theta(\log n)$  worst-case time, if there are  $n$  entries in the database. [5 Marks]

[Note: For the above scenario assume that database is going to be stored in the main memory and not on disk] [10 mark]

\*\*\*\*\*Good Luck\*\*\*\*\*



**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM**  
**Department of Computer Science and Engineering**  
**End-Semester Examination- June 2023**

**ICS225: Datastructures-III**

Date&amp;Time: 07-07-2023, 9.30 AM-12.30 PM

Max Marks: 100

Course Instructor: Dr. Mirza Galib/Dr. Manu Madhavan

Batch: 1&amp;2

**Answer All Questions****PART-A [4 × 10 = 40 Marks]**

1. (a) Design a deterministic quicksort algorithm to sort  $n$  distinct integers in  $\mathcal{O}(n \cdot \log n)$  in the worst case (5 Marks)  
 (b) What is the running time of QUICKSORT when all elements of the array A of size  $n$  have the same value? (5 Marks)

2. In a town of 1024 people, exactly one of them has been infected with COVID. A lab has collected samples from each of them.

- (a) Suppose we have only one testing equipment which will take one day to detect the infection, but the equipment is sensitive enough to detect the positive case even from one drop of the infected sample. Explain how you can detect the positive case in 10 days using the equipment. (5 Marks)

[Hint: You can mix samples.]

- (b) Suppose we have 10 such testing equipment. Can you devise an algorithm to detect the infected case in one day? (5 Marks)

3. You are watching a stream of packets go by one at a time, and want to take a random sample of  $k$  distinct packets from the stream. You face several problems:

- You only have space to save  $k$  packets at any point of time.
- You do not know the total number of packets in the stream.
- If you choose not to save a packet as it goes by, it is gone forever.

Devise a scheme so that, whenever the packet stream terminates, you are left holding a subset of  $k$  packets chosen uniformly at random from the entire packet stream. If the total number of packets in the stream is less than  $k$ , you should hold all of these packets. (10 Marks)

4. Consider the deletion algorithm in Binary Search Tree (BST) given in Figure below. If we were to call TREE-MAXIMUM(z.left) instead of TREE-MINIMUM(z.right) in line number 7 of the TREE-DELETE function, would the deletion procedure still work correctly? Why or why not? Illustrate your answer with an example. (10 Marks)

```

1: function TREE-DELETE(T, z)
2:   if z.left = NIL then
3:     TRANSPLANT(T, z, z.right)
4:   else if z.right = NIL then
5:     TRANSPLANT(T, z, z.left)
6:   else
7:     y ← Tree-Minimum(z.right)
8:     if y.parent ≠ z then
9:       TRANSPLANT(T, y, y.right)
10:      y.right ← z.right
11:      y.right.parent ← y
12:    end if
  
```

```

13:      TRANSPLANT( $T, z, y$ )
14:       $y.\text{left} \leftarrow z.\text{left}$ 
15:       $y.\text{left.parent} \leftarrow y$ 
16:  end if
17: end function

```

[Note: The Transplant procedure in the Tree-Delete operation is responsible for replacing one subtree with another subtree. It updates the relevant parent references to correctly link the subtree to the parent node. In summary, the Transplant procedure essentially replaces the subtree rooted at node  $u$  with the subtree rooted at node  $v$ , updating the parent references accordingly.]

### PART-B [ $4 \times 15 = 60$ Marks]

5. Assume that there are  $n$  books in a library with exactly  $n$  positions to keep books, and the books are sorted according to a unique number corresponding to each book. One afternoon, you feel bored and decide to swap a few pairs of books.
  - (a) Describe a strategy by which you can create a uniformly-random permutation of the books (thereby completely destroying the sorted sequence of books) using at most  $n$  swaps only. Assume that you have access to a random number generator which generates any integer in a given range uniformly at random. (5 Marks)
  - (b) If there is an alarm system in the library to alert the librarian after the first swap, can the librarian identify the swapped pair of books in  $\mathcal{O}(n)$  time and therefore restore the sorted order of the books in  $\mathcal{O}(n)$  time? Let's assume that you are not willing to help the librarian to identify the swapped pair of books. (5 Marks)
  - (c) If there is an alarm system in the library to alert the librarian after  $k$  swaps for any given constant  $k$ , can the librarian still restore the sorted order of the books in  $\mathcal{O}(kn) = \mathcal{O}(n)$  time without your help? (5 Marks)

[Warning: Don't try this out in a real library!]

