

**B.Tech- 3rd(All Br.)**

**Mathematics-III**

Full Marks : 50

Time :  $2\frac{1}{2}$  hours

Answer all questions

*The figures in the right-hand margin indicate marks*

Symbols carry usual meaning

Any supplementary materials to be provided

1. Answer all questions : 2 × 5

(a) Find the Laplace transform of  $f(t) = 2t \cos t$ .

(b) Write the sufficient conditions for existence of Fourier transform.

(c) Poisson distribution is of discrete or continuous type ? Justify your answer.

( Turn Over )

(d) Define type I and type II error in the testing of hypothesis.

(e) State Stoke's theorem. What is its significance ?

2. (a) Define Dirac's delta function and find its Laplace transform. 4

(b) Use Laplace transform to solve

$$y'' + 2y' - 3y = 6e^{-2t}, y(0) = 2, y'(0) = -14 \quad 4$$

Or

(a) Find the Laplace inverse of

$$F(s) = \ln \left( \frac{s^2 + 1}{(s-1)^2} \right). \quad 4$$

(b) Using Laplace transform solve the following integral equation

$$y(t) = t + \int_0^t y(u) \sin(t-u) du. \quad 4$$

3. (a) Find the Fourier sine integral of the function

$$f(x) = e^{-kx}, \text{ for } x, k > 0.$$

4

- (b) Prove that

$$\int_0^{\infty} \frac{\sin \pi \omega \sin x \omega}{1 - \omega^2} d\omega = \begin{cases} \frac{\pi}{2} \sin x, & \text{if } 0 < x \leq \pi \\ 0, & \text{if } x > \pi \end{cases}$$

4

Or

- (a) If the functions  $f$  and  $g$  are piecewise continuous, bounded and absolutely integrable on the  $x$ -axis, then show that

$$F(f * g) = \sqrt{2\pi} F(f)F(g).$$

4

- (b) Find the Fourier integral representation of the function

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

4

4. (a) Find the mean and variance of the Binomial distribution.

4

- (\*) An insurance company has discovered that only about 0.1 percent of the population is involved in a certain type of accident each year. If its 10,000 policy holders were randomly selected from the population, what is the probability that not more than 5 of its clients are involved in such an accident next year ? ( $e^{-10} = 0.000045$ ). 4

Or

- (a) Let a random variable  $X$  has the density function

$$f(x) = \begin{cases} 0.75(1-x^2), & \text{if } -1 \leq x \leq 1 \\ 0, & \text{otherwise} \end{cases} ; \text{ then}$$

- (i) Find the distribution function  $F(x)$ .
- (ii) Find the probability  $p\left(\frac{1}{4} \leq X \leq 2\right)$ . 4
- (b) The mean height of 500 students of a class is 151 cm and standard deviation is 15 cm. Assuming the heights of the students are normally distributed, find the number of students having height between 120 cm to 155 cm. 4

5. (a) Find the maximum likelihood estimate of  $f(x) = \theta e^{-\theta x}$ ,  $x > 0$  using  $\theta$  as the parameter. 4
- (b) Test the hypothesis  $\mu = 0$  against the alternative  $\mu > 0$ , assuming normally and using the sample 1, -1, 1, 3, -8, 6, 0. (Choose  $\alpha = 5\%$ ) 4

Or

- (a) Find the regression line of  $y$  on  $x$  for the data  $(-2, 3.5), (0, 1.5), (2, 1), (4, -0.5), (6, -1)$ . 4
- (b) Find independent measurements of the flash point ( $^{\circ}\text{F}$ ) of Diesel oil (D-2) gave the values 144, 147, 146, 142, 144. Assuming normality, determine a 99% confidence interval for the mean. 4
6. (a) Evaluate  $\oint_C (y^3 dx - x^3 dy)$  where  $C$  is a positively oriented circle of radius 2 centered at origin. 4



- (b) Use Green's theorem to evaluate  $\int_C f dr$  in counter clock wise sense around the curve  $C$  of the region  $R$ , where  $f = [e^{x+y}, e^{x-y}]$ ,  $R$  is the triangle with the vertices  $(0, 0)$ ,  $(1, 1)$ ,  $(1, 2)$ . 4

