Department of Mathematics, NIT Tiruchirappalli
July 2022 Session - B.Tech IInd Year (CSE) - Section-A
Probability and Operations Research - MAIR31 - Assessment-1

Date: 19.09.2022 Duration: 1 Hour (11am - 12 Noon) Max. marks: 20

Attempt all the 5 questions.
Write the complete solution for each question.

1. A company has three operational departments (weaving, processing and packing) with capacity to produce three different types of clothes namely A, B and C yielding a profit of Rs. 40, Rs. 80 and Rs. 60 per meter respectively. One meter of cloth A requires 6 minutes in weaving, 4 minutes in processing and 2 minutes in packing. Similarly one meter of cloth B requires requires 8 minutes in weaving, 2 minutes in processing and 3 minutes in packing. One meter of cloth C requires 6 minutes in each department. In a week, total run time of each department is 60, 50 and 70 hours for weaving, processing and packing respectively. Formulate the linear programming problem to find the product mix to maximize the profit. [2]

2. Consider the following primal linear program

   Maximize $z = 125x_1 + 20x_2 + 105x_3$

   subject to

   $$4x_1 + x_2 + 7x_3 \leq -4$$
   $$8x_1 + 2x_2 + 9x_3 \leq -9$$

   $x_1 \leq 0$, x_2 is unrestricted in sign, $x_3 \geq 0$.

   (i) Solve the dual problem using the graphical method.

   (ii) Find a feasible solution and the optimal value of the primal problem. [4]

3. Solve the following LPP by the simplex method. [7]

   Maximize $z = -x_1 + 3x_2 - 3x_3$ subject to

   $$\begin{aligned} 3x_1 - x_2 + x_3 &\leq 7 \\ -x_1 + 2x_2 &\leq 6 \\ -4x_1 + 3x_2 + 8x_3 &\leq 10 \\ x_1, x_2, x_3 &\geq 0. \end{aligned}$$

4. Use the dual simplex method to solve the following LPP [5]

   Minimize $z = 10x_1 + 6x_2 + 2x_3$ subject to

   $$-x_1 + x_2 + x_3 \geq 1$$
   $$3x_1 + x_2 - x_3 \geq 5$$
   $$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0.$$

[P.T.O.]

3. (a) Define basic feasible solution of a LPP.

(b) Consider the problem of maximizing $z = 7x_1 + 8x_2 - x_3 + x_4$ subject to

$$\begin{aligned} x_1 + x_3 + x_4 &= 2 \\ x_1 - x_3 + x_4 &= 2 \\ 2x_1 - x_2 + 3x_3 + 2x_4 &= 0 \\ x_1, x_2, x_3, x_4 &\geq 0. \end{aligned}$$

Prove or disprove that $(1, 4, 0, 1)$ is a basic feasible solution. [2]

**********END**********

National Institute of Technology, Tiruchirappalli – 15
Department of Computer Science & Engineering

Cycle Test - I
CSPC31 – Principles of Programming Languages

Class / Semester : II CSE / III Time : 4.00 PM to 5.00 PM
Date : 19.09.2022 Marks : 20

Answer all questions

1. Consider the following grammar, G defined for a language, L. (5)

S → XABCA
X → x
A → bB | cBb | a
B → b
C → c

Using Top-Down and Bottom-Up Parsing methods, check whether the string: **Xcbbbca** ∈ L(G) or not.

2. Using the grammar as given below, construct the parse tree and derive the right most derivation for each of the following statements: (5)

<assign> → <id> = <expr>
<id> → A | B | C
<expr> → <expr> + <term> | <expr> – <term> | <term>
<term> → <term> * <factor> | <term> / <factor> | <factor>
<factor> → (<expr>) | <id>

a. A = A / (B + C)
b. A = B / (C * (A - B))

3. Show a complete parse, including the parse stack contents, input string, and action for the string **id / (id + id)**, using the Shift-Reduce parsing of an arithmetic expression grammar as shown below. (5)

E → E + T | E – T | T
T → T * F | T / F | F
F → (E) | id

4. Write a C program to find the largest and smallest of four integer numbers without using any branching control structure. (5)

National Institute of Technology Tiruchirappalli
Computer Science and Engineering
B.Tech. III Semester Section A, **Cycle Test 1**
SUB. CODE & TITLE: *CSPC32* & Data Structures
DATE: 20 09 2022, TIME: 60 MIN, **Max. Marks:** 20, **No. of Pages:**01

Answer all Questions

1. Convert the given infix expression to postfix expression using suitable data structure and evaluate and show the result step by step. [3]

   4+3*10/6 + 7 -4/2 + 5^3

2. Write a function to insert after a specified node in a doubly linked list and show the number of pointers updates required. [3]

3. Given the following sequence of letters and asterisks:
   EAS*Y*QUE***ST***IO*N***

   (a) Consider the stack data structure, supporting two operations push and pop. Suppose that for the above sequence, each letter (such as E) corresponds to a push of that letter on to the stack and each asterisk (*) corresponds a pop operation on the stack. Show the sequence of values returned by the pop operations. [3]

   (b) Consider the queue data structure, supporting two operations insert and remove. Suppose that for the above sequence, each letter (such as E) corresponds to an insert of that letter into the queue and each asterisk (*) corresponds a remove operation on the queue. Show the sequence of values returned by the remove operations. [3]

4. Explain how you can implement a queue using a circular singly linked list. Show how you can do enqueue and dequeue operations in O(1) time. [3]
   Note: A circular singly linked list is a singly linked list where the tail element points back to the head of the linked list (instead of pointing to a null element). The linked list is accessed by an external pointer pointing to one of the elements.

