NATIONAL INSTITUTE OF TECHNOLOGY TIRUCHIRAPPALLI
TIRUCHIRAPPLALLI – 620 015, TAMIL NADU, INDIA

Probability & Operations Research (MAIR 31)	Assessment – 1 (Computer Science Engineering)	Date–19/09/2022

Answer all the questions (Full Marks – 25)

1. Solve the following *linear programming problem* (LPP) **[3+3]**

$$\text{Minimize } Z = 7x_1 + 10x_2$$

subject to $2x_1 + 3x_2 \geq 6,$ $x_1 \leq 4,$ $x_2 \leq 7,$ $4x_1 + 3x_2 \leq 18,$ $x_1, x_2 \geq 0.$

   a) Using graphical method, and
   b) Using Big – M method. Verify both the solutions.

2. Solve the following LPP **[6+3]**

$$\text{Maximize } Z = 20x_1 + 10x_2 + 15x_3$$

subject to $8x_1 + 6x_2 + 2x_3 \geq 60,$ $5x_1 + x_2 + 6x_3 \geq 40$ $2x_1 + 6x_2 + 3x_3 \leq 30,$ $x_1, x_2, x_3 \geq 0.$

   a) using Big – M method, and
   b) Dual – simplex method.

3. Solve the following LPP using *simplex* method **[5]**

$$\text{Maximize } Z = 3x_1 + 2x_2 + 5x_3$$

subject to $x_1 + 2x_2 + x_3 \leq 43,$ $3x_1 + 2x_3 \leq 46,$ $x_1 + 4x_2 \leq 42,$ $x_1, x_2, x_3 \geq 0.$

4. Solve **[5]**

$$\text{Maximize } Z = 3x_1 + 2x_2 - 5x_3$$

subject to $2x_1 + x_2 - 5x_3 \leq 6,$ $x_1 + x_2 \leq 2,$ $x_1 - x_2 + 3x_3 = 0,$ $x_1, x_2, x_3 \geq 0.$

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National Institute of Technology, Tiruchirappalli - 15
Department of Computer Science and Engineering

Cycle Test 1
CSPE32 – Combinatorics and Graph Theory

Course/Department	: B.Tech./CSE	Batch	: 2021-2025
Semester/Section	: III B	Session	: July/2022
Date and Time	: 21-09-2022 & 04.00 PM – 05.00 PM	Marks	: 15

Answer ALL Questions with proper steps and justification.
Draw diagrams wherever necessary.

1. An ice cream shop has various ice cream flavors like strawberry, chocolate, mango, kiwi, tender (1) coconut, and vanilla. Sprinkles, caramel, whipped cream, marshmallow and oreos are the toppings available. A customer can place order by selecting an ice cream flavor and various toppings as add-ons. In how many ways can an order be placed?

2. Determine the coefficient of $m^4y^3z^3$ in $(3m+4x+3y-4z^{-1}+5)^{12}$. (1)

3. Given positive integers m, n with $m \geq n$. Show that the number of ways to distribute m identical (1) objects into n distinct containers with no containers left empty is

$$C(m - 1, m - n) = C(m - 1, n - 1)$$

4. Find the sequence generated by the following exponential generating function. (1)

$$f(x) = \frac{7}{(1 - 3x^2)} + e^{2x} - 3x^4 + 5$$

5. 24 children are to be seated around 3 round tables. The first table has a seating capacity of 9, and (1) that of second and third are 8 and 7 respectively. How many different seating arrangements are possible?

6. A librarian has to place 36 books in 6 shelves so that each shelf has at least 2 books. Consider that (2) the books on each shelf are placed one after the other from left to right. In how many these 36 books be placed?

7. In how many ways can the letters in "OCCURRENCE" be arranged so that (2)

    a) there is no pair of consecutive identical letters

    b) there are exactly two pairs of consecutive identical letters.

8. 40 identical robots are present in a factory which has 6 assembly lines. In how many ways can these (2) robots be assigned such that each assembly line should have at least 4 but no more than 8 robots. Write the generating function for the given scenario and solve the problem using it.

9. Draw the Ferrer's graph for any distinct partition of 9. Using a Ferrer's graph, show that the number (2) of partitions of n is equal to the number of partitions of $2n$ into n summands.