Or

- (a) Evaluate  $\int_1^5 \int_0^{x^2} (1+2x)e^{(x+y)} dy dx$ . 4

- (b) Use divergence theorem of Gauss to evaluate  $\iiint_S F \cdot n dA$ , where  $F = [x, y, z]$ , and  $S$  is the sphere  $x^2 + y^2 + z^2 = 9$ . 4

Total Pages—6

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Set-23(I)

**B.Tech- 4th(IT)**

**Database Engineering**

*Full Marks : 50*

*Time :  $2\frac{1}{2}$  hours*

**Answer all questions**

*The figures in the right-hand margin indicate marks*

**Symbols carry usual meaning**

**Any supplementary materials to be provided**

1. Answer *all* questions : 2 × 5
- ~~(a)~~ Define weak and strong entity sets.
  - ~~(b)~~ What are the integrity rules in DBMS ?
  - ~~(c)~~ What is the difference between NOW () and CURRENT\_DATE () ?
  - ~~(d)~~ Define Normalization. What is the use of Normalization ?

( Turn Over )



State the write ahead log rule. Why is the rule necessary ?

2. (a) Suppose you are given the following requirements for a simple database for the National Hockey League (NHL) :

- the NHL has many teams,
- each team has a name, a city, a coach, a captain, and a set of players,
- each player belongs to only one team,
- each player has a name, a position (such as left wing or goalie), a skill level, and a set of injury records,
- a team captain is also a player,
- a game is played between two teams (referred to as host\_team and guest\_team) and has a date and a score.

Construct a clean and concise ER diagram for the NHL. List your assumptions and clearly indicate the cardinality mappings as well as any role indicators in your ER diagram. 8



( 3 )

Or

(a) Describe the three level schema architecture of database. 4

(b) Explain generalization, specialization and aggregation with example. 4

3. (a) Explain fundamental operations of relational algebra with suitable example. 4

(b) lives(person-name, street, city)  
• works(person-name, company-name, salary)  
located-in(company-name, city)  
manages(person-name, manager-name)

(i) Find the name of all employees (i.e., persons) who work for the City Bank company (which is a specific company in the database)

(ii) Find the name, street and city of all employees who work for City Bank and earn more than \$10,000. 4

Or

(a) Explain different types of JOINS in SQL. 4

(b) What are the types of Triggers available in SQL Server ? 4

4. (a) Write sql syntax for creating table EMP(EMPNO, ENAME, SALARY, JDATE, DIS). Write sql syntax for insert two rows in table, delete one row from table, update salary and view whole table. 4

(b) Differentiate between : 4

(i) HAVING and WHERE clause

(ii) CHAR and VARCHAR.

Or

(a) emp(eno, ename, bdate, title, salary, dno)  
proj(pno, pname, budget, dno)  
dept(dno, dname, mgreno)  
workson(eno, pno, resp, hours)

(i) Write an SQL query that returns the employees (number and name only) who have a title of 'EE' or 'SA' and make more than \$35,000.

(ii) Write an SQL query that returns the employee name, project name, employee title, and hours for all works on records. 4

(b) What is a View in SQL Server ?  
What are the differences between a table and a view in SQL Server ? 4

5. (a) What is Redundancy ? Explain the anomalies in relational database. 4

(b) What is Functional dependency ? Explain its usage in database design. Explain various types of Functional dependency. 4

Or

(a) Show that if a relational database is in BCNF, then it is also in 3NF. 4

(b) Given a relation  $R(P, Q, R, S, T)$  and Functional Dependency set  $FD = \{PQ \rightarrow R, S \rightarrow T\}$ , determine whether the given R is in 2NF ? If not convert it into 2 NF. 4

6. (a) Discuss validation-based protocol with a suitable example. 4

( 6 )

(b) Discuss multi-version scheme of concurrency control.

4

*Or*

(a) What is database Recovery ? Explain Shadow paging in detail.

4

(b) Does two phase locking protocol ensure conflict serializability ? Justify your answer with appropriate examples.

4



**B.Tech-3rd(IT)**  
**Digital Electronics**

Full Marks : 50

Time :  $2\frac{1}{2}$  hours

Answer all questions

*The figures in the right-hand margin indicate marks*

Symbols carry usual meaning

1. Answer all questions :

2 × 5

- (a) Convert  $(1011.10111)_2$  to its equivalent Octal and Hexadecimal number.
- (b) What is Gate delay ? Is it different from Propagation delay? Justify your answer.
- (c) Construct an even parity seven-bit Hamming code for a word 1011.
- (d) What is Excitation Table of a Flip-Flop ? Write the Excitation Table of SR Flip-Flop.

