



THE LNM INSTITUTE OF INFORMATION TECHNOLOGY

COA MID-TERM (2015-2016)

TIME: 90 MINS

MAX MARKS: 30

Q1. A computer has three I/O devices: a scanner, a flash drive and an RS232 (serial) line, with priorities 2, 3, and 6, respectively (6 being the highest). Initially, at $t = 0$ a user program is running. The three devices want to communicate with the system at the following times: scanner at $t = 15$, serial line at $t = 20$ and flash drive at $t = 25$. Assume that the ISR for each device runs for 15 time units. Show how the devices will be handled if the system uses a priority-based interrupt handling scheme. (4)

Q2. In a computer instruction format, the instruction length is 11 bits and the size of an address field is 4 bits. Is it possible to have

- 5 2-address instructions
- 45 1-address instructions
- 32 0-address instructions

using the format? Justify your answer.

b) Assume that a computer architect has already designed 6 two-address and 24 zero-address instructions using the instruction format given in the above problem. What is the maximum number of one-address instructions that can be added to the instruction set? (4+4=8)

Q3. The word-addressable memory unit of a computer has 256K words of 32 bits each. The computer has an instruction format with 4 fields: an opcode field; a mode field to specify 1 of 7 addressing modes; a register address field to specify 1 of 60 registers; and a memory address field. Assume an instruction is 32 bits long. Answer the following:

- a) How large must the mode field be?
- b) How large must the register field be?
- c) How large must the address field be?
- d) How large is the opcode field? (2+2+2+2=8)

Q4. How many bits would you need to address a $2M \times 32$ memory if

- a) The memory is byte-addressable?
- b) The memory is word-addressable? (2+2=4)

Q5. For a certain program, 4% of the code accounts for 70% of the execution time. Compare the following three strategies with respect to programming time and execution time. Assume that it would take 100 man-months to write it in C, and that assembly code is 10 times slower to write and four times more efficient.

- a. Entire program in C.
- b. Entire program in assembler.
- c. First all in C, then the key 4% rewritten in assembler. (1+2+3=6)



Anshul Goyal

THE LNM INSTITUTE OF INFORMATION TECHNOLOGY

B.TECH. 4th SEMESTER (2015-16)

COMPUTER ORGANIZATION & ARCHITECTURE, ENDTERM EXAM

MAX MARKS: 100

TIME: 3 HOURS

Q1. Fill in the blanks: (10*1=10)

- a) The hardware which determines potential data hazards in a pipelined architecture is called _____.
- b) The Hamming distance between 10010 and 10101 is _____.
- c) An optical mouse has an LED and a _____ on the bottom.
- d) A system with frequent page faults is said to be _____.
- e) A 64kB of cache can be organized as _____ cache lines of 64 bytes each.
- f) A device that produces an image line by line is called a _____ device.
- g) Distributing data over multiple drives in RAID is called _____.
- h) _____ modems can transmit data in both directions at the same time.
- i) In a digital camera, the film is replaced by a rectangular array of _____ that are sensitive to light.
- j) In CYMK colour printers, the inks used are cyan, yellow, magenta and _____.

Q2. What do the following acronyms stand for? (5*1=5)

- a) SIMD b) BIOS c) MMU d) LCD e) PSW

Q3. State two differences between: (5*2=10)

- ~~a) RISC and CISC~~ ~~b) Macros and procedures~~ ~~c) Virtual memory implementations using paging and segmentation~~ ~~d) Interrupts and traps~~ ~~e) Synchronous and asynchronous buses~~

Q4. Discuss a two-level centralized bus arbitration system. (5)