10. State and prove Derangement formula. (2)

National Institute of Technology, Tiruchirappalli

Department of Computer Science and Engineering

CSPC33 Digital System Design /Cycle Test 1

Course/ Branch/Sem   : B.Tech/ CSE/III   Date : 20/09/2022

Duration   : 1 Hour   Max Marks : 20

B - Section

106121002

Answer All Questions

1. Write down the boolean expression of a 4-to-1 multiplexer and design only using the NAND gates.

   (4)

2. Minimize the expression $AB + A\overline{C} + BC = AB + A\overline{C}$. Use Boolean rules.

   (3)

3. Implement $F(A, B, C, D) = \sum m(0, 1, 5, 6, 8, 10, 12, 15)$ using 8 : 1 multiplexer.

   (2)

4. Design a combinational circuit whose input is a four-bit number and whose output is the 2's complement of the input number. Write down the truth table, simplify the boolean expression and draw the circuit diagram.

   (5)

5. Minimize the boolean function using K-map

   $F(A, B, C, D) = \Sigma m(1, 3, 4, 6, 8, 9, 11, 13, 15) + \Sigma d(0, 2, 14)$

   (3)

6. Design a 4-to-16 decoder, using 2 to 4 decoders.

   (3)

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NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
CSPC32- Data Structures

Programme: B.TECH

Session: JULY/2022

Date: 20.09.2022

Cycle Test-1   Duration: 1 Hour   Total Marks: 20

Answer all the questions

1. Convert the given infix expression to postfix expression using stack. Show the Step by step conversion and evaluate postfix expression using stack with a = 5, b = 2, c = 10.   [3 M]

   $$c * (a - b * (c/a) + b) + c$$

2. Discuss advantages and disadvantages of arrays and linked lists [2 M]

3. Write *Enqueue ()* and *Dequeue ()* functions for a circular queue using arrays [3M]

4. Write *Push ()* and *Pop ()* functions for a stack using linked list. [3 M]

5. Write a function to remove duplicate elements in a sorted linked list   [3M]

   Ex: Input linked list is 1->5->10->12->12->15->36->36

   Output Linked list: 1->5->10->12->15->36

6. Write a function to swap the pairwise nodes (without swapping the data) in a single linked list. [3 M]

   Ex: Input Linked list: 1->5->10->12->15->36

   Output Linked list: 5->1->12->10->36->15

7. Find the time complexity of the below functions [3 M]

(a)

```
Fun (int n)
{
    for (i=0; i<n; i++)
    {
        for (j=0; j<i ; j++)
            printf (" HI");
    }
}
```

(b)

```
Fun (int n)
{
    for(int i=0; i<n; i++)
        for( int j=i ; j<i*i ; j++)
            if(j%i==0)
                for(int k=0; k<j; k++)
                    printf("HI");
}
```

(c)

```
Fun (int n)
{
    k=0;
    for( i=1; i<=n; i=i*2)
    {
        k++
    }
    for ( j=1; j<k; j=j*2)
    {
        Printf ("HI")
    }
}
```

Subject Code/ Name: CSPC34/ Computer Organization   Date:21 / 09/ 2022
Marks: 20   Time: 11:00AM–12:00 PM

196121002

Answer all the Questions

1. List out and discuss briefly the eight great ideas invented by computer architects. (3)

2. Translate the following C code to MIPS. Assume that the variables f, g, h, i, and j are assigned to registers $s0, $s1, $s2, $s3, and $s4, respectively. Assume that the base address of the arrays A and B are in registers $s6 and $s7, respectively. Assume that the elements of the arrays A and B are 4-byte words: (4)

   ```
   while (f==g) A[f] = B[f] + h
   ```

3. For the register values shown above, what is the value of $t2 for the following sequence of instructions? Assume $t0 as holding the value 0xABCDEFAA (2)

   ```
   srl $t2, $t0, 4
   andi $t2, $t2, 0xEEEF
   ```

4. 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). P1 with a clock rate of 3.5 GHz and CPIs of 1, 2, <last digit of your roll_no>, and 3, and P2 with a clock rate of 3 GHz and CPIs of 1, <second largest digit of your full roll_no.>, 3, and 2.

   Given a program with a dynamic instruction count of 1.0E6 instructions divided into classes as follows: 20% class A, 30% class B, 40% class C, and 10% class D, which implementation is faster? (4)
        i.   What is the global CPI for each implementation?
        ii.   Find the clock cycles required in both cases.

