



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computer Science and Engineering

MID SEMESTER EXAMINATION - February, 2024

COURSE TITLE: ICS 123 IT WORKSHOP II

Date & Time: 21.02.2024 & 9:30 - 11:00 AM

Course Instructor(s): Dr. Victer Paul, Dr. Amit Kumar & Dr. Sivaiah Bellamkonda

Max. Marks: 50

Batch(s): 1, 2 & 3

Answer all Questions

(10 x 5 = 50 marks)

1. Create three classes.

```

Faculty (facultyid, salary)
FullTimeFaculty (basic, allowance) inherits class Faculty
PartTimeFaculty (hour, rate) inherits class Faculty

```

Create a method for accepting input in FullTimeFaculty and PartTimeFaculty, but salary should not be accepted. Salary is calculated based on (basic+allowance) for FullTimeFaculty and (hour*rate) for PartTimeFaculty. Also, create a method in the above classes to display faculty data.

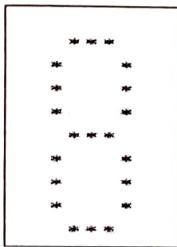
Create another class (say XYZ) for the main method and get input to store full-time and part-time faculty information. Also, print their details.

2. Create abstract class Car

- a) Define an abstract method ignition()
- b) Define a non-abstract/normal method changeGear(). Is this allowed?
- c) Create concrete class Sedan from Car. Overload ignition() method
- d) Inside the main program, Create an instance of Sedan and invoke ignition() and changeGear() methods. Does the program execute?
- e) Define a variable noOfWheels in the Car class. Can it be accessed in Sedan class?

3. Create an application program to track and display the number of instances of the class created, destroyed, and live during the program execution.

4. Write a program to print an 8-star pattern as shown in the below figure.



5. Design a class Student with private variables studentID, name, and testScores for each subject conducted for 100 marks. Implement appropriate accessor and mutator methods. Include a method to calculate the student's percentage based on the test scores. Write a driver program to create an array of Student objects and populate them with different student details taken from the user, then calculate and display the percentage of each student.

6. How are method overloading and method overriding different? Give suitable examples for each.
7. With a suitable program demonstrate how run-time polymorphism is implemented in Java.
8. Create a program that represents a hierarchy of vehicles. Implement the following classes:
- Vehicle**: The base class representing a vehicle, with attributes `brand` and `model`, and `display()` method to display these attributes. The derived class must override this `display()` method to display the specific attribute along with the derived attribute.
 - Car**: A derived class representing a car, with an additional attribute `seats`.
 - Motorcycle**: A derived class representing a motorcycle, with an additional attribute `engineDisplacement`.

Write a driver program to accept the data for vehicles and a user choice, which is passed to a method that returns a specific object on choice (1-Vehicle, 2-Car, 3-Motorcycle) then call display method from the returned object.

9. The Puthettu theatre in Pala city is newly renovated. So, they decided to give a 20% discount if one person buys more than 15 tickets. Also, they give an extra 5% discount, if he/she is a student. There won't be any discount if anyone purchases less than 15 tickets. The ticket rate may vary based on the movie. Karthik has planned to book the tickets for his juniors and friends. Help Karthick to calculate the amount and display whether the discount is applied or not.

Sample test case:

Input 1	Output 1
100	Discounts Applied - Maximum Tickets and Student
20	Total Amount - 1500.00
1	
Input 2	Output 2
100	No Discount Applied
10	Total Amount - 1000.00
2	

10. Define a base class `Animal` with the following attributes:

```
i.name (String)
ii.age (int)
iii.sound (String)
```

- Implement a parameterized constructor in the `Animal` class to initialize the attributes.
- Include a method `makeSound()` in the `Animal` class, which prints the sound the animal makes.
- Create two subclasses: `Mammal` and `Bird`. The `Mammal` class should inherit from the `Animal` class and include an additional attribute: `furColor` (`String`)
- The `Bird` class inherit from the `Animal` class and include an attribute: `wingSpan` (`double`)
- Override the `makeSound()` method in both the `Mammal` and `Bird` classes to print a species-specific sound.

Create FOUR objects two each of the `Mammal` and `Bird` classes and store it in an Array and access the array to check whether the object two and three are the object of `Mammal`, if so print YES otherwise NO.

Name:

Roll No: 23BCS3



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

MID SEMESTER EXAMINATION- FEBRUARY, 2024

IMA 121 CALCULUS AND LINEAR ALGEBRA

Date & Time: 19-02-2024, 09:30 AM - 11:00 AM

Max mark: 50

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

Answer all Questions

1. Let

$$f(x) = \begin{cases} x+4 & \text{for } x < -2 \\ -x & \text{for } -2 < x < 1 \\ x^2 - 2x + 1 & \text{for } 1 < x < 3 \\ 10 - 2x & \text{for } x > 3 \end{cases}$$

Is it possible to define f at $x = -2, 1, 3$ in such a way that f becomes continuous at $x = -2, 1, 3$. If so, find $f(-2)$, $f(1)$ and $f(3)$. If f has discontinuity at any point, identify the type of discontinuity.

[8]

2. (a) Suppose f is continuous and differentiable in $[-7, 0]$ and $f(-7) = -3$, $f'(x) \leq 2$. What is the largest possible value for $f(0)$?
(b) Determine all the numbers c which satisfy Rolle's theorem for the function $g(t) = 2t - t^2 - t^3$ defined on $[-2, 1]$. [4+4]
3. (a) Verify whether the function $f(x) = \frac{1}{x}$, is uniformly continuous on the interval $(0, 1, \infty)$ or not.
(b) Find a number δ for the function $f(x) = 2x - 1$ satisfying $|f(x) - 3| < \frac{1}{2}$ whenever $0 < |x - 2| < \delta$. [4+4]
4. A function f is defined on $[a, b]$ by $f(x) = e^x$. Find $U(P, f)$ and $L(P, f)$. Deduce that f is Riemann integrable by taking n equal partitions on $[a, b]$. [8]
5. Let $t_n = \frac{1}{n} \left(1 + \frac{1}{\sqrt{2}} + \cdots + \frac{1}{\sqrt{n}} \right)$, $n = 1, 2, \dots$ Then, which of the following is true? Justify your claim.
- (a) The series $\sum_{n=1}^{\infty} t_n$ converges and the sequence $\{t_n\}$ converges to 0
(b) The series $\sum_{n=1}^{\infty} t_n$ converges but the sequence $\{t_n\}$ does not converge to 0
(c) The series $\sum_{n=1}^{\infty} t_n$ diverges but the sequence $\{t_n\}$ converges to 0
(d) The series $\sum_{n=1}^{\infty} t_n$ diverges and the sequence $\{t_n\}$ does not converge to 0 [6]

P.T.O

6. Determine whether the series $\sum_{n=1}^{+\infty} \frac{n+1}{\sqrt{1+n^6}}$ converges or diverges. [4]

7. Test whether the following series is conditionally convergent or absolutely convergent:
 $1 - \frac{1}{2} + \frac{1 \cdot 3}{2 \cdot 4} - \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6} + \dots$ [8]



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

Roll No:.....
23BCS3.....