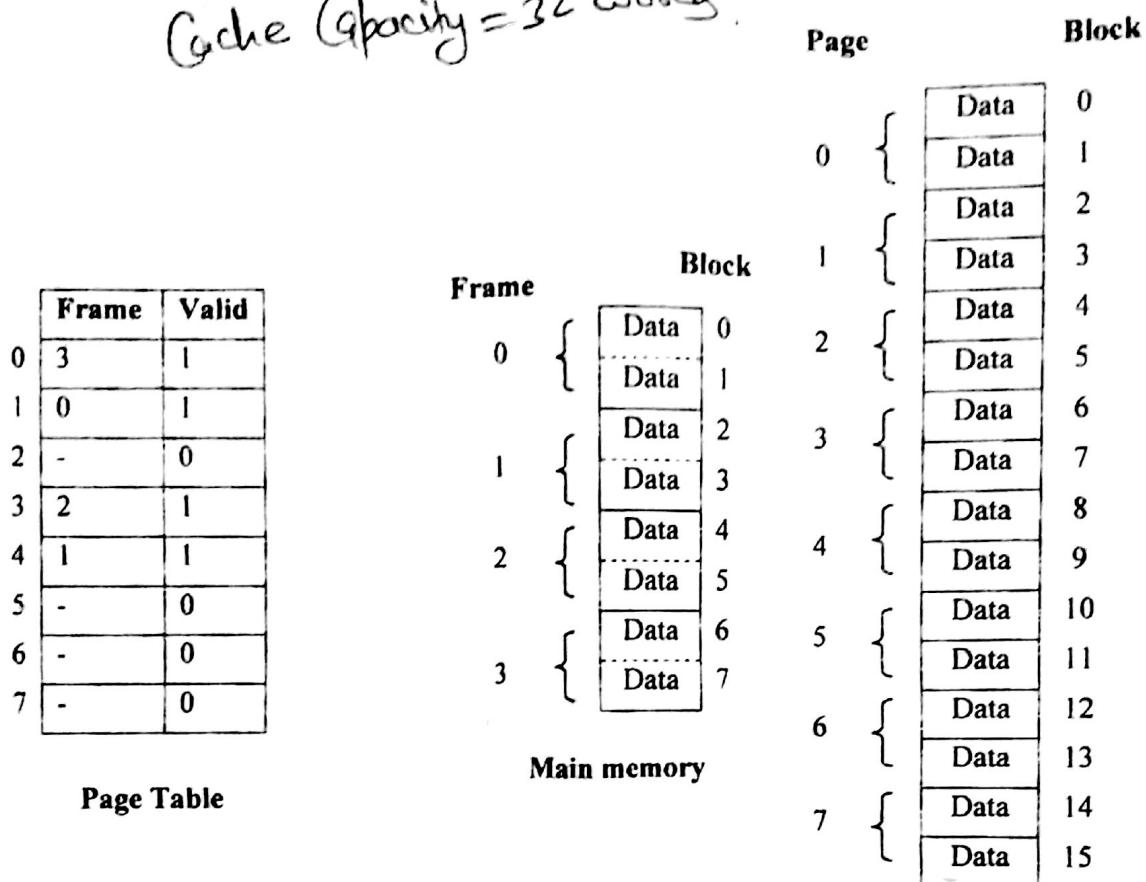
Q5. Assume that for a process, x and y are stored in a memory segment whose base address is in register R5. x is at offset 20 and y is stored in the next word. z is to be stored at memory address whose base address is in register R2 and offset is 30. Assume a byte addressable memory and a 32-bit machine.

For the C statement $z = x * y$

- a) Write the equivalent assembly language instructions and indicate the addressing modes being used in each. (8)
- b) For any two assembly language instructions in your program (must be of different types, ex. data movement and arithmetic), write the corresponding microinstructions. (5+5)

Q6. Given a virtual memory system, a 2-way set associative cache and a page table for a process P. Assume cache blocks of 8 words and page size of 16 words. In the system below, main memory is divided into blocks and two blocks equal one page frame. (DO NOT give objective answers. Show the working.)

Cache Capacity = 32 words



Page	Block	Main memory	
0	1	Data	0
		Data	1
		Data	2
		Data	3
		Data	4
		Data	5
		Data	6
		Data	7
		Data	8
		Data	9
		Data	10
		Data	11
		Data	12
		Data	13
		Data	14
		Data	15

Virtual memory for Process P

- a) How many bits are there in a virtual address of process P? (2)
- b) How many bits are there in the physical address? (2)
- c) Determine the translation of virtual address 18_{10} into physical address. (5)
- d) Determine the number of cache hits and misses if the following sequence of memory addresses is accessed:
 $49, 59, 50, 62, 3, 10, 17, 22$
Show the status of cache at each step. (16)
- e) Compute the hit ratio. (2)

Q7. Use the information in the following table to answer the question below:

Processor	Clock rate	CPI Class A	CPI Class B	CPI Class C	CPI Class D
P1	1.5 GHz	1	2	3	4
P2	2 GHz	2	2	2	2

Given a program with 10^6 instructions, divided into instruction classes as follows: 10% class A, 20% class B, 50% class C and 20% class D, which implementation is faster? (5)

Q8. Consider the following sequence of instructions being executed in a 5-stage pipeline having separate instruction and data caches. The pipeline stages are IF, ID, EX, OF, WB (in this order).

