B.Sc. Engg. CSE / HD 5th Semester 21 May 2019

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION **WINTER SEMESTER, 2018-2019**

DURATION: 3 Hours **FULL MARKS: 150**

CSE 4501: Operating Systems

Programmable calculators are not allowed. Do not write anything on the question paper.

There are 8 **(eight)** questions. Answer any 6 **(six)** of them.

Figures in the right margin indicate marks.

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1. a) Consider the following segment table: 7

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

What are the physical addresses for the following logical addresses?
a) 0,430 b) 1,10 c) 2,500 d) 3,400 e) 4,112

b) Consider a paging system with the page table stored in memory:
   i. If a memory reference takes 200 nanoseconds, how long does a paged memory reference take? 5
   ii. If we add TLBs, and 75 percent of all page-table references are found in the TLBs, what is the effective memory reference time? (Assume that finding a page-table entry in the TLBs takes zero time if the entry is there.) 6

c) On a system with paging, a process cannot access memory that it does not own. Why? How could the operating system allow access to other memory? Why should it or should it not? 7

2. A page-replacement algorithm should minimize the number of page faults. We can achieve this minimization by distributing heavily used pages evenly over all of memory, rather than having them compete for a small number of page frames. We can associate with each page frame a counter. The counter value is a number representing the number of pages associated with this frame that will be used in the future. Therefore, the addition of a page and the very last use of a page change the counter value. Then, to replace a page, we can search for the page frame with the smallest counter value.

a) Define a page-replacement algorithm using this basic idea. Specifically address the problems of (i) what the initial value of the counters is, (ii) when counters are increased, (iii) when counters are decreased, and (iv) how the page to be replaced is selected. 6

b) How many page faults occur for your algorithm for the following reference string with four-page frames? 7

1, 2, 3, 4, 5, 3, 4, 1, 6, 7, 8, 7, 8, 9, 7, 8, 9, 5, 4, 5, 4, 2.

c) What is the minimum number of page faults for an optimal page replacement strategy for the reference string in part (b) with four-page frames? 12

3. Consider the following snapshot of a system. There are no outstanding unsatisfied requests for resources.

available			
r1	r2	r3	r4
2	1	0	0

	current allocation				maximum demand				still needs			
process	r1	r2	r3	r4	r1	r2	r3	r4	r1	r2	r3	r4
p1	0	0	1	2	0	0	1	2				
p2	2	0	0	0	2	7	5	0				
p3	0	0	3	4	6	6	5	6				
p4	2	3	5	4	4	3	5	6				
p5	0	3	3	2	0	6	5	2				

a) Is this system currently in a safe or unsafe state? Why? 7

b) Is this system currently deadlocked? Why or why not? 6

c) Which processes, if any, are or may become deadlocked? 3

d) If a request from p3 arrives for (0, 1, 0, 0), can that request be safely granted immediately? In what state (deadlocked, safe, unsafe) would immediately granting that whole request leave the system? Which processes, if any, are or may become deadlocked if this whole request is granted immediately? 9

4. a) Race conditions are possible in many computer systems. Consider a banking system with two functions: *deposit* (*amount*) and *withdraw* (*amount*). These two functions are passed the amount that is to be deposited or withdrawn from a bank account. Assume a shared bank account exists between a husband and wife and concurrently the husband calls the withdraw () function and the wife calls deposit(). Describe how a race condition is possible and propose a solution to prevent the race condition from occurring. 10

b) The first known correct software solution to the critical-section problem for two processes was developed by Dekker. The two processes, P_0 and P_1, share the following variables: 15

```
boolean flag[2]; /* initially false */
int turn;
```

The structure of process P_i (i == 0 or 1) is given below; the other process is Pj (j == 1 or 0).

```
do {
   flag[i] = TRUE;
   while (flag[j]) {
      if (turn == j) {
         flag[i] = false;
         while (turn == j)
            ; // do nothing
            flag[i] = TRUE;
      }
   }

   // critical section

   turn = j;
   flag[i] = FALSE;
   // remainder section
} while (TRUE);
```

Prove that the algorithm satisfies all three requirements for the critical-section problem.