Name:.....

MID SEMESTER EXAMINATION - FEBRUARY, 2024

COURSE TITLE: ICS122 Computer Organization

Date & Time: 19/02/2024, 2.30 PM – 4 PM

Max. Marks: 50

Course Instructor: Dr. Lakshmi, Dr. Della, Dr. Goutam

Sem: II

Batch: I, II, III

Answer all Questions

1. Describe in detail the roles of primary memory (RAM), cache memory, and control unit for execution of an instruction.

(5)

2. Identify the addressing mode used in given instructions

J LABEL

Addi \$t3, \$t2, 4

BNE \$t3, \$t2, Label

JR RA

lw \$t3, 32(\$t2)

(5)

3. For a particular high-level language statement, the compiler writer is considering two code sequences that require the following instruction counts:

Code sequence	Instruction count for each code sequence		
	A	B	C
1	4	6	7
2	8	5	6

CPI for each instruction class is given below

	A	B	C
CPI	3	4	5

- a) Which code sequence will be faster?
- b) What is the CPI for each sequence?

(2.5+2.5 = 5)

4. Write the MIPS code for the following high level language statements.

```
if (a == b)
    s = a + b;
else
    s = a - b;
```

(5)

5. sub \$t3, \$t2, \$t1. Identify the instruction type format R-type, I-type or J-TYPE. Give the representation of the instruction in binary format.

The following values are given:

opcode=0, funct=34, \$t1=9, \$t2=10, \$t3=11.

(5)

6. Assume the following register contents:

$\$t0 = 0xAAAAAAA, \$t1=0x12345678$

For the register values shown above, what is the value of $\$t2$ for the following sequence of instructions?

sll $\$t2, \$t0, 2$
or $\$t2, \$t2, \$t1$

(5)

7. Consider three different processors P1, P2, and P3 executing the same instruction set. a denotes the instruction set.

	Processor	Clock Rate	CPI
a	P1	4 GHz	2.2
	P2	2 GHz	1.5
	P3	3 GHz	1.0

- a) Which processor has the highest performance expressed in instructions per second?
- b) If the processors each execute a program in 10 seconds, find the number of cycles and the number of instructions.
- c) We are trying to reduce the time by 20% but this leads to an increase of 10% in the CPI. What clock rate should we have to get this time reduction?

(3+3+4 = 10)

8. Consider the following C code:

$A[10] = k - B[2].$

Write the corresponding MIPS assembly code. Then convert the MIPS assembly code to machine code representation of decimal and hexadecimal.

Given: Base address of array A is stored in $\$s1$, base address of array B is stored in $\$s2$, and k is in register $\$s3$, where $\$s1=17$, $\$s2=18$, and $\$s3=19$.

opcode-value:
lw: 35
sw: 43

funct-value:
sub: 34

(10)



Indian Institute of
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Name

Roll No 23BCS3

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM
Department of Electronics and Communication Engineering
IEC 121 Digital Design and Electric circuits
Mid Semester Examination, February 2024

Course Instructors: Dr. Milind Thomas/Dr. Rajesh G

Batch: I and III

Time: 09:30 am – 11:00 am

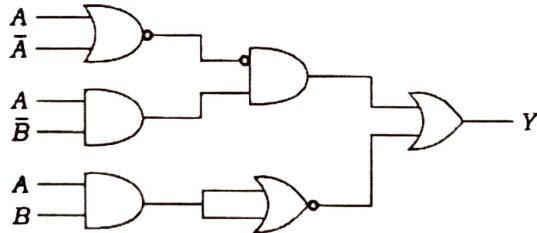
Semester II

Max marks: 50

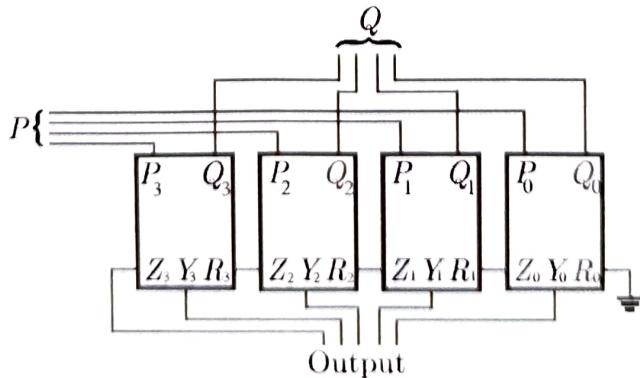
Answer all questions

Write necessary steps for each question

1. (a) If an equation in base- r number system given by $x^2 - 12x + 37 = 0$ has 8 as one of its solutions, then the value of r is _____. (2)
- (b) Two 8-bit numbers represented in signed 2's complement form are $P = 11101101$ and $Q = 11100110$. If Q is subtracted from P , the result in signed 2's complement form represented using 8-bits is _____. (2)
- (c) Let a function be defined as $f(A, B) = A' + B$. Then the simplified expression of the function $f(f(f(x + y', y), y'), x)$ is _____. (2)
- (d) The simplest Boolean expression of the output Y for the circuit shown in the figure is _____ (2)

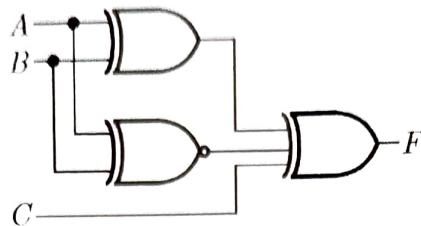


- (e) The circuit in the figure has 4 boxes each described by inputs P, Q, R and outputs Y, Z with $Y = P \oplus Q \oplus R$ and $Z = \overline{P}R + \overline{P}Q + \overline{P}Q$. The circuit acts as a 4-bit _____ [adder/subtractor] which gives the output _____ [select one: $(P + Q) / (P - Q) / (P + Q + R) / (Q - P)$] (2)



(5)

2. For the logic circuit shown below, write all possible combinations of inputs A , B and C for which $F = 1$. Also, replace the given logic circuit using a *single* logic gate which realizes the same Boolean function F .