LOOP: ADDI R12, R12, 4

LW R8, 40(R12)

ADD R9, R9, R8

ADDI R11, R11, -1

CMP R11, R0

BNE LOOP

- a) Identify the different types of pipeline hazards. (5)
- b) Determine the stages where pipeline needs to be stalled to correctly execute the instruction sequence. (5)
- c) Can operand forwarding help reduce the hazards? Show how. (5)
- d) Can you suggest any reordering of instructions that would reduce the number of bubbles. Show how. (5)



Mid Term Exam Question Paper
Subject: Design and Analysis of Algorithms (CSE 325)
Max Marks = 50 **Time = 1.5 hours**

Note: Answer all parts of the question at one place only. Non-conformity will lead to answers being not corrected or deduction of marks. Also write your answers to the point in order to attempt all questions in time.

Q1. Fill in the blanks [5 marks]

- The upper bound for number of iterations in Gale-Shapley algorithm for stable matching between n men and n women is _____.
- An algorithm is "efficient" if _____.
- No efficient algorithm is known for _____ class of problems
- Bucket sort can be used when the numbers to be sorted are _____.
- The 3rd step (before re-arranging) in counting sort computes _____ in auxiliary array.

Q2. Answer the following questions very concisely. [3 x 3 = 9 marks]

- Two algorithms A and B have their running times $T(n) = 5T(n/4) + n \log n$ and $T(n) = aT(n/8) + n \log n$ respectively. Find the maximum value of 'a' such that B algorithm is faster than A?
- To sort an array of integers with range from 1 to n^c using radix sort in $O(n)$ time, find the value of base in which the numbers can be represented?
- For quick sort, let there be a procedure (with $O(n)$ time) for finding a good pivot element which splits into two, each of which contains atleast one-third of elements. Write the recurrence for the worst case $T(n)$ and its asymptotic bound.

Q3. Attempt any three of the following questions. [3 x 6 = 18 marks]

- Solve the recurrence $T(n) = 2T(n/2) + n \log_2 n$ using either substitution or recurrence tree method. (Hint: Take or substitute $n=2^m$)
- Derive the asymptotically tight bound for the BUILD MAX HEAP algorithm (discussed in class) which is used to re-arrange any given array into a max heap array. Note: you won't get credit if your answer is not asymptotically tight bound.
- Let $f(n)$ and $g(n)$ be asymptotically nonnegative functions. Using the basic definition of theta notation, prove that $\max(f(n), g(n)) = \Theta(f(n) + g(n))$

- d) How would you modify Strassen's algorithm to multiply $n \times n$ matrices in which n is not an exact power of 2 so that the algorithm still has a running time of $\Theta(n^{\lg(7)})$? (Hint: Think of extending the idea of block matrix multiplication)

Q4. Although merge sort runs in $\Theta(\log n)$ worst-case time and insertion sort runs in $\Theta(n^2)$ worst-case time, the constant factors in insertion sort can make it faster in practice for small problem sizes on many machines. Thus, it makes sense to coarsen the leaves of the recursion by using insertion sort within merge sort when subproblems become sufficiently small. Consider a modification to merge sort in which n/k sublists of length k are sorted using insertion sort and then merged using the standard merging mechanism, where k is a value to be determined. [10 marks]

- What is the worst case time complexity for insertion sort to sort the n/k sublists, each of length k . [2 mark]
- Write the recurrence relation for the modified algorithm in worst case and solve it to determine the asymptotic running time. [5 mark]
- What is the largest value of k as a function of n for which the modified algorithm has the same running time as standard merge sort, in terms of Θ -notation? [2 mark]
- How should we choose k in practice? [1 mark]

Q5. Given an array of N integers (which can be positive or negative, representing a person's emotional index on each day). Let the happiness in an interval be defined as the sum of the values in that interval. Design an $O(N \log N)$ algorithm to find the happiest interval of the person and its happiness value. For example, if the given array is $\{-2, -5, 6, -2, -3, 1, 5, -6\}$, then the happiest interval value is 7 (see highlighted elements). Write the pseudo code of the algorithm and justify its correctness and time complexity. [8 marks].