5. Assume that a finite number of resources of a single resource type must be managed. Processes may ask for a number of these resources and —once finished—will return them. As an example, many commercial software packages provide a given number of licenses, indicating the number of applications that may run concurrently. When the application is started, the license count is decremented. When the application is terminated, the license count is incremented. If all licenses are in use, requests to start the application are denied. Such requests will only be granted when an existing license holder terminates the application and a license is returned.
The following program segment is used to manage a finite number of instances of an available resource. The maximum number of resources and the number of available resources are declared as follows:

```
#define MAX RESOURCES 5
int available resources = MAX RESOURCES;
```

When a process wishes to obtain a number of resources, it invokes the `decrease_count()` function:

```
/* decrease available resources by count resources */
/* return 0 if sufficient resources available, */
/* otherwise return -1 */
int decrease_count(int count) {
  if (available_resources < count)
    return -1;
  else {
    available_resources -= count;
    return 0;
  }
}
```

When a process wants to return a number of resources, it calls the `increase_count()` function:

```
/* increase available resources by count */
int increase_count(int count) {
  available_resources += count;
  return 0;
}
```

The preceding program segment produces a race condition. Do the following:

a) Identify the data involved in the race condition. Show the race condition with appropriate example. 6

b) Identify the location (or locations) in the code where the race condition occurs. 3

c) Using a semaphore, fix the race condition. It is allowed to modify the `decrease_count()` function so that the calling process is blocked until sufficient resources are available. 8

d) The `decrease_count()` function returns 0 if sufficient resources are available and −1 otherwise. This leads to awkward programming for a process that wishes to obtain a number of resources: 8

```
while (decrease_count(count) == -1)
  ;
```

Rewrite the resource-manager code segment using a monitor and condition variables so that the decrease count() function suspends the process until sufficient resources are available. This will allow a process to invoke `decrease_count()` by simply calling

```
Decrease_count(count);
```

The process will return from this function call only when sufficient resources are available.

6. a) Suppose that a disk drive has 5,000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is: 15

86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130

Starting from the current head position, find the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms.

a) FCFS b) SSTF c) SCAN d) LOOK e) C-SCAN f) C-LOOK

b) None of the disk-scheduling disciplines, except FCFS, is truly *fair* (starvation may occur).

i. Explain why this assertion is true. 5

ii. Describe a way to modify algorithms such as SCAN to ensure fairness. 5

7. a) Here is a table of processes and their associated running times. All of the processes arrive in numerical order at time 0.

Process ID	CPU Running Time
Process 1	6
Process 2	1
Process 3	2
Process 4	4
Process 5	3

i. Show the scheduling order for these processes under First-In-First-Out (FIFO), Shortest-Job First (SJF), and Round-Robin (RR) scheduling with a time slice quantum = 1 time unit. 9

ii. For each process in each schedule above, indicate the queue wait time and turnaround time (TRT). 6

b) Assume an operating system is using a scheduling algorithm that gives a higher priority to processes that have used the least CPU time in the recent past.

i. Why will this algorithm favor I/O-bound processes but not completely starve CPU-bound process? 5

ii. Give a formula for priority that would result in a good schedule for this algorithm. Your algorithm should allow a process to move from CPU-bound to I/O-bound and back over longer intervals. Assume you have a function `cpu_usage(int i)` that returns the total CPU usage (up to the current time) of process i. Hint: to get the CPU time used in the interval $(t, t + \Delta)$, you can call this at time t, call it again at $(t + \Delta)$ and take the difference. 5

8. a) Explain the steps involved in creating a thread. 5

b) How many times does the following program print hello? Justify your answer. 8

```
#include <stdio.h>
#include <unistd.h>
Main() {
  int i;
  for (i = 0; i < 3; i++)
    fork();
  printf("hello\n");
}
```

c) Consider a file system that uses inodes to represent files. Disk blocks are 8 KB in size, and a pointer to a disk block requires 4 bytes. This file system has 12 direct disk blocks, as well as single, double, and triple indirect disk blocks. What is the maximum size of a file that can be stored in this file system? 5

d) What is the copy-on-write feature, and under what circumstances is it beneficial to use this feature? 7