6. The graph diameter of a graph is the length  $\max_{u,v} d(u, v)$  of the “longest shortest path” (i.e., the longest graph geodesic) between any two graph vertices  $(u, v)$ , where  $d(u, v)$  is a graph distance. In other words, a graph’s diameter is the largest number of vertices which must be traversed in order to travel from one vertex to another when paths which backtrack, detour, or loop are excluded from consideration. The following random graphs (see Figure 1) on 10 vertices have diameters 3, 4, 5, and 7, respectively.

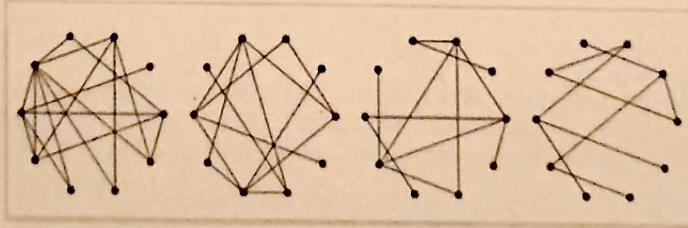


Figure 1

Design an algorithm to find the diameter of a tree. Remember, a tree is an undirected graph in which any two vertices are connected by exactly one path, or equivalently a connected acyclic undirected graph.

(15 Marks)

7. Answer the following questions on the binomial heap and binary heap:

- (a) Prove the number of binomial trees in a binomial heap with  $n$  elements is at most  $\mathcal{O}(\log n)$ ?

Name.....

Roll No.....

(5 Marks)

- (b) Insert numbers from 1 to 16 in a Binomial Heap. Further, delete the element 16, and show the changes that took place in the heap. Finally, how many binomial trees are there in the final binomial heap. (5 Marks)
- (c) A  $d$ -ary heap is like a binary heap, but (with one possible exception) non-leaf nodes have  $d$  children instead of 2 children. (5 Marks)
- How would you represent a  $d$ -ary heap in an array? Find formulae for parent and children of  $i^{th}$  node?
  - What is the height of a  $d$ -ary heap of  $n$  elements in terms of  $n$  and  $d$ ?
8. We have  $n$  nuts and  $n$  bolts. The nuts (and the bolts) are of different sizes. Each bolt fits in exactly 1 nut. We would like to match the nuts with the bolts which fits into them. Since the dimensions of the nuts and the bolts are so small, we can not really tell if a nut (or a bolt) is bigger than another nut (or bolt). So the only operation that is allowed is comparing a nut and a bolt – with such a comparison we can distinguish between three cases, namely, the nut fits a larger bolt, or the nut fits a smaller bolt, or the nut fits this bolt. Give a randomized algorithm which matches nuts with bolts. The expected number of comparisons (of a nut with a bolt) done by this algorithm should be  $\mathcal{O}(n \cdot \log n)$ . (15 Marks)

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**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM**  
**Department of Computational Science and Humanities**  
**FIRST MID TERM EXAMINATION- APRIL, 2023**  
**COURSE TITLE: IMA 221 (Differential equations and transforms)**

Date: 22.04.2023

Max. Marks: 50

Time: 10:00 AM-11:30 AM

**Answer all questions.**

**Part A:**

**Each question carries 2.5 marks.**

**4×2.5=10**

1: Fourier series approximation are applicable for the functions which are \_\_\_\_\_.

2: Find the Fourier coefficient  $a_0$  for the function  $f(x) = x - x^3$  over  $[-1,1]$ .

3: At the point  $t = 1$ , the Fourier series of the periodic function given by

$$f(t) = \begin{cases} t^2, & |t| \leq 1 \\ 0, & \text{otherwise} \end{cases}$$

converges to \_\_\_\_\_.

4: Explain Parseval's Identity for Fourier series.

**Part B:**

**Each question carries 5 marks.**

**4×5=20**

1: Expand  $f(x) = x^2$ ,  $0 < x < 2$ , in (a) half range sine series, (b) half range cosine series.

2: Find the Fourier sine and cosine transformation of

$$f(x) = \begin{cases} x, & 0 \leq x \leq 2 \\ 0, & \text{otherwise} \end{cases}$$

3: Using complex form, find the Fourier series of the function

$$f(x) = \begin{cases} -1, & -\pi \leq x \leq 0 \\ 1, & 0 < x \leq \pi \end{cases}$$

Find the Fourier coefficients of its real form.