(5)

3. Find the values of A , B and C which will simultaneously satisfy the following Boolean equations:

$$A + B = 1$$

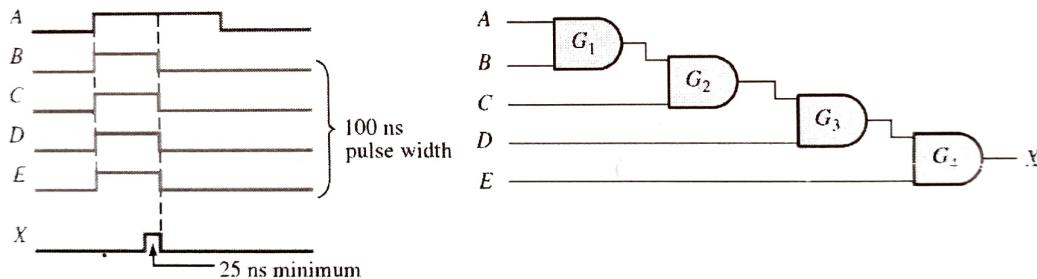
$$AC = BC$$

$$A + C = 1$$

$$AB = 0$$

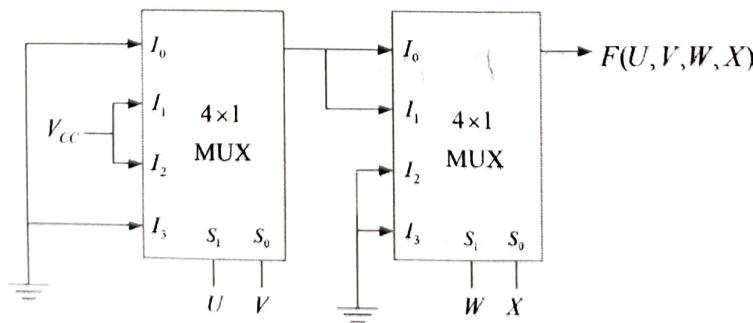
(5)

4. Assuming a propagation delay through each AND gate of 10 nanoseconds (ns), determine if the *desired* output waveform X in Figure (a pulse with a minimum width $t_W = 25$ nsec positioned as shown) will be generated properly with the given inputs.



(5)

5. A four-variable Boolean function is realized using 4×1 as shown in the figure. Find the minimized Sum-of-Products (SOP) expression for $F(U, V, W, X)$. (Note: In positive logic digital circuits, V_{CC} denotes logic 1 and Ground denotes logic 0.)



(5)

6. A binary-to-BCD encoder has four inputs D_0 , C_0 , B_0 and A_0 and five outputs D , C , B , A and VALID. The outputs D , C , B , A give the proper BCD value of the input and the VALID output is 1 if the input combination is a valid decimal code. If the input combination is an invalid decimal code, the valid output becomes 0 and all of the D , C , B and A outputs show 0 values. Assume only not gates and 2-input OR and AND gates are available. Implement the above circuit using minimum number of gates.

(5)

7. In a ternary number system there are three digits: 0, 1, and 2. Table below defines a ternary half-adder. Design a circuit that implements this half-adder using binary-encoded signals, such that two bits are used for each ternary digit. Let $A = a_1a_0$, $B = b_1b_0$ and Sum= s_1s_0 ; note that Carry is just a single bit digit. Use the following encoding: $00 = (0)_3$, $01 = (1)_3$ and $10 = (2)_3$. Realize the ternary half-adder circuit using minimized expressions for Carry and Sum.

AB	Carry	Sum
0 0	0	0
0 1	0	1
0 2	0	2
1 0	0	1
1 1	0	2
1 2	1	0
2 0	0	2
2 1	1	0
2 2	1	1

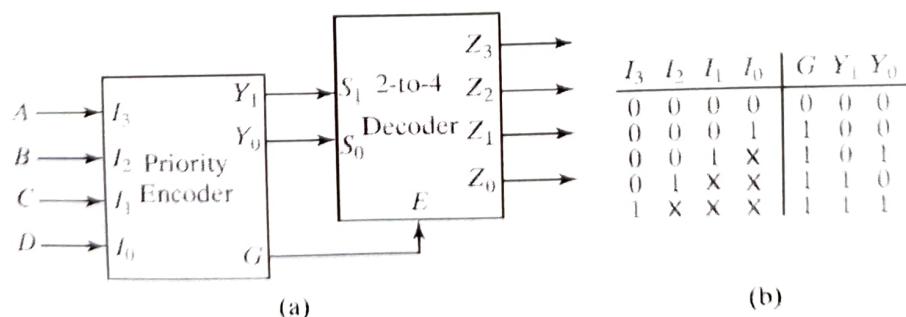
8. Four chairs (A , B , C , and D) are placed in a circle: A next to B , B next to C , C next to D , and D next to A . Each chair may be occupied (1) or empty (0). Give the minterm (using Σ) and maxterm (using Π) expressions for each of the following logic functions:

- (a) $F(A, B, C, D)$ is 1 iff there are no adjacent empty chairs.
- (b) $G(A, B, C, D)$ is 1 iff there are at least three adjacent empty chairs.
- (c) $H(A, B, C, D)$ is 1 iff at least three chairs are full.
- (d) $J(A, B, C, D)$ is 1 iff there are more people sitting in chairs A and B than chairs C and D .

Also write the minimized Product-of-Sums (POS) expression for G .

9. The circuit below has a 4-input priority encoder connected to a 2-to-4 decoder with enable. The truth table for the priority encoder is given. (The I_3 input is highest priority.) All signals are active high. What functions of A , B , C and D are realized by Z_1 , Z_2 , Z_3 and Z_4 ?

(5)



Roll No:..... 23BCS3

Name:..... Aditya



Indian Institute of
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INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computer Science and Engineering

FIRST MID SEMESTER EXAMINATION- FEB. 2024

COURSE TITLE: ICS 121 DATA STRUCTURES I

Time: 20-02-2024, 02:30 – 04:00 PM

Max. Marks: 50

Course Instructors: Dr. Dhakshayani J/ Dr. Lidiya Lilly Thampi / Dr. Chakradhar Varma

Batch: 2023

Answer all Questions

Note: You are allowed to write Pseudocode or Algorithm for the given questions

No clarifications will be provided

Q1. Analyse the time complexity of the following functions in the RAM model of computation.