( Turn Over )



(e) How many Flip Flops are required for MOD-12 Ring counter and Twisted ring counter respectively ?

2. (a) Design a BCD to Excess-3 code converter. 5

(b) Whether Gray code is a reflected code ?  
Justify your answer. 3

Or

(a) Design a 4-bit Binary to Gray code converter. 5

(b) Whether Excess-3 code is self-complementary ? Justify your answer. 3

3. (a) Simplify the Boolean equation  $f(w, x, y, z) = \sum m(0, 1, 4, 5, 8, 13, 15)$  and realize it using NAND gates only. 6

(b) Explain the Absorption law with example. 2

Or

(a) Simplify the Boolean equation  $f(w, x, y, z) = \sum m(0, 4, 8, 9, 12, 14)$  and realize it using NOR gates only. 6

(b) Realize an EX-OR gate using minimum numbers of NAND gates. 2

4. (a) What is Priority Encoder? Design a 4-to-2 Priority Encoder. 5

(b) Implement Full Adder circuit using Decoder. 3

Or

Step by step derive design logic and design a BCD Subtractor circuit for subtraction of two 4-bit BCD number. 8

5. (a) What is Race around condition and how it is avoided? Explain with suitable example. 5

- (b) What is Characteristic table of a Flip-Flop ?  
State the Characteristic table of JK Flip-Flop.  
Derive the Characteristic equation of JK  
Flip-Flop from its Characteristic table. 3

*Or*

What is Universal Shift Register ? Describe  
the operation of a 3-bit Universal Shift Register  
with proper logic diagram. 8

6. (a) What is Counter ? Design a 3-bit Synchro-  
nous binary counter. 5
- (b) What do you mean by Modulus of a Counter ?  
Explain with example. 3

*Or*

- (a) Design a Counter which will count the  
sequences as 0, 1, 3, 7, 6, 4 and repeats using  
T Flip-Flops. 5

( 5 )

(b) Distinguish and differentiate between Synchronous Counter and Asynchronous Counter.

3

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**B. Tech-3rd (IT)**  
**Object Oriented Programming**

*Full Marks : 50*

*Time : 2.30 hours*

Answer **all** questions.

*The figures in the right-hand margin indicate marks.*

Symbols carry usual meaning.

Any Supplementary materials to be provided.

1. Answer *all* questions : 2 × 5

- ☒ (a) Define Abstraction. How it is implemented in C++ ?
- ☒ (b) What does the keyword inline do ? Write the situations where you can't use inline functions.
- ☒ (c) List down the operators that cannot be overloaded as a friend.
- ☒ (d) Define Abstract Class. Write its uses.

( Turn Over )



~~(a)~~ What is meant by generic programming ?  
Give an example.

2. ~~(a)~~ What is object oriented paradigm ? What are the advantages of object oriented programming language ? 4

~~(b)~~ What do you mean by method overloading ?  
Write a C++ program to compute area and perimeter of circle and triangle. 4

Or

(a) What are the different looping structures used by C++ ? Write their respective advantages and disadvantages. 4

(b) Write a program in C++ to illustrate call by reference. 4

3. Design a class Bank\_Account which represents a customer's name and its account number. Design another class Saving\_Account which is inherited from Bank\_account and has a data member Balance which represents the account balance. The Saving\_Account class has withdraw and deposit facilities. Use necessary functions to do the following tasks

- (i) Accept deposit from the customer to update the balance.
- (ii) Permit withdraws and updates the balance. Make sure that the minimum balance of 1000 Rupees must be maintained in the account.
- (iii) Display the account holder's information with updated balance.

Write a main function to test your program.