4: Find the Fourier sine series of  $f(x) = x$  in the interval  $0 \leq x \leq \pi$ . Apply Parseval's identity to show that  $\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$ .

**Part C:**

**Each question carries 10 marks.**

**$2 \times 10 = 20$**

1: Compute the Fourier integral of the function

$$f(x) = \begin{cases} |\sin x|, & |x| \leq \pi \\ 0, & |x| \geq \pi \end{cases}$$

And deduce that,

$$\int_0^\infty \frac{\{\cos(\lambda\pi)+1\}}{1-\lambda^2} \cos\left(\frac{\pi\lambda}{2}\right) d\lambda = \frac{\pi}{2}.$$

2: Let  $f(x)$  be a function of period  $2\pi$  such that  $f(x) = \begin{cases} 0, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases}$ .

(a) Find the Fourier series approximation for  $f(x)$ .

(b) Also show that  $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots$ .

\*\*\*\*\*

Name: Kunal Rajour

Roll No: 2021BCY0035



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computational Science and Humanities

**SECOND MID SEMESTER EXAMINATION- MAY, 2023**

**IMA221: Differential Equations and Transforms**

**Date & Time:** 29-05-2023, 02:30 PM - 04:00 PM

**Max marks:** 50

**Course Instructors:** Dr. Murugan D/Dr. Asha Sebastian

**Batch:** 2021

**Answer all Questions**

1. Find the Fourier transform of the function

[8]

$$f(x) = \begin{cases} x, & \text{if } -T < x < T \\ 0, & \text{otherwise} \end{cases}$$

2. Solve the simultaneous differential equations

[8]

$$\frac{dx}{dt} + 5x - 2y = t, \quad \frac{dy}{dt} + 2x + y = 0$$

given that  $x(0) = 0$  and  $y(0) = 0$ .

3. Find the singular integral of

[8]

$$z = px + qy + p^2 + q^2 + pq.$$

4. Solve by method of variation of parameters

[8]

$$\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = e^{-x} \log x.$$

5. Solve the partial differential equation

[8]

$$x(y^2 + z)p - y(x^2 + z)q = z(x^2 - y^2).$$

6. Solve by undetermined coefficients method

[10]

$$\frac{d^4y}{dx^4} + \frac{d^2y}{dx^2} = 3x^2 + 4 \sin x - 2 \cos x.$$

\*\*\* Best wishes \*\*\*

Name: Kunal Rajou

Roll No: 2021BCU0035



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computational Science and Humanities

END SEMESTER EXAMINATION- JUNE, 2023

IMA221: Differential Equations and Transforms

Date & Time: 28-06-2023, 09:30 AM - 12:30 PM

Max marks: 100

Course Instructors: Dr. Sushil Kumar Joshi/Dr. Murugan D/Dr. Asha Sebastian

Batch: 2021

Answer all Questions

PART A

1. For the function  $f(x) = 3x$ ,  $0 < x < 2\pi$  [5]

- (i) Find the complex form of the Fourier series of  $f(x)$ .
- (ii) Find the half range sine series of  $f(x)$ .

2. Solve the differential equation [5]

$$x^2 \frac{d^2y}{dx^2} - x \frac{dy}{dx} - 3y = x^2 \log x.$$

3. Let  $p(x, y)$  be a particular integral of the differential equation [5]

$$(D + D')^2 z = e^{x-y}.$$

Then find the value of  $p(1, 1)$ .

PART B

4. (i) Find the Fourier transform of [8]

$$f(x) = e^{-2a|x|}, \quad -\infty < x < \infty.$$

- (ii) Find the Fourier cosine transform of

$$f(x) = \begin{cases} 1, & 0 \leq x \leq 1 \\ 0, & x > 1 \end{cases}$$

and hence evaluate  $\int_0^\infty \frac{\sin x}{x} dx$ .

5. Consider the function [8]

$$f(x) = \begin{cases} 0 & x < -1 \\ 1-x, & -1 \leq x < 1 \\ 0, & x \geq 1 \end{cases}$$

Find the Fourier integral of  $f(x)$  and deduce the value of  $\int_0^\infty \frac{\sin \lambda}{\lambda} d\lambda$ .