[3+2=5 Marks]

(a) *int Unknown (int n)*

{

int t=23;

 1

for(int i=0; i<n; i++)

 n+1

 {

*for(int j=1; j<n; j=j*2)*

 log n

 {

for(int k=n; k>=1; k=k--)

 n+1

 {

while(t>0)

 23

 {

printf("I don't think the brain came in the Darwinian manner.");

 t=t-1;

 }

 }

 }

$O(n * \log n * 23) \Leftrightarrow O(n \log n)$

}

(b) *Algorithm ADD(A, B, C, m, n)*

{

for i:= 1 to m do

m

for j:=1 to n do

n

$O(m * n)$

C[i, j] = A[i, j] + B[i, j];

m * n

}

[P.T.O]

Q2. Write an algorithm to convert the given infix expression to postfix. Convert the following expression into its corresponding post fix form and evaluate postfix expression. [10 Marks]

$$(456+25)*(43 - 19)/(64 - 9)$$

Q3. Consider the following scenario for implementing a queue using two stacks: You have two stacks, stack1 and stack2, to simulate the behaviour of a queue. Initially, both stacks are empty. You are required to implement the enqueue and dequeue operations. [10 Marks]

Q4. Given the preorder traversal sequence of a Binary Search Tree as 1, 2, 3, 4, 5, 6, 7, 8, 9.

[3+1+ 1=5 Marks]

- Reconstruct the original Binary Search Tree and determine its type.
- Identify if the BST is full or not.
- Is the BST complete or not.

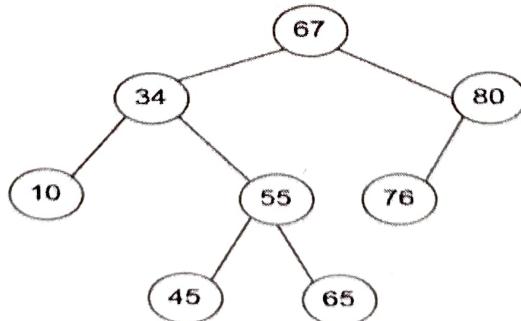
Q5. Write a procedure to swap adjacent elements of a single linked list by exchanging data part.

[10 marks]

For example: if a linked list is A->B->C->D->E->F->G->H, then after swapping adjacent elements it should become B->A->D->C->F->E->H->G.

Q6. What is the problem with implementing a queue using arrays? Explain the process used to overcome this problem by handling overflow and underflow cases. [5 marks]

Q7. Write an algorithm to delete the element 34 from the following Binary Search Tree and draw the resultant tree after deletion.



[5 marks]

Name:

Roll No: 23BCS3



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computational Science and Humanities

END SEMESTER EXAMINATION - EVEN 2023-'24

APRIL 2024

IMA 121 CALCULUS AND LINEAR ALGEBRA

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:** 2023

Answer all Questions

1. (a) Use $\epsilon - \delta$ definition of limit to establish $\lim_{x \rightarrow 1} \frac{x}{2+x} = \frac{1}{3}$. [4]
(b) Discuss about the differentiability of the functions $f(x) = x|x|$ and $g(x) = x + |x|$ on \mathbb{R} . [6]
(c) Find the values of a and b , if Rolle's theorem holds good at the point $x = \frac{4}{3}$ for the function $f(x) = x^3 + ax^2 + bx, x \in [1, 2]$. [5]
2. A function f is defined on $[0, 3]$ by $f(x) = x^3$. Find $U(P, f)$ and $L(P, f)$. Deduce that f is Riemann integrable by taking n equal partitions on $[0, 3]$. [8]
3. Test the series $\frac{x}{\sqrt{3}} - \frac{x^2}{\sqrt{5}} + \frac{x^3}{\sqrt{7}} - \dots$ for absolute convergence and conditional convergence. [7]
4. Find the absolute maximum and minimum of $f(x, y) = 4x^2 + 9y^2 - 8x - 12y + 4$ over the rectangle in the first quadrant bounded by the lines $x = 2$, $y = 3$ and the coordinate axes. [10]
5. Find the work done by the force $F = (x^2 - y^3)\hat{i} + (x + y)\hat{j}$ in moving a particle along the closed path C containing the curves $x + y = 0$, $x^2 + y^2 = 16$ and $y = x$ in the first and fourth quadrants. [10]
6. Verify Stoke's theorem for the vector field $F = (2x - y)\hat{i} - yz^2\hat{j} - y^2z\hat{k}$ over the upper half of the surface $x^2 + y^2 + z^2 = 1$ bounded by its projection on xy-plane. [10]
7. Find the direction derivative of $\nabla(\nabla f)$ at the point $(1, -2, 1)$ in the direction of the normal to the surface $xy^2z = 3x + z^2$, where $f = 2x^3y^2z^4$. [5]
8. Check whether the following vectors are linearly dependent or not. If linearly dependent, find the relation between them.

$$x_1 = (1, 2, 4), x_2 = (2, -1, 3), x_3 = (0, 1, 2), x_4 = (-3, 7, 2)$$

Also, form a basis for \mathbb{R}^3 from the given set of vectors.

[8]

P.T.O

9. On \mathcal{P}_n -the set of all polynomials of degree less than or equal to n, the inner product $\langle p_1, p_2 \rangle$ is defined by $\langle p_1, p_2 \rangle = a_0 b_0 + a_1 b_1 + a_2 b_2 + \cdots + a_n b_n$ for all polynomials,

$$p_1(x) = a_0 + a_1 x + \cdots + a_n x^n$$

$$p_2(x) = b_0 + b_1 x + \cdots + b_n x^n$$

Use Gram schmidt orthogonalization process and this inner product to determine an orthonormal basis for the subspace of \mathcal{P}_n spanned by the given polynomials $p_1(x) = 1 + x^2$, $p_2(x) = 2 - x + x^3$, $p_3(x) = 2x^2 - x$. [12]

10. Find the matrix transformation (A) of the linear map $T : \mathbb{R}^3 \rightarrow \mathbb{R}^3$

$$T(x, y, z) = (8x - 6y + 2z, -6x + 7y - 4z, 2x - 4y + 3z)$$

Find the eigen values, eigen vectors of A and then check whether the matrix is diagonalisable. [15]

Name

Roll No 23 BCS 3



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Electronics and Communication Engineering

IEC 121 Digital Design and Electric Circuits

End Semester Examination, April 2024

Course Instructors: Dr. Milind Thomas/Dr. Santhos Kumar A/Dr. Rajesh G

Time: 09:30 AM – 12:30 PM

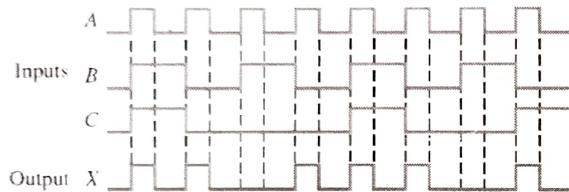
Semester II

Max marks: 100

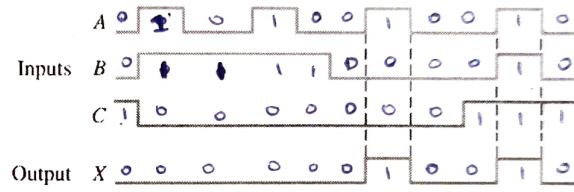
Answer all questions

Write necessary steps for each question

1. For the input waveforms each in Figure (a) and (b), draw the logic circuits (using minimum number of basic logic gates) that will generate the corresponding output waveforms given. (10)