8

*Or*

- (a) What is copy constructor ? Write a program using copy constructor to copy one object into another. 4
- (b) Write a Friend function for adding two different subject marks and display its sum using two classes. 4
- 4. (a) Define the term Virtual Base class and its implementation in C++. How it is used in Function Overloading ? 4

- (b) What is Inheritance ? Explain Multiple and Multilevel Inheritance with suitable example. 4

Or

- (a) Create a class TIME to represent time in Hour, Minute and Second format. Use constructors for initialization. Create two time objects. Overload plus (+) operator to add these objects and display the result in Hour, Minute and Second format. 4
- (b) What is Operator overloading ? Write a C++ program to find the summation of two complex numbers by overloading + operator. 4
5. (a) What is dynamic binding ? How is it achieved in C++ ? Write a program to invoke the member function of the base and derived class using the pointer of the base class. 4
- (b) What is function overriding ? Write a C++ program to find the area of a rectangle and triangle using function overriding. 4

Or

(a) Write a C++ program to write text in the file.  
Read the text from the file from end of file. *at*  
Copy the contents of one text file to another  
text file ? 4

(b) What is object slicing ? Explain it using a  
suitable example. 4

6. (a) Can a function template be overloaded ?  
Justify your answer with a suitable example. 4

(b) Define function template. Write a C++  
Program to swap two numbers using a func-  
tion template. 4

Or

(a) Explain exception handling mechanism in  
detail. Write the mechanism to catch all types  
of exception without knowing their types.  
Write a Program to handle divide-by-zero  
exceptions. 8



Set-22(I)

B.Tech-3rd(ME, ETC, MME, IT, CSE, PE, ChE)

**Economics for Engineers**

*Full Marks : 50*

*Time :  $2\frac{1}{2}$  hours*

Answer all questions

*The figures in the right-hand margin indicate marks*

Symbols carry usual meaning

Any supplementary materials to be provided

1. Answer *all* questions : 2 × 5

~~(a)~~ Write two exceptional cases of law of demand.

~~(b)~~ How Risk is different from uncertainty ?

~~(c)~~ If  $Q = 10\sqrt{LK}$ , What type of returns to scale does it exhibit ?

~~(d)~~ What is the difference between explicit and implicit cost ?

( Turn Over )



(e) Explain the difference between public project and private project.

2. (a) What is meant by cardinal and ordinal utility analysis ? How does a consumer reach his equilibrium position in cardinal utility analysis ?

8

Or

(b) How would you measure price elasticity of demand at a point on the demand curve ? Explain the concept of cross elasticity of demand.

8

3. (a) What is Slutsky Substitution effect ?  
= Explain Slutsky Substitution effect for a fall in price of good-X.

8

Or

(b) How is risk measured through probability distribution of outcomes. Explain standard deviation as a measure of risk.

8

4. (a) Explain three stages of short-run production function. Why second stage is known as production zone ? Explain. 8

Or

(b) The total cost function is  $C = 4Q - Q^2 + 2Q^3$

(i) Find the average cost function.

(ii) At what level of output average cost will be minimum.

(iii) Find the marginal cost function.

(iv) Show at the minimum of average cost, average cost is equal to marginal cost. 8

5. (a) Explain various features of a perfectly competitive market. How price and output determined for the industry and firms under perfect competition ? 8

Or

(b) Explain the equilibrium of a monopoly firm.

B.Tech-3rd(ME, ETC, MME, IT, CSE, PE, ChE)  
Econ. for Engg.(Set-22(I))

( Turn Over )

Explain how monopoly price is higher and output is lower than perfect competition market. 8

6. (a) What are the steps involved with Internal Rate of Return (IRR) methods. Explain using a suitable example. 8

*Or*

- (b) Mr. Patro has made an arrangement to borrow Rs 1,000 now and another Rs 1,000 two years hence. The entire obligation is to be repaid at the end of four years. If he projected interest rate in years one, two, three, four are 10%, 12%, 12% and 14% respectively, how much will be paid as a lump-sum amount at the end of four years ? 8