5. Show how to store (implement) a sparse matrix using array of structures. Analyse and compare the space requirement of the proposed method and normal way of storing a sparse matrix. [3]

6. Given an array of n positive integers and a number k. Find the minimum number of swaps required to bring all the numbers less than or equal to k together. Use the following input show the resultant array. [2]
   Input: arr[] = {2, 7, 9, 5, 8, 7, 4}, k = 5

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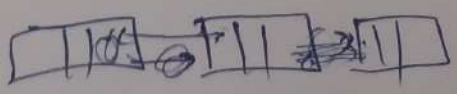


NATIONAL INSTITUTE OF TECHNOLOGY TIRUCHIRAPPALLI
END SEMESTER EXAMINATION - JULY. 2022 SESSION

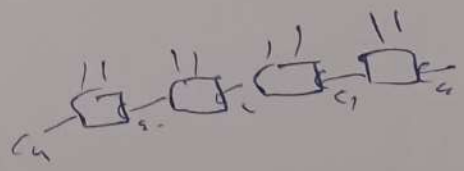
DEPARTMENT : Department of Computer Science and Engineering
DATE & TIME OF CYCLE TEST 1 : 20/09/2022 04:00 pm to 5:00 pm
SUB CODE & TITLE : CSPC33 Digital Systems Design Max. Marks : 20
FACULTY NAME : R. Leela Velusamy

Note to Student: Detailed answer is expected

Answer all questions

1. How many 5-bit two's complement numbers are greater than 0? How many are less than 0? How would your answers differ for sign/magnitude numbers? (3)
2. Given two binary number **X = 1011100 Y = 1001101**, perform the subtraction **X – Y & Y – X** using 2's complements. (2)
3. Express the function **F = a'b + acd** as a sum of minterms and product of maxterms. (2)
4. Simplify and find a NAND-NAND circuit realization of the function **F = ac' + bcd + a'd**. (3)
5. Formulate a weighted binary code for the decimal digits, using the following weights: (a) **6, 3, 1, 1** (b) **6, 4, 2, 1**. Are they self-complementary codes? (4)
6. A circuit has four inputs and two outputs. The inputs A3:0 represent a number from 0 to 15. Output P should be TRUE if the number is prime, (0 and 1 are not prime, but 2, 3, 5, and so on, are prime). Output D should be TRUE if the number is divisible by 3. Give simplified Boolean equations for each output and sketch a circuit. (3)
7. Derive the Boolean function for a 4-bit carry look ahead generator. (3)

*****Best Wishes*****



DEPARTMENT OF COMPUTER SCIENCE AND ENGG.
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI.
CYCLE TEST I

CSPC34 COMPUTER ORGANIZATION

21/09/22 Time: 60 mins

ANSWER ALL THE QUESTIONS: MAX: 20 Marks

1. Consider two programs with number of instructions under each class as given in table. Assuming that Compute takes 1 cycle, Load and Store instructions take 10 cycles, and Branches take 3 cycles,
(i) Find the execution time of each program on a 3GHz ARM machine. (3)
(ii) What is the speed-up if the number of Compute instructions is reduced by half? (2)

	#Instructions				
	Compute	Load	Store	Branch	Total
Program 1	1000	400	100	50	1550
Program 2	1500	300	100	100	~~1750~~

2. What are the different methods of representation of instructions in the memory of a computer? Explain with examples. (5)

3. How is the performance of a computer accessed? Explain. (5)

4. Translate the following C procedure into ARM / MIPS assembly instructions. Use minimum number of instructions.

```
int sum(int n)
{
int res;
if (n == 1)
    {
return (1);
    }
else
    {
res = n + sum(n - 1);
  }
return (res);
        }
```

Assume n in X22, res in X23, sum to be stored in X1(for ARM)

Assume n and res are in registers $s3 and $s4 , sum to be stored in $s1 (for MIPS)

Trace the usage and contents of various data structures for a value of n =3 (5)

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

First Class Test

Combinatorics and Graph Theory

Marks: 15 Course Code: CSPE32 Time: 1hr

Instructions to the Students: Answer Sec A and Any two from Sec B.