(a)
5

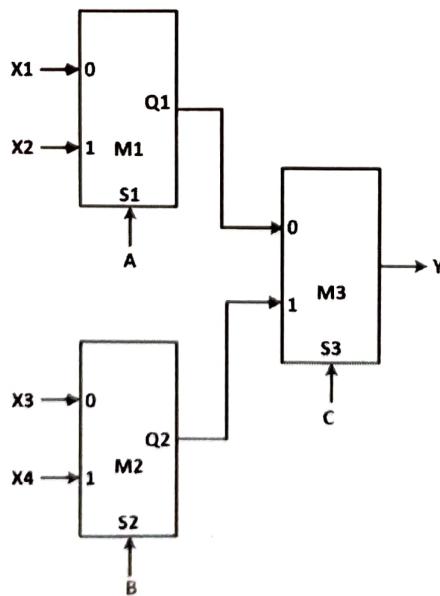


(b)
6

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

(5)

2. (a) Consider a digital logic circuit consisting of three 2-to-1 multiplexers M1, M2, and M3 as shown below. X1 and X2 are inputs of M1. X3 and X4 are inputs of M2. A, B, and C are select lines of M1, M2, and M3, respectively. (5)



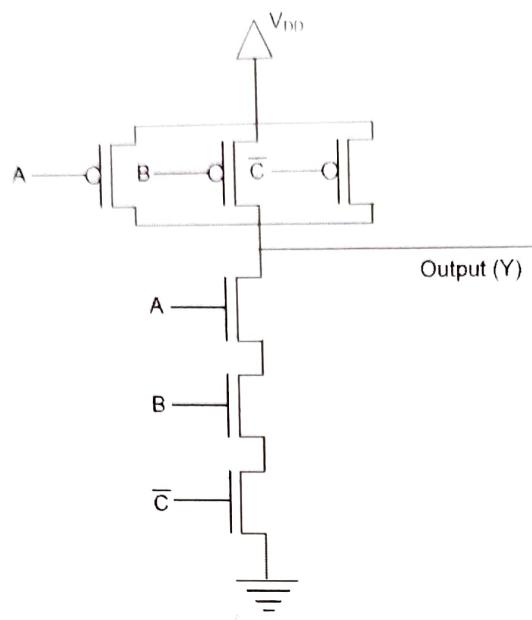
(5)

For an instance of inputs $X_1 = 1$, $X_2 = 1$, $X_3 = 0$, and $X_4 = 0$, write down all the combinations of A, B, C that give the output $Y=1$.

- (b) Show that the number 121_b where b is any base greater than 2, is a perfect square (i.e., it is equal to the square of some number). Repeat the same for the number 12321_b , where $b > 3$. (5)

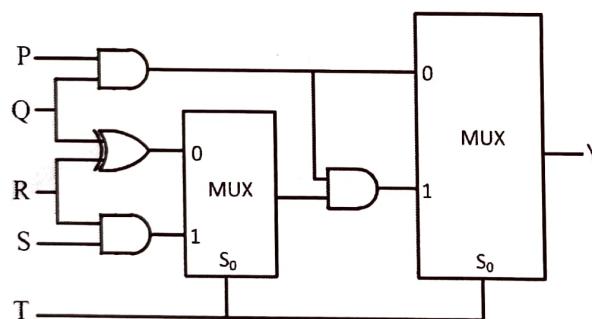
(2)

3. (a) Find the output (Y) of the circuit shown in the figure below in minimal SOP (or) POS form. (5)



(5)

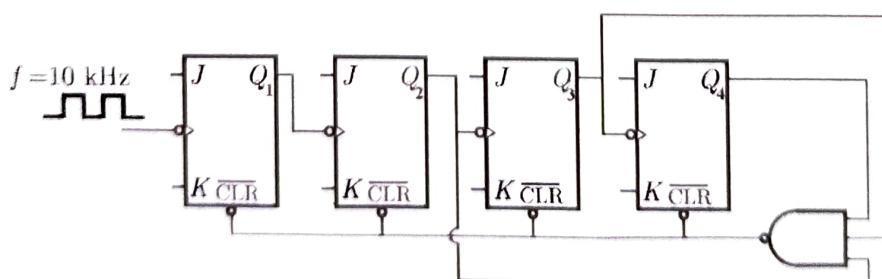
- (b) The propagation delays of the XOR gate, AND gate and multiplexer (MUX) in the circuit shown in the figure are 4ns, 2ns and 1ns, respectively. (5)



(5)

If all the inputs P , Q , R , S and T are applied simultaneously and held constant, find the maximum propagation delay of the circuit.

4. In the figure, the J and K inputs of all the four flip-flops are made logic HIGH. All the flip-flops have asynchronous active-LOW clear inputs. (10)



(3)

Draw the state table of the given counter circuit. If the frequency of the clock signal applied is 10 kHz, calculate the frequencies of the waveforms of

- (i) Q_1 (ii) Q_2 (iii) Q_3 and (iv) Q_4

(1)

5. A sequential circuit has two JK flip flops A and B and one input X. The circuit is described by the following input equations: (10)

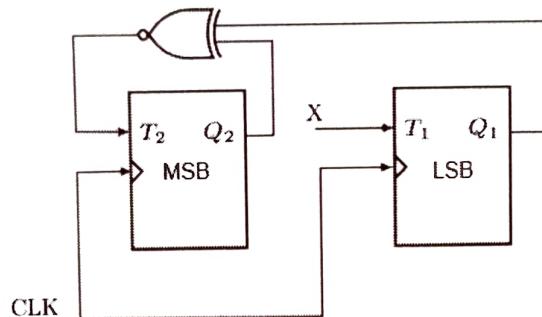
$$\begin{aligned} J_A &= X; K_A = Q'_B \\ J_B &= X; K_B = Q_A \end{aligned}$$

(4)

- (a) Obtain the next-state equations $Q_A(t+1)$ and $Q_B(t+1)$ using the input equations of the J and K variables.