End Term Exam Question Paper

Subject: Design and Analysis of Algorithms (CSE 325)

Max Marks = 80

Time = 3 hours

Note: Answer all parts of the question concisely at one place only. Sub part of questions which are answered elsewhere may not be corrected. ~~There are~~ Total 4 sheets

Q1. Answer the following questions concisely. [15 marks]

- a) What is minimum spanning tree? State the difference between Prim's and Kruskal's algorithm for finding minimum spanning tree. [2 marks]
- b) Mention the names of two algorithms used for finding single source shortest path in a given graph and their time complexity. [2 marks]
- c) What is meant by topological sort and strongly connected component in a directed graph. [2 marks]
- d) When a problem is said to be polynomially reducible to another problem? [2 marks]
- e) Explain why the statement, "the running time of algorithm A is at least $O(n^2)$ " is meaningless. [2 marks]
- f) Briefly state two properties that the problems solved by greedy algorithm exhibit? [2 marks]
- g) State the principle of optimality. [1 marks]
- h) Define NP Complete problem and mention the first problem that was shown to be NP Complete. [2 marks]

Q2. Attempt any Five of the following questions. [5 x 5 = 25 marks]

- a) Prove or disprove: If $f_1(n) = O(g_1(n))$ and $f_2(n) = O(g_2(n))$, then $f_1(n) \times f_2(n) = O(g_1(n) \times g_2(n))$.
- b) For an Array A of N elements, if there are K inversions then prove that Insertion sort will sort the array in $\Theta(N+K)$ time. (note: Elements i and j are inverted if $i < j$ but $A[i] > A[j]$.)
- c) Write the pseudo code of Kruskal's algorithm and analyze its time complexity?
- d) Explain how Bellman-ford algorithm is used to detect the presence of negative edge cycle in the given graph?



- Q3) Explain the algorithms for union and find operation on disjoint sets represented using rooted trees and weighted union heuristic.
- f) Prove the correctness of Dijkstra's algorithm.

Part 2. Attempt any Four of the following questions (from Q3 to Q7). [4 x 10 = 40 marks]

Q3. (a) Explain Theta notation. Also express the lower bound for the time complexity of the below function $h(n)$ in terms of T_1 , T_2 and n , where $T_1(n)$ and $T_2(n)$ is the time complexity for some functions $f(n)$ and $g(n)$, respectively and n is the input value. [4 marks]

```
int h(int n)
{
    int sum=0;
    for (int i=0; i<n-1; i++) { sum += i; }
    if ((sum%5) > 2) { i= f(n); }
    else { i=g(n); }
    return i;
}
```

(b) Consider the problem of scheduling n jobs of known durations t_1, t_2, \dots, t_n for execution by a single processor. The jobs can be executed in any order, one job at a time. You want to find a schedule that minimizes the total time spent by all the jobs in the system. (The time spent by one job in the system is the sum of the time spent by this job in waiting plus the time spent on its execution.) Design a greedy algorithm for this problem and show that it will always yield an optimal solution. [6 marks]

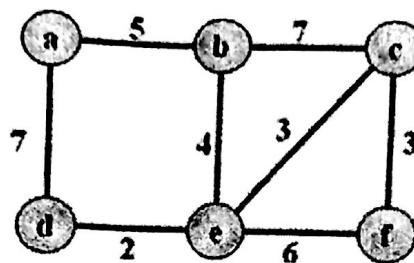
~~Q4 (a)~~ Give an algorithm using dynamic programming to determine how many distinct ways there are to give ' x ' cents in change using any coins from among pennies (1), nickels (5), dimes(10), and quarters(25). For example, there are 6 ways to give 16 cents change: a dime, a nickel, and a penny; a dime and 6 pennies; 3 nickels and a penny; 2 nickels and 6 pennies; one nickel and 11 pennies; and 16 pennies. Demonstrate your solution by showing a step-by-step solution for 12 cents change. [6 marks]

(b) Solve the following instance of knapsack problem where capacity $W=20$. The pairs (w,v) below corresponding to a task describe the weight w and its total value v . (Assume fractional knapsack.) [4 marks]

Task1: (4, 40), Task2: (7, 56), Task3: (9, 63), Task4: (5, 15), Task5: (6, 54)

Q5 (a) Prove that for almost uniform character distribution (where the maximum character frequency is less than twice the minimum character frequency), Huffman encoding is no more efficient than using fixed length encoding. [5 marks]