**B. Tech-3rd (IT)**

**Data Structures**

Full Marks : 50

Time :  $2\frac{1}{2}$  hours

Answer all questions

*The figures in the right-hand margin indicate marks*

Symbols carry usual meaning

Any supplementary materials to be provided

1. Answer all questions :

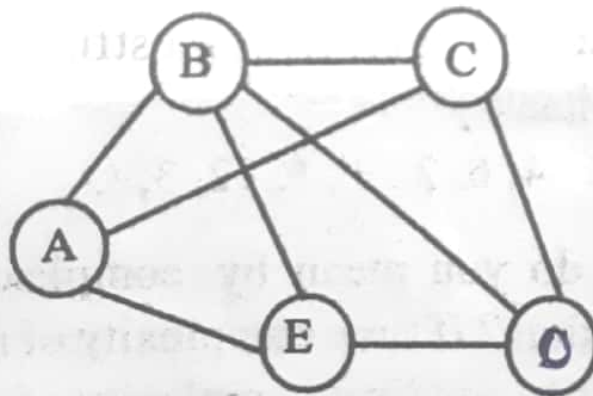
2 × 5

- (a) Suppose a circular queue of capacity  $(n - 1)$  elements is implemented with an array of  $n$  elements. Assume that the insertion and deletion operation are carried out using REAR and FRONT as array index variables, respectively. Initially, REAR = FRONT = 0. Write conditions to detect queue full and queue empty.

( Turn Over )



- ~~(b)~~ Write two applications of stack and queue in context of computer science.
- ~~(c)~~ The preorder traversal of binary search tree  $T$  is 23, 12, 11, 9, 6, 45, 32, 67, 56. Write the inorder and postorder traversals of  $T$ .
- ~~(d)~~ Given  $T_1(n) = 5n^2 + 6n + 9$ ,  $T_2(n) = 7n \log n + n^2 \log n + 5n^2$ , find  $O(T_1(n) + T_2(n))$ .
- ~~(e)~~ Write the adjacency matrix for the following graph.



- ~~2.~~ (a) Consider three array  $A[-15 \dots 10][15 \dots 40]$ ,  $B[0 \dots 25][-10 \dots 15]$  and  $C[-20 \dots 20][-15 \dots 20]$  respectively. Find the size of each



array and calculate address of element at  $X[5][20]$  using row major order and column major order. Assume base address of  $X$  is 1000 and each element takes 2 byte of memory space. 4

- (b) Why do you have to check the full and empty conditions of STACK ? Write an algorithm to perform insertion and deletion in STACK that implemented using an array. 4

Or

- (a) Evaluate the following postfix expression using stack

4, 6, 2, +, \*, 12, 3, /, -

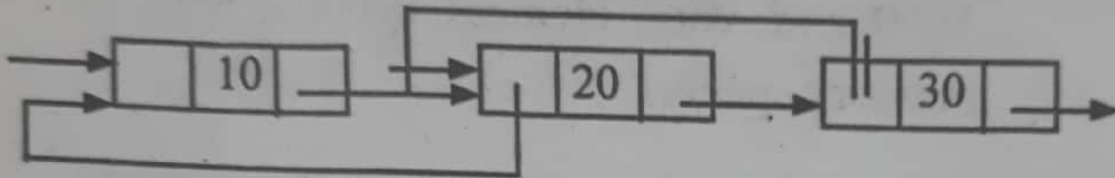
4

- (b) What do you mean by complexity of an algorithm ? If time complexity of algorithm A is  $T(A)$  and time complexity of algorithm B is  $T(B)$  then  $T(A) + T(B) = ?$  4

3. (a) Write an algorithm to convert a single linked list to circular linked list ? Why header node is used in circular list. 4

- (b) Write an algorithm to inset an element 45 into the double link list after the element 20 and delete the node 20

4



Or

- (a) Create a linked list to represent the following polynomial.

4

$$P(n) = 2xy^2z^3 + 3x^2yz^2 + 5xy^3z - 3x^2y^2 + 8xy^2z^5 + 19$$

- (b) Briefly explain the quick sort algorithm. Sort the following data in ascending order and calculate the worst case time complexity of quick sort. Elements : 24, 9, 29, 14, 19, 27.

4

4. (a) Sort the following elements using merge sort procedure and write the recurrence equation for time complexity of sorting of  $n$  elements. List of elements are 9 7 8 3 2 1.

4

- ④ Use the radix sort to sort the following elements in descending order and calculate the time complexity of the radix sort. 4  
128, 539, 365, 861, 792, 573, 374, 255, 427.