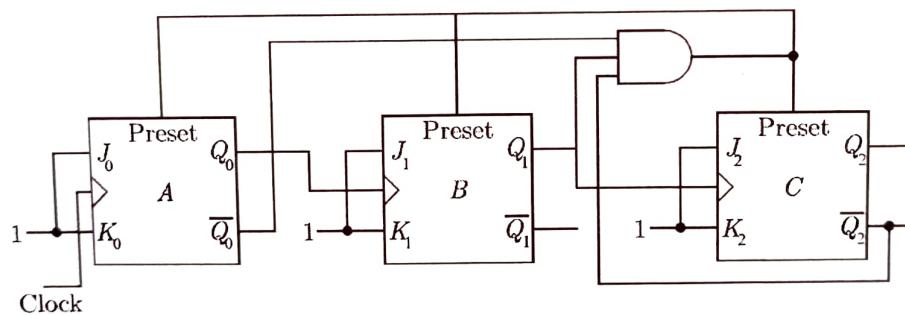
- (b) Draw the state diagram of the circuit described by the equations.

6. (a) Consider the partial implementation of a 2-bit counter using T flip flops following the sequence $0 \rightarrow 2 \rightarrow 3 \rightarrow 1 \rightarrow 0$ as shown. What should be the value of the input X to realize the sequence ? (5)



(5)

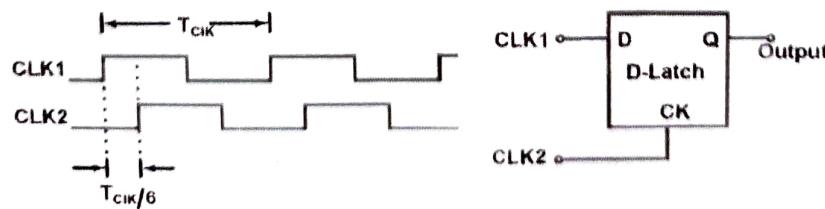
(b) Write the sequence of states ($Q_2Q_1Q_0$) the ripple counter shown in the figure goes through. Hence find the modulus of the counter. (5)



(4)

7. Design a synchronous counter using JK flip-flop that counts the sequence $0 \rightarrow 1 \rightarrow 0 \rightarrow 2 \rightarrow 0 \rightarrow 3$, and then repeats. (10)

8. (a) Consider the D-latch shown in the figure, which is transparent when its clock input CK is high and has zero propagation delay. In the figure, the clock signal CLK1 has a 50% duty cycle and CLK2 is a one-sixth period delayed version of CLK1. Find the duty cycle at the output of the latch (in percentage). (5)



(5)

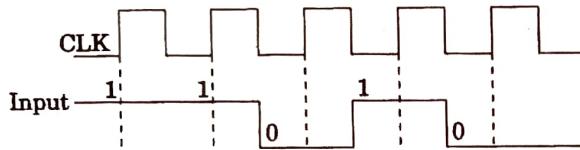
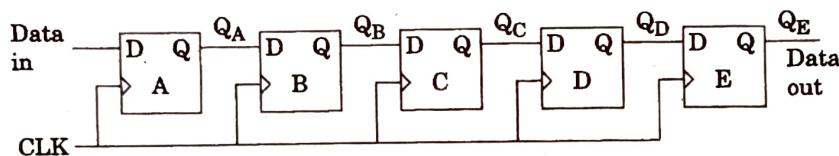
Note: Duty cycle of a periodic signal with period T is defined as the fraction of one period in which the signal is HIGH. It is given by the ratio T_{on}/T , where T_{on} is the time duration for which the signal is HIGH inside one period T .

- (b) The truth table for XY flip-flop is shown below. Design this flip-flop using JK flip-flops and additional logic gates. (5)

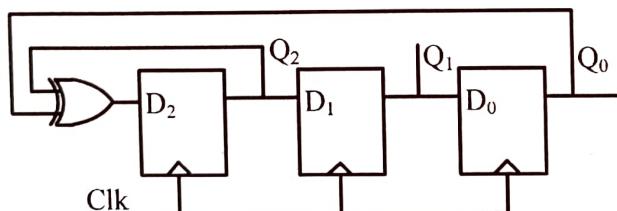
X	Y	Q_{n+1}
0	0	0
0	1	\bar{Q}_n
1	0	Q_n
1	1	1

(5)

- 9. Show the states (Q_A, Q_B, Q_C, Q_D and Q_E) of the five-bit register shown below using waveforms, for the specified data input and clock signal. Assume the registers to be initially cleared (all 0s). How long will it take to shift an 8-bit number into the shift register if the clock is set to 10 MHz? (10)



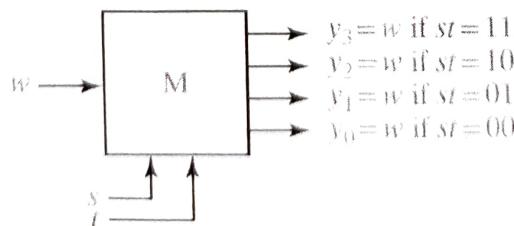
10. (a) The propagation delay of the exclusive-OR (XOR) gate in the circuit in the figure is 3 ns. The propagation delay of all the flip-flops is assumed to be zero. The clock (Clk) frequency provided to the circuit is 500 MHz. (5)



(5)

Starting from the initial value of the flip-flop outputs $Q_2Q_1Q_0 = 111$ with $D_2 = 1$, find the minimum number of triggering clock edges after which the flip-flop outputs $Q_2Q_1Q_0$ becomes 100 (with the help of the state table).

- (b) The module M below is a demultiplexer (i.e., it routes the input w to one of the four outputs depending on the value of the select lines s and t ; thus, an output is 0 or equal to input w depending on the value of s and t). The outputs of module M can be OR-ed to realize functions of the inputs. (5)



Show how to realize the function $f(a, b, c) = ab' + b'c'$ using one module M and one three-input OR gate. (Assume that the inputs are available in both true and complement form.)

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



END SEMESTER EXAMINATION - APRIL, 2024
COURSE TITLE: ICS122 Computer Organization

Date & Time: 19/04/2024, 9.30 AM – 12.30 PM

Max. Marks: 100

Course Instructor: Dr. Lakshmi, Dr. Della, Dr. Goutam

Sem: II

Batch: I, II, III

Answer all Questions

- 1) A program running on a processor has an instruction count of 2.389×10^{12} , an execution time of 750 s, and a clock cycle time of 0.333 ns.
 - a) Find the CPI.
 - b) Find the increase in CPU time if the number of instructions of the program is increased by 10% without affecting the CPI.