5. What are Pseudoinstructions? Why are they used? Give two examples. (2)

6. Provide the type, assembly language instruction, and binary representation of the instruction described by the MIPS fields: op=0x43, rs=4, rt = 3, constant = 0x55. Explain your answer. (2)

7. Distinguish between server computers and super computers. (2)

8. What are the different kinds of branch instructions in the MIPS ISA? (1)

				op(31:26)				
28-26 / 31-29	0(000)	1(001)	2(010)	3(011)	4(100)	5(101)	6(110)	7(111)
0(000)	R-format	Bltz/gez	jmp	jump & link			blez	bgtz
1(001)	add immediate	addi u		and imm.			xori	
2(010)	TLB	flt						
3(011)								
4(100)	load byte		lw				lwr	
5(101)			sw				swr	
6(110)	load linked word							
7(111)	store cond. word							

				op(31:26)=010000 (TLB), rs(25:21)				
23-21 / 25-24	0(000)	1(001)	2(010)	3(011)	4(100)	5(101)	6(110)	7(111)
0(00)	mfc0		cfc0		mtc0		ctc0	
1(01)								
2(10)								
3(11)								

				op(31:26)=000000 (R-format), funct(5:0)				
2-0 / 5-3	0(000)	1(001)	2(010)	3(011)	4(100)	5(101)	6(110)	7(111)
0(000)	shift left logical		shift right logical	sra	sllv		srlv	srav
1(001)	jump register	jalr			syscall	break		
2(010)	mfhi	mthi	mflo	mtlo				
3(011)	mult	multu	div	divu				
4(100)	add	addu	subtract	subu	and	or	xor	nor or (nor)
5(101)			set l.t.	set l.t. unsigned				
6(110)								
7(111)								

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CSPC31: Principles of Programming Languages – CT I   **Date: 19.09.2022**

Duration: 1 Hour

Time: 04:00 – 05:00 PM

Total Marks: 20

Note: *MCQ may have multiple answers. In such case, you have to write all the correct choices. Otherwise, mark will not be awarded for that question.*

1. Using the following grammar and table, check whether the string **id + (id)** will be accepted or not: **(4 M)**

   1. E → E + T
   2. E → T
   3. T → (E)
   4. T → id

State	Action					Goto	
	id	+	(	)	$	E	T
0	S4		S3			1	2
1		S5			Accept		
2	R2	R2	R2	R2	R2		
3	S4		S3			6	2
4	R4	R4	R4	R4	R4		
5	S4		S3				8
6		S5		S7			
7	R3	R3	R3	R3	R3		
8	R1	R1	R1	R1	R1		

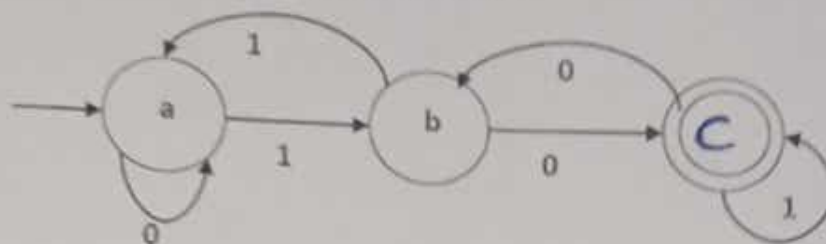2. What operation does the operator +.x do?   **(1 M)**
   - (a) Addition Operation only
   - (b) Multiplication Operation only
   - (c) Addition followed by Multiplication
   - (d) Multiplication followed by Addition

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3. (i) State whether the following diagram is NFA or DFA.　　　　　　　　　(1 M + 2 M)

(ii) Which of the following sentences are generated by the automaton given in 3 (i)?
　　(a) 00000110000　　　(b) 110000011　　　(c) 01100000011　　(d) None of the above

4. (i) For the statement, **123.55*2*e^+10** derive the leftmost derivation and corresponding parse tree using the following grammar.　　　　　　　　　(5 M + 3 M)

```
digit → 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
digits → digits digit
       | digit *
       | digit
optionalFraction → . digits * digits
optionalExponent → e ^+ digits
                 | e ^- digits
number → digits optionalFraction optionalExponent
```

(ii) Is the grammar given in 4 (i) left recursive? If yes, write the name of the left recursion and also rewrite the particular rule without left recursion.

5. (i) What is the output of lexical analyzer called?　　　　　　　　　(1 M + 3 M)
(ii) What outputs are generated by lexical analyzer while parsing the following two statements?