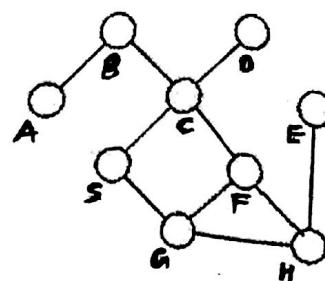
(b) Apply the Prim's algorithm on the following graph to find minimum spanning tree in given graph. Show the intermediate steps clearly [5 marks]



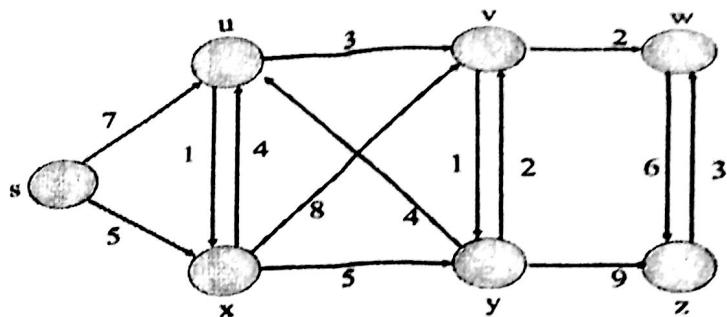
Q6 (a) What is transitive closure of the given graph $G(V,E)$ and how Floyd-Warshall's algorithm is used for finding it. [4 marks]

(b) Use dynamic programming recurrence for the matrix chains problem for 4 matrices of dimension 4×5 , 5×3 , 3×2 and 2×7 to determine the optimum number of scalar multiplications to multiply the matrices? Also find the best way to multiply these matrices. [6 marks]

Q7 (a) Describe how DFS algorithm will work for the following graph starting at vertex A. Show the intermediate steps and mention the time stamps for each vertex. [4 marks]



(b) Use Bellman Ford's algorithm to find distance on a shortest path between the nodes s and others in the following directed graph. Show the intermediate steps clearly. [6 marks]



The LNM Institute of Information Technology
 Design & Analysis of Algorithms (Quiz 2)
 (First 6 x 1 + Last 7 x 2 = 20 marks) Time: 40 min

1. Which of the greedy approach results in optimal solution for knapsack problem?
 - Selecting based on profit only
 - Selecting based on weight only
 - Selecting based on profit/weight ratio
 - All of the above
2. What is the time complexity of Interval Partitioning algorithm?
 - $O(N)$
 - $O(N \log N)$
 - $O(N(\log N)^2)$
 - $O(N^2)$
3. If edge weights in a graph is changed by a linear function, then minimum spanning tree in the new graph is different. (True/False?) False
4. Loop invariant for B.S. Algo $i \leq n$ is
4. MST always contains the edge with minimum weight of a graph. (True/False?)
Precisely $\text{lowest} \leq \text{target} \leq \text{high}$ \times
5. We are given as input a set of n requests (e.g., for the use of an auditorium), with a known start time si and finish time ti for each request i . Assume that all start and finish times are distinct. Two requests conflict if they overlap in time. Our goal is to select a maximum-size subset of the given requests that contains no conflicts. Which of the following greedy rules is guaranteed to always compute an optimal solution?
 - At each iteration, pick the remaining request with the earliest start time.
 - At each iteration, pick the remaining request with the fewest number of conflicts with other remaining requests (breaking ties arbitrarily).
 - At each iteration, pick the remaining request with the earliest finish time.
 - At each iteration, pick the remaining request which requires the least time (i.e., has

the smallest value of $ti - si$) (breaking ties arbitrarily).

6. Suppose that some of the weights in a connected graph G are negative. For constructing MST which statement is true?
 - Prim's algorithm will work but not Kruskal's \times
 - Kruskal's algorithm will work but not Prim's \times
 - None of them will work
 - Both will work

(D)

7. Suppose T is a minimum spanning tree of the graph G . Let H be an induced subgraph of G . (I.e., H is obtained from G by taking some subset $S \subseteq V$ of vertices, and taking all edges of E that have both endpoints in S .) Which of the following is true about the edges of T that lie in H ? You can assume that edge costs are distinct, if you wish.
 - They form a minimum spanning tree of H
 - They might have non-empty intersection with a minimum spanning tree TH of H , but at least one of the edges will be missing from TH
 - They are always contained in some minimum spanning tree of H
 - They might be disjoint from every minimum spanning tree of H