Section A

1. Derive a formula for the number of diagonals in a polygon with n vertices. Then prove your formula using mathematical induction. [4]

2. During a month with 30 days, a baseball team plays at least one game a day, but no more than 40 games. Show that there must be a period of some number of consecutive days during which the team must play exactly 19 games. [4]

OR

Define the height h(T) of a complete binary tree T recursively. Let n(T) denotes the number of vertices in T. Prove that, $n(T) \leq 2^{h(T)+1}-1$. [4]

Section B

3. Let n be a positive integer. Show that ${}^{2n}C_{n+1}+{}^{2n}C_n = {}^{2n+2}C_{n+1}/2$. [3.5]

4. How many solutions are there to the equation $x1+x2+x3+x4 = 17$, where x1, x2, x3 and x4 are nonnegative integers? [3.5]

5. Show that for every integer n there is a multiple of n that has only 0s and 1s in its decimal expansion. [3.5]

National Institute of Technology, Tiruchirappalli – 15
Department of Computer Science & Engineering

Cycle Test - II

CSPC31 – Principles of Programming Languages

Class / Semester : II CSE / III **Time** : 3.00 PM to 4.00 PM
Date : 31.10.2022 **Marks** : 20

Answer all questions

1. Write a User-Defined Function in C to perform Matrix Multiplication using Pointers by passing the row, column values and the two input arrays as parameters to that function (use dynamic allocation) **(5)**

2. Write a C++ program to implement the following Hybrid Inheritance. Create a new Class named **A** that returns the Sum of two integers. Create another new Class named **B** that returns the Difference of two integers. Derive a Child class **C** from **A** and **B** that inherits the return values from A and B and return the product.

   Derive two Child classes named **D, E** from **C** that inherits the return value from **C. D** will check whether that number derived from **C** is Prime or Not. **E** will check whether that number derived from **C** is Palindrome or Not. **(10)**

3. Write a C++ program to implement the **QUEUE**. Include member functions for **ENQUEUE, DEQUEUE, ISFULL and ISEMPTY**. Use Constructor to allocate the Queue Array and to initialize other member variables. Also include the Destructor to deallocate the memory. **(5)**

National Institute of Technology Tiruchirappalli
Computer Science and Engineering
B.Tech. III Semester Section A, **Cycle Test 2**
SUB. CODE & TITLE: *CSPC32* & Data Structures
DATE: 01.11.2022, TIME: 60 MIN, **Max. Marks: 20, No. of Pages:01**

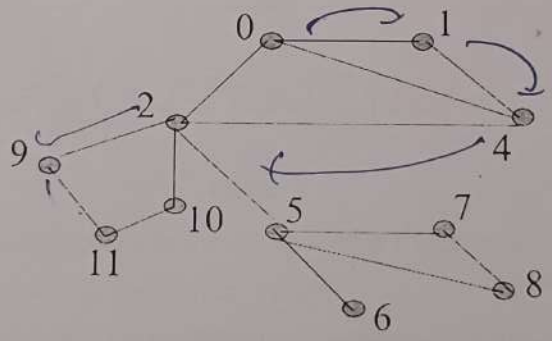
Answer all questions. Each question carries 4 marks

1. Obtain height balanced tree (AVL) starting with empty binary tree on the following sequence. ***"December, January, April, March, July, August, October, February, November, May, June"***. Traverse it through step by step process and show all height balance operations. [Note: Tree should follow strict alphabetical order].

2. Write a pseudo code for the searching an element in a binary tree. Construct a binary tree from the following data and give its post order. Provide each step and its explanation.
   Preorder: 9, 1, 2, 12, 7, 5, 3, 11, 4, 8
   Inorder: 9, 5, 1, 7, 2, 12, 8, 4, 3, 11

3. Write a pseudo code for the insert and delete operations in a Binary Search Tree (BST). Construct a BST from the following data. Delete the node 13 from the constructed tree. Give its Postorder and Preorder. Provide each step and its explanation.
   Postorder: 2,3,5,7,11,23,19,13

4. Write algorithm to perform DFS and BFS. Write one possible order of visiting the nodes of the following graph starting at vertex 0 using both techniques. Also illustrate the graph with step-by-step stack and queue operations.



5. What is Pattern Matching? Discuss about the working process of Kuth-Morris-Pratt algorithm. For the following data apply the algorithm and give intermediate steps.

Index	***0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19***
Text	***S = a c b a c x a b c d a b x a b c d a c b a c d a b c***
Pattern	***P = a c b a c d a b c y***

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NATIONAL INSTITUTE OF TECHNOLOGY TIRUCHIRAPPALLI
CYCLE TEST 2 EXAMINATION - JULY. 2022 SESSION

DEPARTMENT	: Department of Computer Science and Engineering
DATE & TIME OF CYCLE TEST 2	: 01/11/2022 & 03:00 pm to 4:00 pm
SUB CODE & TITLE	: CSPC33 Digital Systems Design Max. Marks: 20
FACULTY NAME	: Dr. J. Pavan Kumar