(5+5=10 marks)
- 2) Translate the following MIPS assembly language into C program. Assume that the C-level integer **i** is held in register \$t1, \$s2 holds the C-level integer called **result**, and \$s0 holds the base address of the integer **MemArray**.

```

addi $t1, $0, $0
LOOP: lw $s1, 0($s0)
      add $s2, $s2, $s1
      addi $s0, $s0, 4
      addi $t1, $t1, 1
      slti $t2, $t1, 100
      bne $t2, $s0, LOOP
    
```

(10 marks)

- 3) Sketch the single cycle datapath for MIPS instruction sw \$rt, 16 (\$rs). The control lines, datapath units and the connections should be shown neatly.

(10 marks)
- 4) Multiply 64 by 3 using binary multiplication algorithm, and show the contents of the associated registers in each step.

(10 marks)
- 5) Answer the following.
 - a) Describe different hazards in CPU pipelined architecture.
 - b) Analyze the code given below, which has to be executed in a 5 stage pipelined architecture. Check if pipeline hazard exists, and give the reason. Suggest a technique to eliminate the hazard and depict it with the help of appropriate timing diagram.

```

add $s0, $t0, $t1
sub $t2, $s0, $t3
    
```

(5+5=10 marks)

- 6) Answer the following.
- a) Consider the following decimal number: 71.25. Write down the binary representation of this number assuming IEEE 754 single precision format.
 - b) Consider two signed 16-bit hexadecimal numbers: 0C34 and CC17. Determine the sum of these numbers. Mention whether there is overflow, underflow or neither.

(5+5=10 marks)

- 7) Assuming a cache of 4K blocks, a 4-word block size, and a 32-bit address, find
- a) the total number of sets/indexes, total number of tag bits, and block offset for direct mapped cache,
 - b) the size of the direct mapped cache.

(5+5=10 marks)

- 8) Below is a sequence of 9 memory references to an empty eight-block cache. The tag field size is 2 bits. Show the values of all the fields (i.e., index, valid bit, tag, and data) in direct mapped cache memory for all the 9 memory references in tabular form. The sequence of memory references: 20, 16, 23, 20, 15, 12, 15, 17, and 4.

(10 marks)

- 9) Answer the following.

- a) What is virtual memory? Describe how virtual memory is translated into physical memory.
- b) Given a cache with hit ratio of 90%, access time of 5 nanoseconds, and miss penalty of 25 nanoseconds, what is the average access time for this cache?

(5+5=10 marks)

- 10) Explain in detail the following I/O data transfer mechanisms.

- a) Interrupt-driven I/O
- b) Direct Memory Access.

(5+5=10 marks)



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of Computer Science and Engineering

END SEMESTER EXAMINATION - APRIL, 2024

COURSE TITLE: ICS121 – Data Structures I

Time: 22.04.2024 – 09:30 AM to 12:30 PM

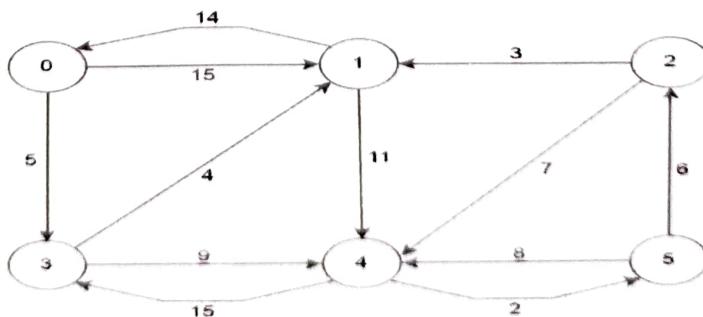
Max. Marks: 100

Course Instructor(s): Dr.Dhakshayani J, Dr. Lidiya Thampi & Dr.Chakradhar

Batch: 2023

*Answer all the questions
No clarifications will be provided.*

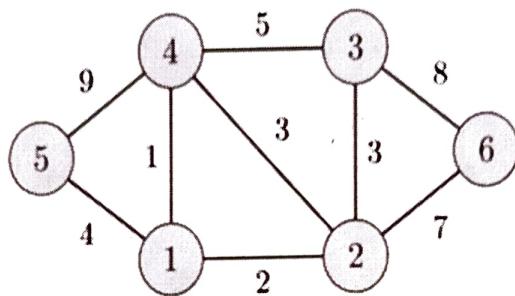
1. With a neat table, give the time complexity in best case and worst case for any five sorting algorithms. **(5 marks)**
2. Given the queue data structure, write an algorithm to implement the stack using only the given queue data structure (Note: No additional data structures can be used). **(10 marks)**
3. Construct Red-Black Tree by inserting the following key values sequentially
50, 60, 70, 40, 55, 75, 53, 54, 30, 45, 35, 51 **(10 marks)**
4. A chocolate factory produces a variety of chocolate bars that differ in weight. The bars need to be packaged and shipped, but before that, they must be sorted by weight in non-decreasing order to ensure even distribution in each shipment. The weights of the bars are given as **7, 6, 10, 5, 9, 2, 1, 15**. You have been tasked with
 - a) Sorting the chocolate bars by weight by choosing the first element as a pivot.
 - b) Writing the appropriate sorting algorithm. **(5+10=15 marks)**
5. Given the values {12, 18, 13, 24, 5, 3}, a hash table of size of 7, and a hash function $h(x) = x \bmod 7$, show the resulting table after inserting the values in the given order with each of the following collision resolution strategies: **(5+10=15 marks)**
 - a). Linear probing
 - b). Double hashing with second hash function $h'(x) = (2x - 1) \bmod 7$
6. For the following graph compute the shortest paths from vertex 0 to all other vertices using Dijkstras algorithm. (Note : Direct answer will be considered wrong and carried out no marks) **(15 marks)**



7. For the following graph, answer the following

(5+7+3=15 marks)

- Find the Minimum Spanning tree by using Prim's Algorithm.
- Explain the pseudo code for Prim's Algorithm and determine its time complexity.
- Can this algorithm work with negative weights? If not, Justify?



8. a) The following function tries to find out whether a BST is AVL tree or not. Trace and find out whether it gives correct output or not. Write the modified version if required.

(5+5+5=15 marks)

```
Int IsAVL(struct node *ptr)
{
    int h_l, h_r, diff;
    if(ptr == NULL)
        return 1;
    h_l = height(ptr ->lchild);
    h_r = height(ptr ->rchild);
    diff = h_l - h_r;
    if(diff <= 1)
        return 1;
    return 0;
}
```

b) Construct an AVL Tree by inserting the following values sequentially.

50, 40, 35, 58, 48, 42, 60, 30, 33, 25

c) Construct an AVL tree by deleting the following values sequentially from the resultant AVL tree obtained from the above question.

60, 48, 25, 30, 35, 33, 58



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, KOTTAYAM.
DEPARTMENT OF COMPUTATIONAL SCIENCE AND HUMANITIES

END SEMESTER EXAMINATION - EVEN 2023-'24
23 APRIL, 2024.