[Hint: Consider d, e, f and g are all integer datatypes; _ represents Space character]
　(a) int_d_=_e_+_f_*___g;　　　　// Assignment Operation
　(b) printf_(_"HelloHowAreYou"_);　//Print Statement

---------------- END ----------------

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CYCLE TEST -II

Subject Code/ Name: CSPC34/ Computer Organization   Date:2 / 11/ 2022
Marks: 20   Time: 11:00AM–12:00 PM

Answer all the questions

1. Calculate $1.666015625 \times 10^0 (1.9760 \times 10^4 + -1.9744 \times 10^4)$ by hand, assuming each of the values are stored in the 16-bit half precision format Assume 1 guard, 1 round bit, and 1 sticky bit, and round to the nearest even. Show all the steps, and write your answer in both the 16-bit floating point format and in decimal. (4)

2. Draw neatly the data path diagram for the MIPS load instruction. Use a pencil and ruler. (4)

3. For the code below: (1+2+2)

```
lw $t0, 0($s1)
add $t1, $s1, $a2
sub $t0, $t0, $s2
sw $t1, 0($s1)
addi $s1, $s1, -4
```

   a. Identify all the data dependencies in the code given below and identify which dependencies will cause data hazards without forwarding hardware.
   b. Assuming there is no special hardware that is added for forwarding, add "nop" instructions to the code to avoid the data hazards.
   c. Assume that the hardware supports forwarding and stalling. Show from which pipeline register the data is taken from and where it is forwarded. How many cycles will it take to execute this code (no need for nops)?

4. Using a table calculate 16 divided by 5. You should show the contents of each register on each step. Assume both inputs are unsigned 5-bit integers. (3)

5. Briefly describe the floating-point load and store instructions. (2)

6. What is the need of a biased representation for the exponent in IEEE-754 format? (2)
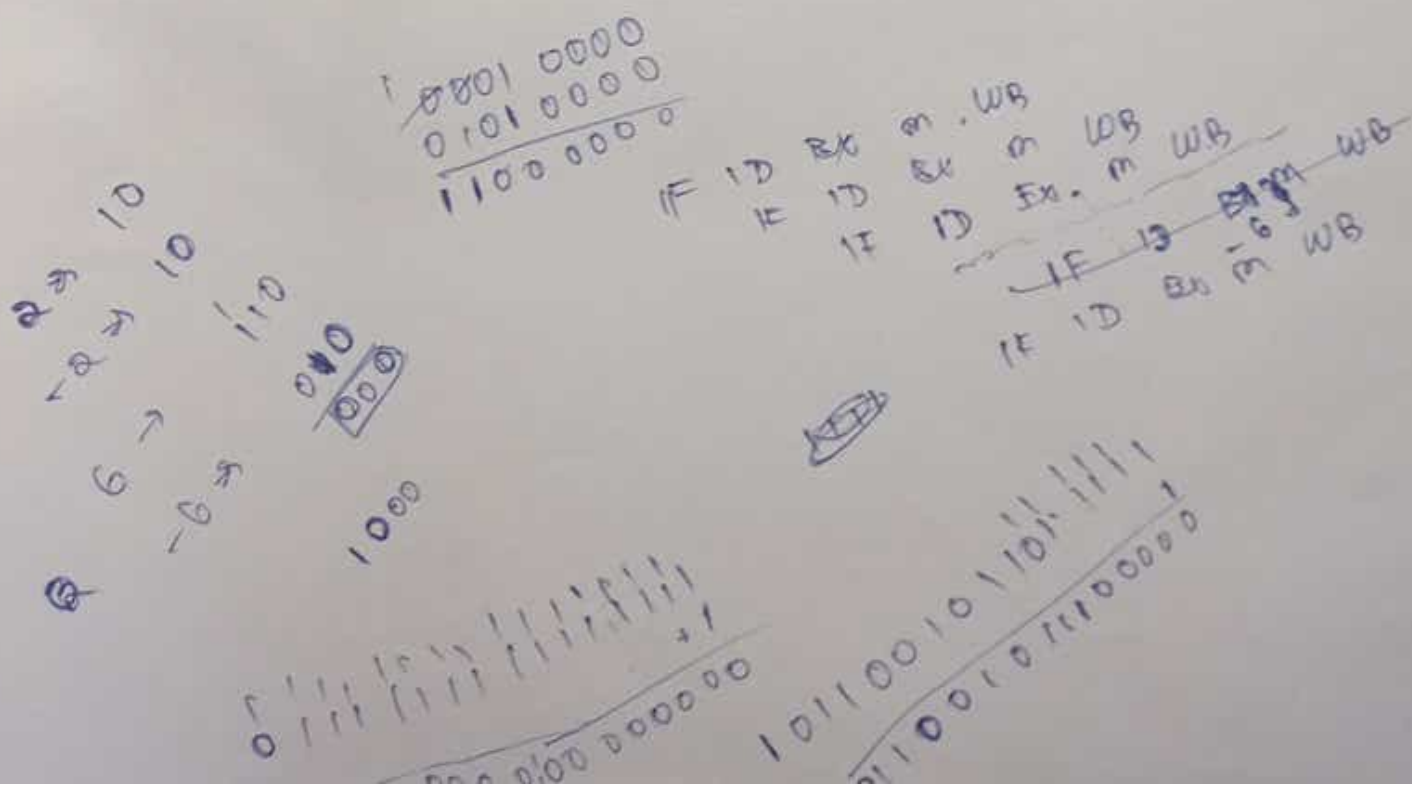
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Department of Computer Science and Engineering