Note: Detailed answer is expected

Answer all questions

1. Design a modified priority encoder that receives an 8-bit input, A7:0, and produces two 3-bit outputs, Y2:0 and Z2:0 Y indicates the most significant bit of the input that is TRUE. Z indicates the second most significant bit of the input that is TRUE. Y should be 0 if none of the inputs are TRUE. Z should be 0 if no more than one of the inputs is TRUE. Give a simplified Boolean equation for each output, and sketch a schematic. (4)
2. Write a Verilog code that implements the logic function $f(x, y, z) = (x \wedge y) \vee (x' \wedge z)$. Write a test script to verify the operation of your code on all eight combinations of *x*, *y*, and *z*. What function does this circuit realize? (4)
3. Draw the state table and design a circuit to implement the circuit using J K flip flops for the state diagram given in Figure 1. (5)

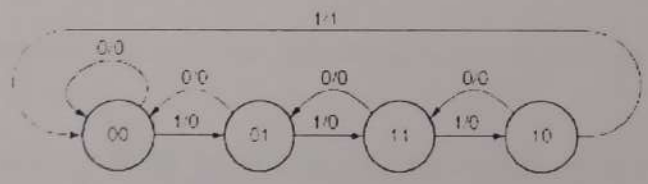


Figure 1

4. Draw the circuit diagram and prove that positive edge triggered D-flip flop does not respond to the input change while the clock is set. (4)
5. Design the right shift register using D-flip flops and determine the number of clock pulses required to shift 4 bit binary information. (3)

*****Best Wishes*****

DEPARTMENT OF COMPUTER SCIENCE AND ENGG.
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI.

CYCLE TEST II

CSPC34 COMPUTER ORGANIZATION

02/11/22

Time: 60 mins

ANSWER ALL THE QUESTIONS:

MAX: 20 Marks

1. What are Hazards? What are its types? Explain with examples. (5)

2. Given the following sequence of instructions to be executed in a Five stage pipeline:

   OR r1, r2, r3
   OR r2, r1, r4
   OR r1, r1, r2

   Assume the cycle times for each of the options related to forwarding as below:

Without forwarding	With Full forwarding	With ALU – ALU Forwarding only
250ps	300ps	290ps

   (i) What is the total execution time of this instruction sequence without forwarding and with full forwarding? (3)

   (ii) What is the speedup achieved by adding full forwarding to a pipeline that had no forwarding? (2)

3. Draw a m –way Set Associative Cache memory organization with 64KB D-Cache and 16 words/block. Compute the number of index bits required if m is
   (i) 4
   (ii) 8 (5)

4. With a neat diagram, explain the need and use of TLB in a Virtual Memory organization. (5)

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

Second Class Test

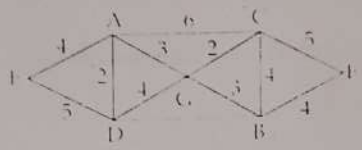
Combinatorics and Graph Theory

Marks: 15 | Course Code: CSPE32 | Time: 1h

Instructions to the Students: Answer all questions.

1. Find all solutions of the recurrence relation:
$a_n = 7a_{n-1} - 16\,a_{n-2} + 12\,a_{n-3} + n4^n$ with $a_0 = -2, a_1 = 0$ and $a_2 = 5$. [4]

2. Derive and prove the formula for the sum of the first n positive odd integers. [2]



3. Use Kruskal's algorithm to find the minimum spanning tree of this graph. [3]

4. Answer the following questions with explanations:
   a. The degree sequence of a simple graph is the sequence of the degrees of the nodes i the graph in decreasing order. Which of the following sequences can not be the degre sequence of any graph? [3]
      (I) 7, 6, 5, 4, 4, 3, 2, 1 (II) 6, 6, 6, 6, 3, 3, 2, 2
      (III) 7, 6, 6, 4, 4, 3, 2, 2 (IV) 8, 7, 7, 6, 4, 2, 1, 1,
   b. Let G be the non-planar graph with the minimum possible number of edges. Then has [1]
      I) 10 edges and 6 vertices II) 10 edges and 5 vertices
      III) 9 edges and 6 vertices IV) 9 edges and 5 vertices
   c. Let s and t be two vertices in a undirected graph G + (V, E) having distinct positiv edge weights. Let [X, Y] be a partition of V such that s ∈ X and t ∈ Y. Consider th edge e having the minimum weight amongst all those edges that have one vertex in X and one vertex in Y. Let the weight of an edge e denote the congestion on that edge The congestion on a path is defined to be the maximum of the congestions on the edge of the path. We wish to find the path from s to t having minimum congestion. Whic one of the following paths is always such a path of minimum congestion? [2]
      (I) a path from s to t in the minimum weighted spanning tree
      (II) a weighted shortest path from s to t
      (III) an Euler walk from s to t
      (IV) a Hamiltonian path from s to t

Department of Mathematics, NIT Tiruchirappalli

July 2022 Session - B.Tech IInd Year (CSE) - Section-A

Probability and Operations Research - MAIR31 - Assessment-2

Date: 02.11.2022 Duration: 1 Hour (3pm - 4pm) Max. marks: 20

Attempt all the questions.

Write the complete solution for each question.