COURSE TITLE: IHS 121 PERSONALITY DEVELOPMENT

Time: 9.30 AM- 12.30 PM

Max. Marks: 100

Batch: 2023 Admission

Course Instructors: Dr. Gayathri G.R., Dr. Josit Mariya & Ms. Renjitha T. R

Answer all Questions

I. Answer each in a paragraph, not exceeding 50 words. (10x2= 20 marks)

- A. Define personality and explain any two measures to assess one's personality
- B. How do interpersonal skills contribute to effective teamwork?
- C. Explain the term 'arms akimbo' posture.
- D. What does the 'T' stand for in SWOT?
- E. What is your understanding about B need and D need?
- F. Give an example of how social media can influence self-image.
- G. Explain the four archetypes proposed by Carl Yung
- H. Define personal construct theory, elucidate with an example
- I. How can positive self-talk contribute to building self-esteem?
- J. How does functional analysis help to break one's smoking habit? Explain the three aspects

II. Answer in a paragraph not exceeding 100 words. (5x4= 20 marks)

- A. Explain the birth order theory proposed by Alfred Adler
- B. How will you set a SMART goal?
- C. Write a short note on the OCEAN theory of personality
- D. Why do body language experts consider the feet as the most honest part of your body?
- E. What are the characteristics of self-actualizers? Mention any four

III. Answer in a paragraph not exceeding 150 words. (5x6= 30 marks)

- A. Discuss the importance of conducting a SWOT analysis for business planning.
- B. Sigmund Freud is considered as the major contributor in the field of personality. Elucidate this statement on the basis of his contribution
- C. How does identity theory differ from Horney's neurotic needs?
- D. What is assertive behaviour? How is it related to leadership quality?
- E. Discuss the challenges of multitasking and its impact on time management effectiveness.

IV. Answer the following in not less than 300 words.

(2x15= 30 marks)

- A. Compare and contrast Behavioural approach and Humanistic approach
- B. How do you define stress management, and why is it important to maintain a healthy work-life balance?



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTTAYAM

Department of COMPUTER SCIENCE & ENGINEERING

END SEMESTER EXAMINATION- APRIL, 2024

COURSE TITLE: ICS123-IT WORKSHOP II

Date & Time: 25.04.2024 & 9:30AM – 12:30 PM

Max. Marks: 100

Course Instructor: Dr. Victer Paul, Dr. Amit Kumar & Dr. Sivaiah Bellamkonda

Batch: 1, 2 & 3

Answer all Questions

- 1) A) What is the mistake in the following code? Rewrite the code if required and write the output. **5M**
- ```
class Main { public void static main(String[] args) {
 System.out.println("Hello, World!"); } }
```
- B) Trace the following program and write the output: **5M**
- ```
class Main { public static void main(String[] args) {
    int sum=0, i=0;
    for(i=0;i<100;i=i+3);
    sum+=i;
    System.out.println(sum); } }
```
- 2) Write a Java program to create a class known as "**BankAccount**" with data members: **10M**
cust_name, acc_no, p_amount (principal amount) and a parameterized constructor to assign values to instance variables and display() method to display the customer details. Create two subclasses called "**SavingsAccount**" and "**CurrentAccount**" inherited from the "**BankAccount**" class. Both subclasses should have
- (i) parameterized constructors to assign the values for instance variables of superclass and subclass.
 - (ii) void deposit() method to accept the amount and update the principal amount as p_amount = p_amount + amt
 - (iii) void withdraw() method to accept the amount and update the principal amount as p_amount = p_amount - amt
- If the withdrawal amount is greater than the principal amount, then it should display "Insufficient funds."
- 3) Write a single program to execute the final, finally and finalize method. **10M**
- 4) Create a class named '**Member**' having the following members: Name, Age, Phone number, Address, Salary. Two classes '**Employee**' and '**Manager**' inherit the '**Member**' class. The '**Employee**' and '**Manager**' classes have data members '**specialization**' and '**department**' respectively. Now, assign name, age, phone number, address, salary, specialization or department for 5 employees and 5 managers by making an array of objects of both of these classes and print the same. **10M**
- 5) Write a program to execute nested try and catch blocks. The program should handle the Null Pointer Exception and ArrayIndexOutOfBoundsException exception. **10M**
- 6) Create an interface **Department** with attributes **deptName** and **deptHead**. It also has abstract methods for printing the attributes. Create a class **Hostel** with attributes **hostelName**, **hostelLocation** and **numberofRooms** with corresponding getters, setters. Write **10M**

Student class extending the Hostel and implementing the Department interface. **Student** has attributes **studentName**, **regdNo**, **electiveSubject** and **avgMarks**. Write suitable methods like **getData** and **printData** for **Student** class. Also implement the abstract methods of the Department interface. Write a driver class to test the Student class. The program should be menu driven containing the option

- (i) Admit new student
- (ii) Change hostel for a student
- (iii) Display details of a selected student

For the third option a search is to be made on the basis of the entered registration number.

- 7) List all the Interfaces of the collection framework. Perform max and min heap operation using the priority queue. **10M**
- 8) Write a Java application that manages a list of student records using ArrayList. The application should allow users to perform various operations on the student records stored in the ArrayList. Below are the detailed requirements for the application:
- Student** Class:
- (i) Create a Student class with the following attributes: **studentID** (int), **firstName** (String), **lastName** (String), and **GPA** (double).
 - (ii) Implement appropriate getter and setter methods for the Student class attributes.
- ArrayList** Management: Create an ArrayList named "studentList" to store Student objects.
- Implement the following operations using ArrayList:
- a. Add Student: Allow users to add a new student record to the ArrayList. The user should input the student details (ID, first name, last name, GPA) via the console.
 - b. Display All Students: Display the details of all students currently stored in the ArrayList in a tabular format (ID, First Name, Last Name, GPA).
 - c. Search Student: Allow users to search for a student by entering their **studentID**. Display the details of the student if found; otherwise, show a message indicating that the student is not found.
 - d. Remove Student: Allow users to remove a student record from the ArrayList based on the **studentID**.
- 9) A) What is the difference between a Cookie and a Session in PHP? **3M**
- B) Develop a PHP application that manages a simple text-based inventory system for a small retail store. The application should allow users to perform various file handling operations to maintain and update the inventory data stored in a text file. **7M**
- 10) Assume a MySQL database named 'IITK' has a user 'iiitk' with password '123456' running on same webserver and has a table named Student with fields Regno (string), Name (string), phone (integer), email (string). Write a single PHP program to connect to the database, insert student details into table which are read from HTML form coming from the same page and display all students data in a HTML table on the same page. **10M**