8. Let w be the minimum weight among all edge weights in an undirected connected graph. Let e be a specific edge of weight w . Which of the following is True?
 - There is a minimum spanning tree containing e
 - If e is not in a minimum spanning tree T , then in the cycle formed by adding e to T , all edges have the same weight. \times
 - Every minimum spanning tree has an edge of weight w

4. Loop invariant for B.S Algo^m is Precisely \times $\text{lowest} \leq \text{target} \leq \text{high}$.

d) All the above ✗

9. A networking company uses a compression technique to encode the message before transmitting over the network. Suppose the message contains the following characters with their frequency:

character Frequency

a	5
b	9
c	12
d	13
e	16
f	45

If the compression technique used is Huffman Coding, how many bits will be saved in the message w.r.t fixed length coding?

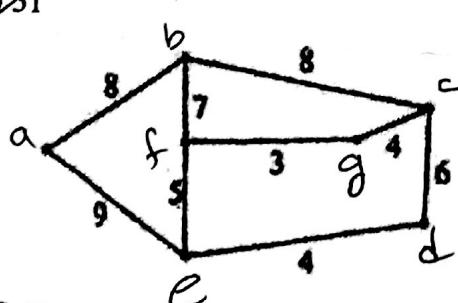
- a) 224
 - b) 800
 - c) 876
 - d) 324
- a) 90
b) 76
c) 95
d) 115
- (b) = 76 ✓

10. In the above question, which of the following code may represent the word "dead"?

- a) 1011111100101
- b) 0100000011010
- c) Both A and B
- d) None of these

11. Refer to the graph below. The minimum cost spanning tree has cost

- a) 28
- b) 29
- c) 30
- d) 31



12. We are given 4 sorted files x_1, x_2, x_3, x_4 whose size are 20, 30, 10, 5. What is the

weighted external path length of the optimal merge tree for the sequence of 2 way merge operation?

_____ 115 ✓

13. For fractional knapsack problem with following data. $m=30$, $(p_1, p_2, p_3, p_4) = (25, 24, 10, 15)$ and $(w_1, w_2, w_3, w_4) = (12, 15, 5, 10)$ what is the optimal solution vector ?

~~$x \{ \} = (1, \frac{13}{15}, 1, 0)$~~

✓

Time : 1 hour 30 minutes

Max Marks: 30

PART-A
Correct the syntax errors (if any) and find the output of the following Java program segments
Note: Show the workout in the answer script.

[2X10]

Q1. class Overload {

```
static int x;
double y;
static { x = 10; }
void add(double c, double d){
    x = (x+c*d);
    y = (c + d)*x;
}
```

```
Overload() {
    this.y = 10.0;
}
```

```
}
```

```
class Output {
    public static void main(String args[]){
        Overload obj = new Overload();
        Overload obj1 = new Overload();
        int a = 2; double b = 3.5;
        obj.add(a, a); obj1.add(b, b);
        System.out.println(obj.x + " " + obj.y);
        System.out.println(obj1.x + " " + obj1.y);
    }
}
```

Q3.

```
class Output {
    public static void main(String args[])
    {
        short x = 0x8000;
        byte y = 010;
        System.out.println(x + " and " + y);
        x = x >>> 15;
        y = y << 4;
        System.out.println(x + " and " + y);
    }
}
```

Q5. public class Test

```
{ public static void main(String [] args) {
    String names [] = new String[5];
    for (int x=0; x < args.length; x++)
        names[x] = args[x];
    System.out.println(names[2]);
}
```

\$ java Test Hello World

(if we run the program by giving the above command then what will be the output)

Q2. class Test {

```
int a;
int b;
Test(int i, int j) {
    a = i;
    b = j;
}
```

void meth(Test o) {

```
Test ob = new Test(o.a,o.b);
ob.a= ob.a*2;
ob.b = ob.b/2;
System.out.println(ob.a + " " + ob.b);
}
```

class Output {

```
public static void main(String args[])
{
    Test obj = new Test(10 , 20);
    obj.meth(obj);
    System.out.println(obj.a + " " + obj.b);
}
```

Q4. class X2

```
{ public X2 x;
public static void main(String [] args) {
    X2 x2 = new X2();
    X2 x3 = new X2();
    x2.x = x3;
    x3.x = x2;
    x2 = new X2();
    x3 = x2;
    System.out.println("Garbage Collection");
}}
```

how many objects are eligible for garbage collection?