6. Solve the differential equation

[8]

$$(2x+3)^2 \frac{d^2y}{dx^2} - (2x+3) \frac{dy}{dx} - 12y = 6x.$$

7. Solve the partial differential equation

[8]

$$x(y^2 - z^2)p + y(z^2 - x^2)q = z(x^2 - y^2).$$

8. A bar of 50 cm long, with insulated sides has its ends maintained at temperatures  $20^0 C$  and  $60^0 C$  respectively, until steady-state conditions prevail. The temperature at both ends are suddenly reduced to zero, and kept so. Find the temperature distribution in the bar at time  $t$ .

[8]

### PART C

9. Find the Fourier series of  $f(x) = x - x^2$ ,  $-\pi < x < \pi$  and hence deduce that

[10]

$$\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots$$

10. Solve the differential equations

[10]

$$(D^2 - DD' - 6D'^2)z = x^2y + e^{3x+y}.$$

11. Find the general solution of the differential equation

[10]

$$\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = 2x^2 + e^x + 2xe^x + 4e^{3x}.$$

12. A string is stretched and fastened to two points  $x = 0$  and  $x = l$  apart. Motion is started by displacing the string into the form  $y(x) = k(lx - x^2)$  from which it is released at time  $t = 0$ . Find the displacement of any point on the string at a distance of  $x$  from one end at time  $t$ .

[15]



## INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computer Science &amp; Engineering

IV Sem MID -1 EXAMINATION- APRIL, 2023

ICS 223 Compiler Design

Time: 10:00 AM - 11:30 AM

Date: 20.04.2023

Max. Marks: 50

Course Instructor: Dr. Koppala Guravaiah /Dr. Chakraborty

Answer all Questions

Part-A

8 X 4 = 32

- How many lexemes, and tokens are present in the following C code?

```
int x=120, y=50;
printf("Hello, %d IIIT Kottayam Students\n This exam is for %d marks",&x,y);
```

- Why is lexical analysis required as a separate phase in compiler design?
- Write a Regular Expression to validate the mail-id of IIIT Kottayam students. (Consider 200 students are there for CSE and 60 for Cyber Security and 60 for ECE).
- Check whether the following grammar has left recursion and remove it if it is there.

$$\begin{aligned} S &\rightarrow Aa \mid b \\ A &\rightarrow Ac \mid Sd \mid \epsilon \end{aligned}$$

- Design a Context Free Grammar to describe the language consisting of strings made of even numbers of 0's and even numbers of 1's.
- What is a lexical error? Justify your answer with an example.
- Describe the language denoted by the following Regular Expression  $(00 \mid 11)^*((01 \mid 10)(00 \mid 11)^*(01 \mid 10)(00 \mid 11)^*)$ . Design the NFA for the same.
- Given a parse tree, how do we obtain the string? What do you mean by the derivation of a string?

Part-B

3 X 6 = 18

- Write a lex program to validate while loop statements in C program. Explain the evaluation process.
- Consider the following code that is fed to Lexical Analyzer:

```
#include <stdio.h>
int maximum(int x, int y) {
    // This will compare 2 numbers
    if (x > y)
        return x;
    else {
        return y;
    }
}
```

- Describe the tokens created for the above program.
  - Describe the non-tokens present in above program.
- Consider the following grammar:

$$\begin{aligned} E &\rightarrow I \mid E + E \mid E * E \mid (E) \\ I &\rightarrow \epsilon \mid 0 \mid 1 \mid \dots \mid 9 \end{aligned}$$

- Generate the string  $3^*2+5$  using Left Most Derivation.
- Justify whether the given grammar is ambiguous or not. If yes, remove ambiguity from the above grammar.

Roll No: 2021BCY0035

Name: Kunal Rajour



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM  
Department of Computer Science & Engineering  
IV Sem MID -II EXAMINATION- MAY, 2023  
ICS 223 Compiler Design

Time: 9.30 AM - 11.00 AM

Date: 30.05.2023

Max. Marks: 50

Course Instructor: Dr. Koppala Guravaiah/Dr. Chakraborty

Batch: I and II

Answer all Questions

- Answers without proper justification will be awarded 0 marks
- There will be no partial marking

1. Consider the following grammar:

$$\begin{aligned} E &\rightarrow EAE \mid id \\ A &\rightarrow + \mid * \end{aligned}$$