1. Consider the following Linear Programming Problem LP(A, b, c): [4]

Maximize $z = 3x_1 + 4x_2 + x_3 + 7x_4$ subject to

$$\begin{aligned} 8x_1 + 3x_2 + 4x_3 + x_4 &\leq 7 \\ 2x_1 + 6x_2 + x_3 + 5x_4 &\leq 3 \\ x_1 + 4x_2 + 5x_3 + 2x_4 &\leq 8 \\ x_1, x_2, x_3, x_4 &\geq 0. \end{aligned}$$

The optimal simplex tableau for the standard form of the above LPP (with slack variables s_1, s_2, s_3) is given below:

			3	4	1	7	0	0	0
c_{B_j}	Basic Variables	x_{B_j}	x_1	x_2	x_3	x_4	s_1	s_2	s_3
3	x_1	$\frac{16}{19}$	1	$\frac{9}{38}$	$\frac{1}{2}$	0	$\frac{5}{38}$	$\frac{-1}{38}$	0
7	x_4	$\frac{5}{19}$	0	$\frac{21}{19}$	0	1	$\frac{-1}{19}$	$\frac{4}{19}$	0
0	s_3	$\frac{126}{19}$	0	$\frac{59}{38}$	$\frac{9}{2}$	0	$\frac{-1}{38}$	$\frac{-15}{38}$	1
$(z_j - c_j)$:		0	$\frac{169}{38}$	$\frac{1}{2}$	0	$\frac{29}{38}$	$\frac{53}{38}$	0	

Suppose the cost vector $c = (3, 4, 1, 7)^T$ is changed to $\widehat{c} = (2, 4, 1, 8)^T$. Using sensitivity analysis, find an optimum solution to LP$(A, b, \widehat{c})$

2. What is an assignment problem and give the mathematical formulation of it. [2]

3. Use Hungarian method to solve the assignment problem: [3]

10	5	13	15	16
3	9	18	13	6
10	7	2	2	2
5	11	9	7	12
7	9	10	4	12

[P.T.O.]

[4]

4. Consider the transportation problem:

3	1	7	4	300
2	6	5	9	400
8	3	3	2	500
250	350	400	200	

Starting with the given basic feasible solution $x_{12} = 300, x_{21} = 250, x_{22} = 50, x_{23} = 100, x_{33} = 300, x_{34} = 200$, find an optimum solution.

5. Consider a project consisting of twelve activities $(A, B, \cdots, L)$ with the following precedence relations and time estimates: [7]

Activity	Immediate Predecessor(s)	Duration (Days)
A	–	4
B	–	3
C	–	6
D	C	6
E	A, B	7
F	A, B	5
G	A	9
H	A, F	11
I	D, E	4
J	D, E, H	8
K	D, E, H	4
L	G, J	4

(a) Draw the project network with 9 nodes.

(b) Calculate the earliest time (U_i) and latest time (V_i) of each node. (Write the values in a table).

(c) Determine the earliest completion time of the project and identify a critical path.

**********END**********

Department of Mathematics, NIT Tiruchirappalli

July 2022 Session - B.Tech IInd Year (CSE) - Section-A

Probability and Operations Research - MAIR31 - Final Assessment

Date: 06.12.2022 Duration: 3 Hours (9.30 am - 12.30 pm) Max. marks: 40

Attempt all the questions.

Write the complete solution for each question.

1. Use Big-M method to solve the Linear Programming Problem (LPP) [5]

$$\text{Maximize } z = -2x_1 - x_2 \text{ subject to}$$

$$\begin{aligned} 3x_1 + x_2 &= 3 \\ 4x_1 + 3x_2 &\geq 6 \\ x_1 + 2x_2 &\leq 3 \\ x_1 \geq 0, x_2 &\geq 0. \end{aligned}$$

2. Consider the following primal linear program [3]

Max $z = 3x_1 + 6x_2 + 3x_3$

subject to

$$3x_1 + 4x_2 + x_3 \leq 2$$

$$x_1 + 3x_2 + 2x_3 \leq 1$$

x_1 is unrestricted in sign, $x_2 \geq 0$, $x_3 \leq 0$.

Prove using duality theory that the maximum value of z for the primal problem cannot exceed 3.

3. Consider the transportation problem: [5]

2	2	2	1	3
10	8	5	4	7
7	6	6	8	5
4	3	4	4	

(i) Starting with a basic solution $x_{11} = 2, x_{14} = 1, x_{23} = 4, x_{24} = 3, x_{31} = 2, x_{32} = 3$, find an optimum solution.

(ii) Find an initial basic feasible solution using Vogel's Approximation method.

4. Does there exist a LPP such that neither the primal nor the dual has feasible solution. Give reasons for your answer. [2]

5. The contents of urns I, II and III are as follows:

2 white, 1 black and 3 green balls;

1 white, 2 black and 1 green balls and

5 white, 4 black and 3 green balls.

One urn is chosen at random and two balls are drawn. They happen to be black and green. What is the probability that they came from Urn III. [4]

[P.T.O.]