Q6. public class A

```
{}
void A()
{
    System.out.println("Class A");
}
public static void main(String[] args)
{
    new A();
}
```



```

Q7. class A {
    final public int getResult(int a, int b)
    { return 0; }
}
class B extends A
{ public int getResult(int a, int b) {return 1; }
}
public class Test
{ public static void main(String args[])
{
    B b = new B();
    System.out.println("x = " + b.getResult(0, 1));
}
}

```

```

Q9. public class Except
{
    public static void main(String[] args)
    {
        try
        {
            return;
        }
        finally
        {
            throw new RuntimeException();
            System.out.println("Finally");
        }
    }
}

```

```

Q8. interface Count
{ short counter = 0;
void countUp();
}
public class TestCount implements Count
{ public void countUp()
    counter = counter + 10;
    System.out.print(" " + counter);
}
public static void main(String [] args)
{
    TestCount t = new TestCount();
    t.countUp();
}
}

```

```

Q10. public class MyProg
{
    public static void main(String args[])
    {
        try
        {
            System.out.print(args[0].substring(2));
        }
        finally
        {
            System.out.println("Finally executing ");
        }
    }
}

```

\$java MyProg
 (if we run the program by giving the above command.then what will be the output)

PART – B

[10Marks]

Q1. The Charity Collection Box contains money in different currencies - dollars-cents or pounds-pence or rupees-paise. All of these currencies have notes and coins. The note and coin numbers are counted when they are added based on their value (that is number of 5 rupee notes, or \$1 dollar note).

- Create a super class representing Currency is created with different denomination for of notes and coins and subclasses Dollar, Pound and Rupee has conversion methods to rupees, print() and compute().
- Create a class called CollectionBox that allows entry of these currencies in terms of number of notes and coins of different denomination. Create a display method that allows any of these currency types and displays the total amount collected in terms of Rupees. (Assume 1 dollar= Rs. 50 and 1 pound = 78).



Introduction to Psychology

Quiz 2

Name: ANSHUL GOYAL

Roll No.: 14UCS020

1. An employee receives a reward every 45 minutes. What type of reinforcement schedule is being used?
a) Variable Ratio Schedule b) Fixed Ratio Schedule
c) Variable Interval Schedule d) Fixed Interval Schedule
2. You had a car crash; now all cars scare you. ----- is occurring.
a) Extinction b) Generalization c) Discrimination d) Punishment
3. The "magic number" 7 ± 2 represents the average number of "bits" of information that short-term memory can usually handle.
4. The three stages of memory are ...Encoding, ...Storage & Retrieval
5. Which cognitive process helps in transferring information into the short-term store/ Memory?
Elaborative Rehearsal
6. The dominant encoding in LTM is
7. Outline the stages of observational learning.....
① Generalization
② Come back after some time
③ Extinction
8. We encode fromleft.....hemisphere whereas we retrieve from
.....right.....hemisphere.
9. Two types of declarative memory are.....Semantic (fact based) & Episodic (duty oriented)
10. Which Reinforcement schedule is known as Gambler's Schedule?.....Variable Ratio Schedule

6.



Date: 2/05/2016

Time: Three hrs.

Total Marks: 50

Instructions:

- Answers should include relevant concept/ theories/ examples in a logical manner.
- Highlight important points in your answer.

Q1. Is memory reconstructive in nature? Give rationale for your answer. Critically analyze the function of "Short Term Memory" for overall memory system and discuss the real life implications of "serial position curve".

10 marks

.....
.....
Attempt Any Five: Word Limit: 300-400 words

Q2. Every individual in certain respect "Like all other men, Like some other men and Like no other men." Critically analyze the relevance of this statement keeping in view "S. Freud's and Maslow's" perspective.

8 marks

Q3. What is "learned helplessness"? What message/ s does it impart for our life?

8 marks

Q4. Analyze how rational decision making, bounded rationality and intuitive decision making are different from each other. Which decision making is best and why?

8 marks

Q5. Analyze the advantages and disadvantages of the processes of "Accommodation and Assimilation" with reference to adjustment with a new culture with suitable example/ s. According to you which process has more advantages and why?

8 marks

Q6. What is normative and informational social influence? Give one example of each when you conformed due to normative and informational social influence.

8marks

Q7. In what manner the cognitive processes of learning, memory, perception, motivation and emotion are linked together. Analyze this connection with real life examples.

8 marks

Q8. Analyze real life applications of classical and instrumental conditioning.

8 marks