- Check whether the given grammar is an operator precedence grammar and if not convert it into one. 4
- Parse the string "*id+id\*id\*id*" for the converted operator precedence grammar using operator precedence parsing. 6

2. Consider the following grammar:

$$\begin{aligned} S &\rightarrow Aa \mid bAc \mid Bc \mid bBa \\ A &\rightarrow d \\ B &\rightarrow d \end{aligned}$$

Solve the following:

- Construct the CLR(1) parsing table? 6
- Construct the LALR(1) parsing table? 6
- Justify whether the above grammar is CLR(1), LALR(1), both CLR(1) and LALR(1), or none. 4
- Parse the string "bda" from the above grammar using LALR(1) and CLR(1) parsers? 4

3. Consider the following grammar

$$\begin{aligned} S &\rightarrow L=R \mid R \\ L &\rightarrow *R \mid a \\ R &\rightarrow L \end{aligned}$$

- Calculate *First* and *Follow* for the given grammar? 4
- Justify whether the given grammar is LL(1). If yes, construct the LL(1) predictive parsing table? 4
- Justify whether the given grammar is LR(0). 6
- Is the given grammar SLR(1)? Give proper justification. 6



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computer Science & Engineering  
IV Sem External EXAMINATION- June/July, 2023  
ICS 223 Compiler Design

Time: 09:30 AM - 12:30 PM

Date: 26.06.2023

Max. Marks: 100

Course Instructor: Dr. Koppala Guravaiah /Dr. Chakraborty

Answer all Questions

1. a. Generate machine code (containing register descriptors and address descriptors) for the following sequence assuming that x, y, and z are in memory locations: [10M]

```
x=0  
y=10  
z=30  
if x < y  
    z = 0  
else x = y
```

- b. Optimize this code by eliminating common subexpressions, performing reduction in strength on induction variables, and eliminating all the induction variables. [10M]

```
dp = 0  
i = 0  
L: t1 = i*8  
t2 = A[t1]  
t3 = i*8  
t4 = B[t3]  
t5 = t2*t4  
dp = dp+t5  
i = i+1  
if i < n goto L
```

2. Translate the arithmetic expression  $a + - (b + c)$  into: [4\*5=20M]

a) Abstract syntax tree b) Quadruples c) Triples d) Indirect triples

3. Consider the following grammar, [20M]

$S \rightarrow (S)S \mid \epsilon$

Construct L-attributed grammar with semantic rules and check whether given grammar will accept the string  $((())()$  with the help of constructed L-attributed grammar.

4. "If there is no SR-conflict in CLR(1) then definitely there will be no SR-conflict in LALR(1)". Prove the correctness of the above statement by taking an appropriate example grammar and constructing the automata and parse tables. [20M]

5. Explain each phases of compiler and walk through the transformations at each phase for the following code snippet [10+10=20M]

```
#include<stdio.h>  
#define PI 3.14  
int main()  
{  
    int r=5;  
    print("Area of circle is: %d", PI*r*r);  
    return 0;  
}
```

Roll No.: 2021BCY0035.....

Name: Kunal Rajour.....



**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM**  
**Department of Computational Science and Humanities**

**END SEMESTER EXAMINATION- JUNE, 2023**

**COURSE TITLE: IHS 221 – Fundamentals of Economics**

**Time: 3 Hrs**

**Course Instructor: Dr. Remya Mohan**

**Max. Marks: 100**  
**Batch:**

**Answer all Questions**

**Part A**

**(5 x 10 = 50)**

**Each question carries 10 marks**

1. Define managerial economics. Discuss the nature and scope of managerial economics.
2. A dentist was charging Rs. 300 for a standard cleaning job, and per month it used to generate total revenue equal to Rs. 30,000. She has increased the price of dental cleaning to Rs. 350 since last month. As the result of, few customers are now coming for dental cleaning, but the total revenue is now Rs. 33,250. From this, what can we conclude about the elasticity of demand for such a dental service. Calculate price elasticity of demand by proportionate method.
3. Explain production function with one variable.
4. Differentiate between micro and macro economics.
5. Discuss the monetary policy instruments to control inflation?

**Part B**

**(2 x 25 = 50)**

**Each question carries 25 marks**

6. Evaluate economic reforms in India.
7. Define demand forecasting. Discuss the different techniques used in demand forecasting.