CYCLE TEST - 2
Digital System Design

Course/ Branch   : B.Tech/ CSE   Course Code : CSPC33

Duration   : 1 Hour   Max Marks : 20   106121002

Answer All Questions

1. Convert JK flipflop to T flipflop. Draw necessary truth tables excitation tables and diagrams. (3)

2. With diagrams and truth tables, explain NOR latch in detail. (3)

3. Differentiate latch and flip-flop. (2)

4. Design a counter using JK-flipflop which counts the following sequence.
   0, 7, 6, 2, 3, 4, 1, 5, 0, 7, ... (5)

5. Design a 4-bit bi-directional shift register with direction control (C) bit. (Hint: If C=0, do left shift, else right shift) (5)

6. Differentiate Synchronous and asynchronous counters. (2)

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J	K	Q_n	Q_{n+1}
1	0	0	1
		1	1
0	1	0	0
		1	0
1	0	0	1
		1	1
1	1	0	1
		1	0

Course/Department : B.Tech./CSE   Batch : 2021-2025
Semester/Section   : III B   Session : July/2022
Date and Time   : 27-09-2022 & 03.00 PM – 04.00 PM   Marks : 15

Answer ALL Questions with proper steps and justification.
Draw diagrams wherever necessary.

1. Find the unique solution for $2a_n - 3a_{n-1} = 0$, $n \geq 1$, $a_4 = 81$.   (2)

2. Find the vertex connectivity and edge connectivity of the graph. Write down the corresponding cut-set and vertex cut/cut-vertex of the graph. Is there an articulation point in the graph?   (2)

3. Prove that every tree has either one or two centers.   (2)

4. State and prove Havel-Hakimi theorem.   (2)

5. Generate Prufer sequence from the labeled tree and also construct a tree from the generated sequence. (Cayley's Formula)   (2)

6. Construct induced subgraphs S1 and S2 from the graph given below using

   edge set, E(S1) = {c, n, h, g, d, k, i} and

   vertex set, V(S2) = {C, A, D, H, G, E, I}.

   Perform ring sum operation on S1 and S2. Show the resultant graphs.   (2)

7. Construct the minimum spanning tree from the graph using Prim's method. Find the cost of the minimum spanning tree.   (3)
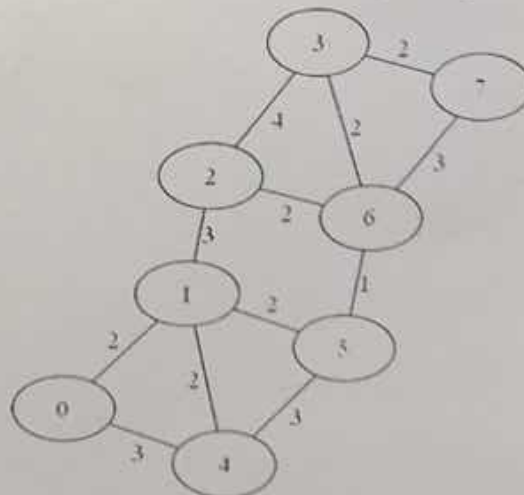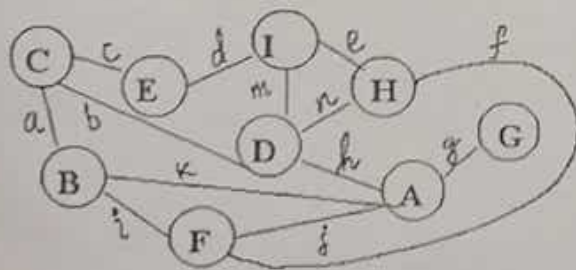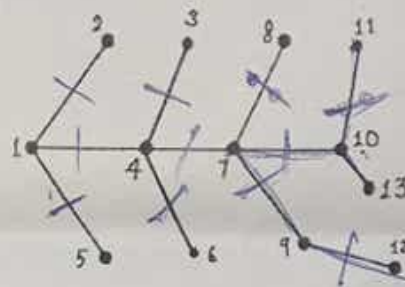
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
CSPC32- Data Structures