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B.Sc. Engg. / HD CSE 5th Semester — 18 May 2019

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION — **WINTER SEMESTER, 2018-2019**

DURATION: 3 Hours — **FULL MARKS: 150**

CSE 4503: Microprocessors and Assembly Language

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

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1. a) What is machine language? How can we get machine language from an assembly language? Explain with an example. 10

   b) Briefly explain about multiple interrupt concepts. 8

   c) What are basic differences between `LOOP` and `LEVEL` in assembly language programming? 7

2. a) Derive the contents of the following `MOV` instructions using its coding template and also show how the contents of the instructions can be stored in memory: 12

   i. `MOV DX, BX`
   ii. `MOV AAFFh[DI], AH`
   iii. `MOV AX, [1234h]`

   b) Write an assembly language program that will display "Microprocessors and Assembly Language" 10 (ten) times in different lines with line feed and carriage return. 6

   c) Considering following memory segments, offsets and instructions, write the sequence of PUSH/POP operations on stack segment mentioning different Stack Pointer (SP) values. Assume, initially the stack segment is empty. 7

Segment	Offset	Assembly Language
1000h	0100h	`IN AL, 27h`
1000h	0102h	`MOV DL, AL`
1000h	0104h	`MOV AH, 1`
1000h	0106h	**`INT 21h`**
1000h	0108h	`ADD AL, DL`

3. a) Draw the coding template of `IN` instruction. Explain the significance of using '`MOD`' and '`R/M`' in `MOV` coding template. 9

   b) Write the equivalent assembly language code structures using *conditional jump* and *loop* instructions to implement the *if-else*, *for* and *while* loop operations. 9

   c) Suppose, while debugging an assembly language program the values of the registers are: `Flag=FEB9h`, `IP=0102h`, `CS=0500h`, `SP=FFFCh`. Now, if `INT 21h` is requested, derive the memory addresses from where the new `IP` and `CS` can be retrieved; Also show the new `SP` value and steps involved in handling the interrupt by the 8086 microprocessor. 7

4. a) Write short differentiations between the following 8086 assembly language instructions: 9

   i. `ROL` and `SHL` ii. `LEA` and `OFFSET` iii. `NOT` and `NEG`

   b) Narrate the function of using `1`, `2` and `9` under `INT 21h` instruction. 8

   c) Distinguish between Memory-mapped I/O and Isolated I/O. 8

5.	a)	Draw the bus timing diagram for a microprocessor's operation while it performs a WRITE operation toward an OUTPUT unit.	10
	b)	What are the basic differences between MIN and MAX mode of 8086 pin diagram?	6
	c)	In how many ways can you define an array using assembly language programming? Give example code for each of them.	9
6.	a)	Draw a comparative table to differentiate between the features of 8086, 80186 and 80286 microprocessors.	10
	b)	'Utilization of parallel processors can be achieved through parallel programming'. How? Prove with appropriate example.	8
	c)	Write the functionalities of IOPL and NT flags for 80286 microprocessor.	7
7.	a)	What do you mean by Coppermine? How do Coppermine and L2 cache memory differ from each other?	8
	b)	How are the main memory of 80386 and Pentium processors segmented? Mention the use of address bus pins for both 80386 and Pentium microprocessors.	9
	c)	Write an assembly language program, where a MACRO is used to address a string and a PROCEDURE is used to display that string.	8
8.	a)	Define Thread and Turbo Mode in the context of multi-core processor system?	10
	b)	Differentiate between the features of core i3, i5 and i7 processors.	9
	c)	Write short notes on: i. U-Pipeline ii. V-Pipeline iii. Floating Point Unit (FPU)	6

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B.Sc. Engg. / HD CSE 5th Semester — 16 May 2019

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION — **WINTER SEMESTER, 2018-2019**