Roll No: Kunal Rajour.....

Name: 2021BCYR025.....



## INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

### Department of Cyber Security

END SEMESTER EXAMINATION- JUNE, 2023

COURSE TITLE: IHS 223 (Risk management in cyber security)

Time: 9:30-12:30 PM

Max. Marks: 100

Course Instructor: Dr. Susheel Kumar Joshi

#### Answer all Questions

#### **Part A (4 marks each)**

- 1: Define the major components of risk in IT infrastructure?
- 2: How do threats, vulnerabilities, assets, and the impact of loss relate to each other in the context of security and risk management?
- 3: What strategies and steps should be followed to identify and protect organizational data and information assets effectively?
- 4: What is the concept of overlapping countermeasures in risk mitigation, and what strategies can be employed to effectively manage them for developing a robust risk mitigation plan?
- 5: How can organizations prioritize and classify risks based on their potential impact on cybersecurity?

#### **Part B (8 marks each)**

- 1: Define the significance of cost-benefit analysis (CBA) in risk management and risk mitigation plan.
- 2: What is the demilitarized zone (DMZ)? How can DMZ be considered a vulnerability of any IT system?
- 3: What are exploits? What are the best practices for managing exploits?

- 4: What are the countermeasures and their significance in the risk mitigation plan? Describe with an example.
- 5: Illustrate with an example the role of maximum acceptable outage (MAO) in business impact analysis.

### **Part C (10 marks each)**

- 1: Describe the seven domains of typical IT infrastructure. Categorize their vulnerabilities, threats, assets, and impacts.
- 2: Design a risk management plan for the software development of any IT company.
- 3: Explain business impact analysis (BIA), its scope, objectives, and best practices to develop a risk management plan for any IT organization.
- 4: Explain the best practices for threat and exploit assessments within the seven domains of typical IT infrastructure?

\*\*\*\*\*

Roll No.: Kunal Rajour

Name: 2021BCY0025

**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, KOTTAYAM**

DEPARTMENT OF CSE - CYBER SECURITY



Indian Institute of  
Information Technology  
Kottayam

**MID SEM-I, APRIL, 2023**

**ICS226 SECURE SOFTWARE ENGINEERING**

**Timing:** 10:00 AM to 11:30 AM

**Max marks:** 50

**Course Instructor:** Dr.A.BALU

**Semester:** IV

**Batch:** 2021 CSY

**Attend all questions**

1. Compute the story units and velocity for the user story which has 10 sprints, each of which has a varying complexity. (2)
2. Define Radial Dimension, angular dimension in Spiral Model (2)
3. Write the use case for Rent Bike function. (5)
4. Write an user story for the Food Order and Delivery system , divide the user story into atleast 3 sprints with sub tasks. (5)
5. Draw a data flow diagram for an Internet Based Polling Booth for public election (8)
6. Create the XP software process model for creating a new e-commerce website for a client. (10)
7. Write the SRS document for renting a bike from a railway station (10)

8. The following is a code in C language for the return bike function in renting a bike from a railway station, Refactor the following code.

```
1 int returnBike(int bikeID, int stationID) {
2     int i, j, found = 0;
3     for (i = 0; i < NUM_STATIONS; i++) {
4         if (stations[i].id == stationID) {
5             for (j = 0; j < NUM_BIKES_PER_STATION; j++) {
6                 if (stations[i].bikes[j].id == bikeID) {
7                     if (stations[i].bikes[j].status ==
8                         → RENTED) {
9                         stations[i].bikes[j].status =
10                            → AVAILABLE;
11                         printf("Bike ↳ %d ↳ returned ↳ to ↳ Station ↳
12                            → %d\n", bikeID, stationID);
13                         return 1;
14                     } else {
15                         printf("Bike ↳ %d ↳ is ↳ not ↳ rented\n",
16                                → bikeID);
17                         return -1;
18                     }
19                 }
20             if (!found) {
21                 printf("Bike ↳ %d ↳ not ↳ found ↳ at ↳ Station ↳ %d\n",
22                                → bikeID, stationID);
23                 return -1;
24             }
25         }
26     }
27 }
```

(8)

Roll No.: Kunal Rajour

Name: 2021BC40035



Indian Institute of  
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## INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, KOTTAYAM