Or

- (a) Create a height balanced tree using the following data entered as a sequential set. Show the balance factors in each step while creating the tree. 4  
110, 55, 75, 130, 160, 70, 60
- (b) Build a binary max-heap tree using the following sequence of numbers 25, 35, 18, 90, 46, 70, 48 and delete the node 90 from the heap tree. Calculate the complexity of heapify algorithm. 4
5. ④ Draw the B-tree of order 3 created by inserting the following data arriving in sequence : 92, 24, 6, 7, 11, 8, 22, 4, 5, 16, 19, 20, 78 and delete the elements 22 and 11 from the tree. 4

- 4  
(b) Draw a binary tree using the following pre-order and post-order traversal expression. 4

Pre-order - A, B, F, D, H, C, E, I, G

Post-order - F, H, D, B, I, E, G, C, A

Or

- (a) What is the precondition to perform BINARY SEARCH on a linear array and explain in steps to find the position of the element 50 in list given below ? Calculate the time complexity of BINARY SEARCH. 4

13, 25, 27, 29, 34, 45, 50, 78, 89

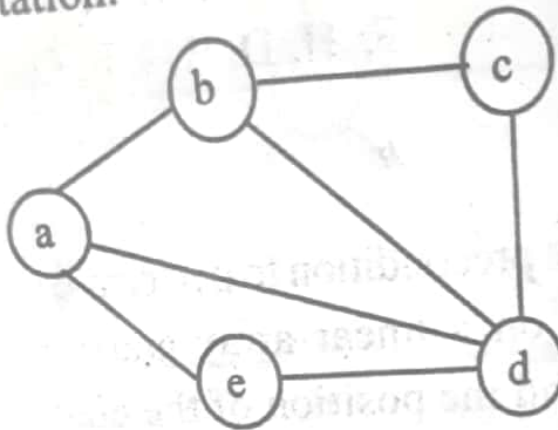
- (b) Sketch the binary search tree resulting from the insert of the following integer keys : 4

50, 72, 96, 99, 107, 26, 12, 9, 2, 10,  
25, 51, 21

- (i) Traverse the tree in post-order and pre-order.  
(ii) Convert the tree into an in-order threaded binary tree.



6. (a) Consider the following graph. Find the adjacency list and adjacency matrix representation. 4



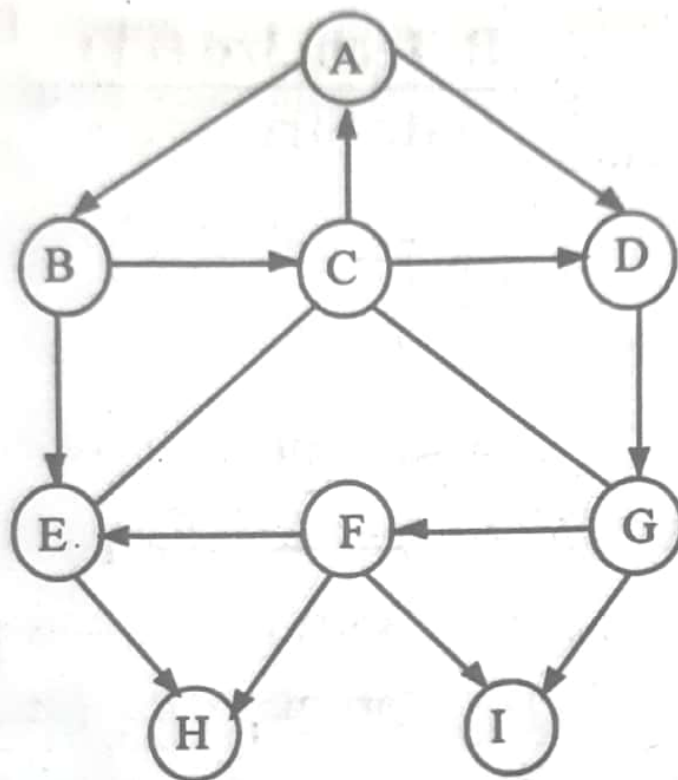
- (b) Given the input (4371, 1323, 6173, 4199, 4344, 9679, 1989) and a hash function of  $H(x) = x \pmod{10}$  show the resulting : 4
- (i) Separate chaining hash table
- (ii) Open addressing hash table using linear probing.

Or

- (a) Write an algorithm to perform DFS on a graph. Find out the path from D to K using DFS 4



( 8 )



- (b) Given the following input (4322, 1334, 1471, 9679, 1989, 6171, 6173, 4199) and consider the hash function  $H(x) = x \pmod{10}$ . Generate the hash table for the above input. Find the number of collisions occurs in the hash table and also find the location of the collision.

4