DURATION: 3 Hours — **FULL MARKS: 150**

CSE 4511: Computer Networks

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

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1. a) What is the slot time in CSMA/CD? Explain how the slot time is related to the maximum network length. Explain why a minimum frame size is required for Ethernet. — 3+6+4

   b) An Ethernet MAC sublayer receives 3040 bytes of data from the upper layer. Can the data be encapsulated in one frame? If not, how many frames need to be sent? What is the size of the data in each frame? — 4

   c) Write short notes on any two of the followings: — 4×2

      i. Bluetooth ii. Go-Back-N ARQ iii. Network Allocation Vector (NAV)

2. a) Derive the maximum achievable throughput of a pure ALOHA network. Derive the formula to determine the average transfer delay of a pure ALOHA network. — 4+7

   b) What do you mean by vulnerable time? "The vulnerable time in ALOHA depends on the frame transmission time, whereas it depends on the propagation delay in CSMA" - Justify the statement in your own word. — 2+7

   c) In CSMA/CA, contention window (CW) changes according to the binary exponential back-off strategy. The initial value of the contention window (CW_{min}) is 64. If a station requires 4 transmission attempts to successfully transmit a frame, what would be the back-off counter value for those transmission attempts? — 5

3. a) Name three ICMPv4 query message and three error-reporting messages. Depict the encapsulation process of ICMPv4 error messages. Under what circumstances no ICMPv4 error messages is generated? — 3+3+3

   b) Find the class and default mask of the following IPv4 address. Mention the number of possible IP addresses in each IP class. — 3 × 2

      i. 11000001.00000010.11111110.00000000 ii. 25.23.12.25 iii. 172.32.25.14

   c) A University is granted the address block 18.15.40.0/24, which contains 256 addresses. The university has six departments and needs to divide the addresses into six sub blocks of 128, 64, 32, 16, 8, and 8 addresses. Design the sub blocks and give the slash notation for each sub block that are assigned to different departments. With the aid of a diagram, show the configuration of the University network and answer the following questions: — 10

      i. What are the valid subnets?

      ii. What are the broadcast addresses for each subnet?

      iii. What are the valid hosts in each subnet?

4. a) Both IPv4 and IPv6 assume that packet may have different priorities or precedence. Explain how each protocol handles this issue. 6

b) In an *IPv4* datagram, the M-bit is 0, the value of HLEN is 5, the value of total length is 200, and the fragment offset value is 200. What is the number of the first byte and number of the last byte in this datagram? Is this the last fragment, the first fragment, or a middle fragment? 6

c) Mention the benefit of dropping the checksum field from IPv6 header. Does it introduce any potential danger of forwarding erroneous packets by IPv6? Explain. 6

d) Briefly explain the major functionalities of Address Resolution Protocol (ARP) of TCP/IP protocol suite? 7

5. a) Write short notes on any two of the followings: 2 × 4
i. Longest Mask Matching ii. Address Aggregation iii. Counting to Infinity (C2I)

b) How does link state routing differ from distance vector routing? Consider the network given in Figure 1. With the indicated link costs, use Dijkstra's shortest-path algorithm used in link state routing to compute the shortest path from **X** to all network nodes. Prepare the routing table for node **X**. 4+6

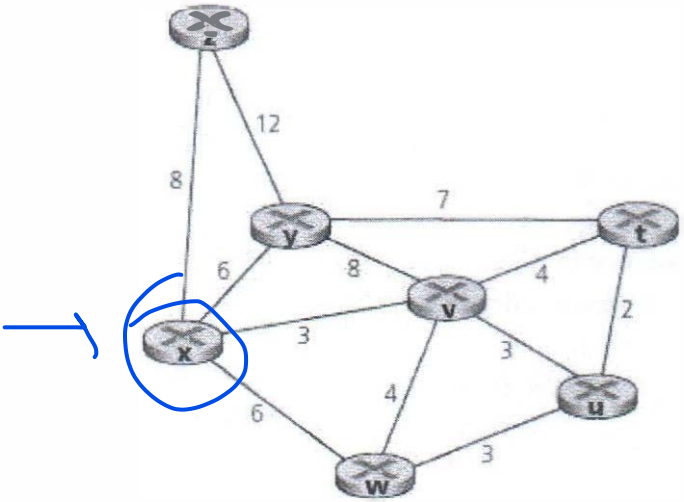

Figure 1: Network for Question 5.b)

c) What is the C2I (counting to infinity) problem of distance-vector routing? Mention some of the methods to eliminate the problem. 5+2