DEPARTMENT OF CSE - CYBER SECURITY

MID SEM-II, MAY, 2023

### ICS226 SECURE SOFTWARE ENGINEERING

Timing: 10:00 AM to 11:30 AM

Max marks: 50

Course Instructor: Dr.A.BALU

Semester: IV

Batch: 2021 CSY

Attend all questions

1. (a) What are all the Golden rules in User Interface design and also create an UI for Internet-Based Polling Booth. (10)
2. (a) Design the test case for calculating the highest temperature of the day. (5)
3. (a) Draw the CFG, def-use graph for the following and also find the test case using all defs path.

```
1 void main()
2 {
3     char STR[n];
4     int i=0, j, test;
5     for(i=0;i<=n;i++)
6         scanf ("%s", STR);
7     j= strlen(STR)-1;
8     while(i<=j)
9     {
10         If (STR[i]==STR[j])
11             test = 1;
12         else
13         {
14             test = 0;
15             break;
16         }
17         i++;
18         j--;
19     }
20     if (test ==1)
21         printf ("\nWord is Palindrome");
22     else
23         printf ("\nWord is not Palindrome");
24
25 }
```

(15)

4. (a) Draw the cause-effect graph for the following system :

A supermarket has a policy of cashing customer's cheques. If the cheque is a personal cheque for Rs. 10000 or less, the cheque can be cashed. If the cheque is a customer's pay cheque, it can be cashed for over Rs.10000, provided it is a company accredited by the supermarket.

(10)

5. (a) A simple event registration system for which the size is estimated at 19 KLOC is to be developed for an institution. The values of cost drivers are as follows : Low reliability = 0.88, high product complexity = 1.15, low application, experience = 1.13, high programming language experience = 0.95. Other cost drivers assumed to be nominal. Compute the initial effort, development effort and time, and phase-wise development effort. Use the following table.

(10)

Table 1: Phase-wise distribution of the development effort and time

Project type and size	Plan and requirement	System design	Detailed design	Code and unit test	Integration test
Organic(2 KLOC)	6	16	26	42	16
Organic(32 KLOC)	6	16	24	38	22

Roll No.: \_\_\_\_\_

Name: \_\_\_\_\_

**INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, KOTTAYAM**

DEPARTMENT OF CSE - CYBER SECURITY

**END SEMESTER- JULY, 2023**



Indian Institute of  
Information Technology  
Kottayam

**ICS226 SECURE SOFTWARE ENGINEERING**

**Timing:** 09:30 AM to 12:30 PM

**Max marks:** 100

**Course Instructor:** Dr.A.BALU

**Semester:** IV

**Batch:** 2021 CSY

**Attend all questions**

1. (a) Explain any two OWASP top 10 vulnerabilities in detail (10)
2. (a) Give a detail note on SQUARE process (10)
3. (a) Draw the CFG, def-use graph for the following and also find the test case using the independent paths in CFG, all-def in def-use graph.

```
1 void main()
2 {
3     int i,j;
4     char text[30];
5     get(text);
6     for (i= 65; i<= 90;i++)
7     {
8         for (j=0;j<30;j++)
9         {
10            if (text[j]==toupper(i) || text[j]==tolower(i)
11                -->
12                printf("%c", text[i]);
13            }
14        }
15    }
```

(15)

4. (a) Draw the cause-effect graph for the following system :  
A system to find the greatest number among three numbers (10)
5. (a) Suppose a student helpdesk system is to be developed with the following services: registration(0.7K), data entry (1.5K), student reports(1.6K), online query(0.9K) and search(1.3K) The values of cost drivers are as follows : high reliability = 1.15, low size of database = 0.94, low programmer capability = 1.17, low application experience = 1.13, high programming language experience = 0.95. Other cost drivers assumed to be nominal. Compute the initial effort, development effort and time, and phase-wise development effort. Use the following table.

(15)

**Table 1: Phase-wise distribution of the development effort and time**

Project type and size	Plan and requirement	System design	Detailed design	Code and unit test	Integration test
Organic(2 KLOC)	6	16	26	42	16
Organic(32 KLOC)	6	16	24	38	22

6. (a) Why security is a Software issue? Explain in detail. (10)
7. (a) Create a IEEE standard 1016-2009 System Design Document for the Bike rental system (10)
8. (a) Explain the Software Architecture design and frame work tools in detail (10)
9. (a) Describe the scope and necessity of Software Engineering in detail (10)