6. Consider a project consisting of ten activities $(A, B, \cdots, J)$ with the following precedence relations and time estimates in weeks:

Activity	Immediate Predecessor(s)	a (optimistic time)	m (most likely time)	b (pessimistic time)
A	–	4	4	10
B	–	1	2	9
C	–	2	5	14
D	A, B, C	1	4	7
E	A, B, C	1	2	3
F	A	1	5	9
G	D	1	2	9
H	D, E, F	4	4	4
I	D, E, F	2	2	8
J	G, H	6	7	8

(i) Draw the project network with 8 nodes.

(ii) Find the expected duration and the variance of each activity.

(iii) Identify the critical path and the expected project completion time. [5]

7. If A and B are independent events, show that A and $\bar{B}$ are independent events, where $\bar{B}$ is the complementary event of B. [2]

8. In a normal distribution, (26)% of the items are under 44 and $(\frac{53}{2})$% of the items are over 65. Find the mean and standard deviation of the distribution. [4]

9. The joint probability mass function of a two-dimensional discret random variable (X ,Y) is given by $p(x, y) = K(6x + 5y), x = 1, 2, 3; y = 0, 1, 2$. Find

(i) the constant K.

(ii) the conditional probability distribution of X given $Y = 2$.

(iii) $P(X \leq 2|Y \leq 1)$. [5]

10. The joint pdf of a two-dimensional random variable (X ,Y) is given by:

$$f(x, y) = \begin{cases} \frac{C}{36}, & 0 < x < y,\ 0 < y < 3 \\ 0, & \text{otherwise.} \end{cases}$$

Find

(i) the constant C.

(ii) the correlation coefficient of X and Y. [5]

**********END**********

National Institute of Technology, Tiruchirappalli – 15
Department of Computer Science & Engineering

End Semester Examination – DEC 2022
CSPC31 – Principles of Programming Languages

Class / Semester : II CSE / III Time : 9.30 AM to 12.30 PM
Date : 07.12.2022 Marks : 40

Answer all questions

1. Using the grammar as given below, construct the parse tree and derive the leftmost derivation for each of the following statements: (5)

<assign> › <id> = <expr> (R1)
<id> › A | B | C (R2)
<expr> › <expr> + <term> | <expr> – <term> | <term> (R3)
<term> › <term> * <factor> | <term> / <factor> | <factor> (R4)
<factor> › (<expr>) | <id> (R5)

   a. A = A / (B - C)
   b. A = B / (C * (A + B))

2. Show a complete parse, including the parse stack contents, input string, and action for the string **id * (id - id)**, using the Shift-Reduce parsing of an arithmetic expression grammar as given below. (5)

E › E + T | E – T | T
T › T * F | T / F | F
F › (E) | id

3. Write a C-program to create the following employee record using structure. Get employee id, name and basic pay. Compute salary basic pay + DA + HRA. DA 38% of basic pay and HRA – 18% of basic pay. (5)

4. Write a User-defined Function in C to perform Linear Search. Get the total number of elements in the array (use dynamic allocation) and the search element X from the user. Pass the input array and X as parameters to the function. If X is present, then return its index otherwise return -1. (5)

5. Write a C++ program to implement the following Function Overloading. Overload the member function **add()** as per the prototypes given below. (5)
   a. Return the Sum of three integer numbers
   b. Return the Sum of two floating-point numbers
   c. Print the Sum of two integer numbers
   d. Print the Sum of three floating-point numbers
   e. Return the Sum of three floating-point numbers

6. Write a C++ program to implement the following Hybrid Inheritance. Create a class A that returns a string. Create a class B that returns another string. Derive a child class C from A and B that get the return strings from A, B and return the Concatenated String. Derive a new class from C that inherits the concatenated string from C and reverse that string. (5)

7. Write a program in LISP to return the Factorial of a number using recursion. (5)

8. Convert the following sentences into Logical representation using First Order Predicate Calculus. (5)
   a. If today is not Sunday, then the market will be opened.
   b. I will use cycle, if the school is far away.
   c. Jack likes a person, if that person does not like oranges.
   d. Nobody likes taxes.
   e. All players who play football are taller.

National Institute of Technology Tiruchirappalli
BRANCH: *Computer Science and Engineering*
B.Tech. III Semester, End Semester
SUB. CODE & TITLE: *CSPC32* & Data Structures
DATE: 08.12.2022, TIME: 180 MIN, Max. Marks: 50, No. of Pages:02

Instructions: Answer all the questions

1.

a. Write an algorithm/pseudocode to convert a given infix expression to a postfix expression? Trace the steps in converting the given infix expression **R/D-Y*(G/C*(D-E)+B/Z)+S*A** to a postfix expression. **[5]**

b. Write Pseudo code to represent the Sparse Matrix using the Array and Linked list. Show the steps for the same using the given matrix. **[5]**

$$\begin{bmatrix} 0 & 0 & 3 & 0 & 4 \\ 0 & 0 & 5 & 7 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 2 & 6 & 0 & 0 \end{bmatrix}$$

2.

a. What are the data structure approaches used for representing the Polynomials? Which approach will give the optimal representation? Write the pseudocode for optimal representation the given polynomial. Represent the given polynomials and perform addition of these polynomials $5-2x+9x^4$ and $6x-7x^2+10x^3$. **[5]**

b. Can a queue be represented by an array? How can one specify the number of elements in the queue in terms of "front", "rear", and MAX_QUEUE_SIZE? Write a C Function to delete the K-th element from the front of a circular queue. **[5]**

3.