10 612002

Session: JULY/2022

Programme: B.TECH

Date: 01.11.2022

Cycle Test-2   Duration: 1 Hour   Total Marks: 20

Answer all the questions

1. Derive the time complexities for searching operation in BST and AVL tree? What is the height balancing factor, why height balancing is required in AVL trees? Explain with suitable examples [2 M]

2. Write a function to find the second largest element in BST and write the time complexity of the algorithm [3 M]

3. Write a function for inserting an element into the BST and write the time complexity of the function [3]

4. Discuss the different rotations and construct an AVL tree with the following elements [4 M]

    48 7 26 44 6 13 9 23 25 91 57 100 5 32

5. Sort the following list of elements by using bubble sort. What are the number of comparisons and swaps you have done during the sorting process of following list of elements and write the time complexity of bubble sort. [4 M]

    25, 2, 6, 14, 81, 20, 57, 100, 32, 28

6. Find all possible BFS and DFS orders for the following adjacency matrix [4 M]

	A	B	C	D	E	F
A	0	1	1	1	0	0
B	1	0	0	0	1	1
C	1	0	0	1	0	1
D	1	0	1	0	0	0
E	0	1	0	0	0	0
F	0	1	1	0	0	0

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Principles of Programming Languages – Cycle Test II   Date: 31.10.2022

Duration: 1 Hour   Time: 03:00 – 04:00 PM

Total Marks: 20

1. For the following program: **(2 M + 1 M + 6 M + 1 M)**

   (i)   Draw the basic Activation Record Instance

   (ii) Write the order in which the function calls are made

   (iii) Draw the complete Activation Record Instance *[Hint: Mark the current locations of EP and SP as well]*

   (iv) Write the final output of the program

```
int div(int j, int k)              int add(int d, int e, int f)
{                                  {
  int w = j / k;                     int z = sub(d, e, f);
  return w;                          return d;
}                                  }
int sub(int g, int h, int i)       void main()
{                                  {
  int x = div(g, h);                 int a = 5, b = 6, c = 8, x;
  return x;                          x = add(a, b, c);
}                                    printf("%d", x);
                                   }
```

2. Draw the descriptor table of multi-dimensional array.   **(2 M)**

3. What is the output of the following statement in C-Program?   **(1 M)**

   printf();

   (a) Prints Nothing   (b) NULL   (c) ""   (d) Error

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4. What is the size of the following two datatypes? (Consider, int = 2 Bytes; char = 1 Byte, float = 4 Bytes) **(2 M)**

```
struct                    union
{                         {
    int a;                    int a;
    char b;                   char b;
    float c;                  float c;
}                         }
```

(a) 7 Bytes, 2 Bytes   (b) 4 Bytes, 7 Bytes   (c) 7 Bytes, 4 Bytes   (d) None of the above

5. If the memory address to which a pointer (P_1) is pointing to has been deallocated, then the pointer (P_1) will be called as _____ **(1 M)**

(a) NULL Pointer   (b) Dangling Pointer   (c) Missing Pointer   (d) Empty Pointer

6. What is the output of the following statement? (Consider, list[0] is at address 1000 and the size of int is 2 Bytes) **(2 M)**

```
int list[5] = {1, 2, 3, 4, 5};
int *ptr = list;
printf("%d, ", *(ptr+2));
*ptr++;
printf("%d", *ptr);
```

(a) 3, 4   (b) 2, 4   (c) 2, 3   (d) 3, 2

7. What is the final value of p1, if the functional parameters are evaluated from R→L? **(2M)**

```
void sub(out int a, out int b)
{
    a = 17;
    b = 35;
}
int p1 = 5;
int p2 = 10;
f.sub(out p1, out p1);
```

(a) 5   (b) 35   (c) 17   (d) None of the above

------------------ END ------------------