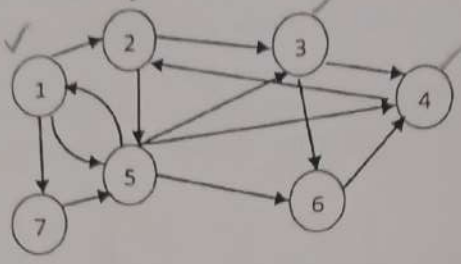
a. Given a BST in pre-order as {13,5,3,2,11,7,19,23}, draw this BST and determine if this BST is the same as one described in post-order as {2,3,5,7,11,23,19,13}. **[3]**

b. The Inorder and Preorder traversal of a tree is given. Construct the binary tree for the same and perform the post-order traversal. **[3]**
Pre-Order Traversal: G B Q A C K F P D E R H
In-Order Traversal: Q B K C F A G P E D H R

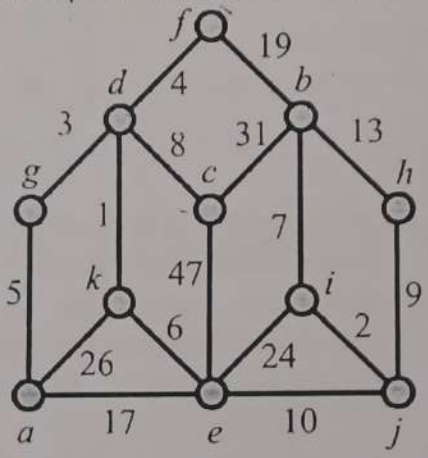
c. Using the Red Black Tree, insert the following elements 2, 1, 4, 5, 9, 3, 6, 7. Show the tree after inserting each element into it. **[4]**

4.

a. Write algorithms for DFS and BFS traversal on a graph. Write the output of DFS and BFS traversals on the following graph considering starting vertex as 1. [6]



b. For the given graph, find the minimum spanning tree using kruskal algorithm with each step and write its Pseudocode. [4]



5.

a. Write the Merge Sort pseudocode for the given set of array. Show step by step implementation of Merge sort on the following array: 24, 28, 15, 13, 18, 34, 19, 06. Analyse the best-case and worst-case time complexity of the Merge sort algorithm. [4]

b. Given the values {2341, 4234, 2839, 430, 22, 397, 3920} a hash table of size 7 and a hash function h(x) = x mod 7, show the resulting table after inserting the values in the given order with each of the following collision strategies. [6]

(i) separate chaining

(ii) linear probing

(iii) double hashing with second hash function h1(x) = (2x – 1) mod 7.

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NATIONAL INSTITUTE OF TECHNOLOGY TIRUCHIRAPPALLI
END SEMESTER EXAMINATION - JULY. 2022 SESSION

DEPARTMENT : Department of Computer Science and Engineering

DATE & TIME : 09/12/2022 & 09:30 am to 12:30 pm

SUB CODE & TITLE : CSPC33 Digital Systems Design Max. Marks: 40

FACULTY NAME : Dr. J. Pavan Kumar

Note: Detailed answer is expected

Answer all questions

1. Determine the gray code for the octal number 737. (1)
2. Design a 10X1 multiplexer using 4X1 multiplexers. (3)
3. Determine the pros and cons of Johnson counter and Ring counter by analysing corresponding circuit diagrams. (4)
4. Find the complement: a) **a+a' (b'c+de).** b) **(x + y' + z) (x' + z')(x + y).** (2)
5. Design a serial adder to perform addition of two 4-bit numbers without using full-adder and store the result in new register. (4)
6. Design a sequence detectors for the following scenarios. (9)
   a) To detect 1101 using Mealy model and no overlapping
   b) To detect 1101 using Mealy model and 1-bit overlapping
   c) To detect 11011 using Moore model and 2-bit overlapping
7. Design a sequential circuit to multiply the given number (binary form) by 16. (3)
8. Design a 3-bit synchronous updown counter using JK flipflops. (4)
9. Design a circuit that is functionally equivalent to 2-input XOR gate using only 2-input NAND gates. (2)
10. Determine the minimum number of basic gates required to implement the following. (2)
    a) **(a'+c')(a+b'+c')**
    b) **ab + (ac)' + ab'c(ab + c)**
11. Which of the following expressions are equivalent? (2)
    a) **x'y'z' + w'xy' + wy'z + xz**
    b) **w'y'z' + wx'y' + xz**
    c) **w'y'z' + wx'y' + xyz + xy'z**
    d) **x'y'z' + wx'y' + w'y**
12. Write a Verilog code to verify the circuit that converts a four-bit Gray code to a bit four binary number using a case statement. (3)
13. How one can reduce the number of states in state diagram? Give example. (1)

*****Best Wishes*****

NATIONAL INSTITUTE OF TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
B.Tech. III SEMESTER EXAMINATION

CSPC34 COMPUTER ORGANIZATION

12/12/2022

MAX : 50 MARKS
TIME : 3 Hrs.

ANSWER ALL THE QUESTIONS:

1.(a) What is a clock? How is it useful? Explain. (5)

(b) Consider two different implementations of the same instruction set architecture. The instructions can be divided into four classes according to their CPI (Class A,B,C,and D).Processor P1 is with a clock rate of 2.5GHz and CPIs of 1,2,3, and 3, and P2 with a clock rate of 3GHz and CPIs of 2,2,2, and 2. Given a program with a dynamic instruction count of 1.0E06 instructions divided into classes as follows: 10% Class A, 20% Class B, 50% Class C, and 20% Class D, find out which implementation is faster. (5)

2.(a) With a neat functional block diagram, explain how multiplication of two 32 bit numbers can be performed. Is it possible to incorporate parallelism in multiplication? Justify your answer. (5)

(b) Given A = $3.264 * 10^3$ and B = $6.52 * 10^{-2}$, calculate A divided by B using Binary arithmetic. Show all the steps to get the answer. Write the final answer in both Single precision format and in decimal notation. (5)

3.(a) What is a pipeline stall? How can it be avoided? Explain with an example. (5)

(b) How are exceptions handled? Explain. (5)

4. (a) Consider a video streaming workload that accesses a 512 KB working set sequentially with the following address stream:

0,2,4,6,8,10,12, 16,....

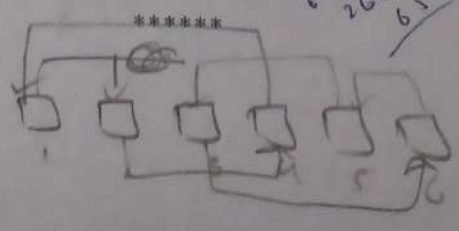
Assume a 64KB direct mapped cache with a 32-byte block

i. Draw the direct mapped cache organization. (2)
ii. What is the miss rate for the address stream above? (1.5)
iii. Is the miss rate sensitive to the size of the cache or working set? Justify. (1.5)

(b) What is a page table? How is it useful in getting a physical address? Explain with diagrams and examples. (5)

5. (a) Write short notes on RAID. (5)

(b) Design a Perfect Shuffle interconnection network for N = 8. List the salient features of this type of interconnection. What is the limitation of this network? How can it be rectified? (5)



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

End Semester Examination

Combinatorics and Graph Theory

Marks: 40 Course Code: CSPE32 Time: 3hr

Instructions to the Students: Answer all questions.

1. Apply Master's theorem to solve the following: [3×2]
   a. $T(n) = 2T(\sqrt{n}) + 1$ if $n>2$, else $T(n) = 2$.
   b. $T(n) = \sqrt{2}T(n/2) + \log n$
   c. $T(2^k) = 3\,T(2^{k-1}) + 1$, $T(1) = 1$
2. State the Travelling Salesperson Problem (TSP). Given any n-vertex weighted complete graph that satisfies triangle inequality, derive an approximate solution to TSP for this graph whose complexity is bounded by twice of the optimal solution. Show and prove its approximation ratio. [1+3+1]
3. State and prove the five coloring theorem. [3]
4. Define chromatic polynomial $P_G(x)$ of a graph G. Prove that degree of $P_G(x)$ is equal to the number of vertices in the graph. Suppose a graph G and a graph G' are combined to create a graph H by connecting each vertex of G to each vertex of G' and otherwise all vertices and edges remaining unchanged. Prove that $P_G(x) \cdot P_{G'}(x) = P_H(x)$. [1+2+2]
5. State and prove Cayley's formula. Find the Prüfer sequence for a star graph of 6 vertices. [2+2]

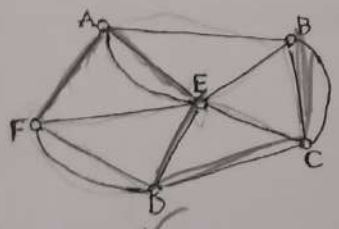


Fig. A

6. Define Euler graph and Hamiltonian graph with example. Find a Euler circuit for the graph of Fig A. using Fleury's algorithm. [2+2]
7. Define coefficient of internal stability and external stability. Find all maximal independent sets and minimal dominating sets for the graph of Fig. A. Find the values of coefficient of internal stability and external stability for it. [1+4+1]
8. Find the dual of the graph of Fig. A. [2]
9. Define minimum vertex cover problem. How is it related to matching? Use a 2-approximation algorithm to find the minimum vertex cover for the graph of Fig. A. Show steps. [1+1+3]
10. Consider graph of Fig A and a spanning tree (F—A—E—D—C—B). Find all fundamental cut-sets and fundamental circuits determined by this spanning tree. [2+2]