6. a) A TCP client opens a connection using an initial sequence number (ISN) of 14,534. The TCP server opens the connection with an ISN of 21,732. 4+4
i. Show the three TCP segments during the **three-way handshaking** connection establishment.
ii. Show the contents of the segments during the connection termination using **four-way handshaking with half-close**.
(Use timeline in y-axis for each side to show the **states** and the relative duration of the client and the server.)

b) Briefly explain the acknowledgement and retransmission policy of TCP error control mechanism. 6+6

c) Name different control flags in a TCP segment. Mention the minimum and maximum size of a TCP segment header. 3+2

7. a) How does congestion control differ from flow control in TCP? Suppose you have a TCP source, which starts transmission from segment number 15 with initial value of slow start threshold (*ssth*) 65000. The size of the receiver window (*rwnd*) is always larger that the congestion window (*cwnd*). Draw the timing diagram (time axes toward the bottom of the page for both the source and destination) for the transmission of segments at least up to 25. The diagram should include slow start, congestion avoidance, and one packet loss identified by triple duplicate acknowledgment and one by time out. 3+10

   b) Briefly explain the significance of Persistence timer and TIME-WAIT timer in TCP? A host sends five packets and receives three acknowledgments. The time is shown as hour:minute:seconds. 6+6

   i. Segment 1 was sent at 0:0:00.
   ii. Segment 2 was sent at 0:0:05.
   iii. ACK for segments 1 and 2 received at 0:0:07.
   iv. Segment 3 was sent at 0:0:20.
   v. Segment 4 was sent at 0:0:22.
   vi. Segment 5 was sent at 0:0:27.
   vii. ACK for segments 3 and 4 received at 0:0:45.
   viii. ACK for segment 5 received at 0:0:65.

   Calculate the values of RTT_M, RTT_S, RTT_D, and RTO of the retransmission timer of TCP. Given that the original RTO is 6 seconds.

8. a) Mention the major security goals of a computer network. How does symmetric key cryptography differ from asymmetric key cryptography? 2+4

   b) How do the classical ciphers differ from the modern ciphers? Encrypt the message "`successful`" using the Playfair cipher using the key "*Crypto*". 4+4

   c) Organizations with strict security often enforce password policies in order to make password management more secure. What could such policies be? Give examples. Discuss in what ways strict password policies may actually make password management less secure. 6

   d) Write a short note on any one of the followings: 5

   i. Replay Attack ii. Reflection Attack

B.Sc. Engg. / HD CSE 5th Semester 27 May 2019

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION **WINTER SEMESTER, 2018-2019**

DURATION: 3 Hours **FULL MARKS: 150**

CSE 4513: Software Engineering and Object Oriented Design

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

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1. a) What is the relationship among error, fault and failure? How can software defects be prevented in the early stage of the software development? 2+3

   b) "Consider a hospital management website used by hospital staffs, doctors and patients for making appointments. The system also provides suggestions regarding nearby hospitals, consultancy centers, diagnostic centers etc. The system stores data in both cloud and file storage system." Given the scenario, draw the Architectural Context Diagram of the system. 5

   c) Assume, IUT course management system enables the course manager, teachers and students manage courses during a semester. At the beginning of each semester, the course manager creates the list of offered courses. It is the task of the course manager to create, delete or update course information. Teachers are also assigned courses by the manager. Each course is coordinated by a teacher. Students can enroll in multiple courses during a semester through the system. 2+4+4
   Given the scenario, answer the followings:
   i. Identify the data entities of the system.
   ii. Draw the Entity Relationship Diagram of the scenario
   iii. Draw the Schema Diagram of the scenario.

   d) Identify and explain the Generalization, Aggregation and Composition relationships in the following Figure 1. 5

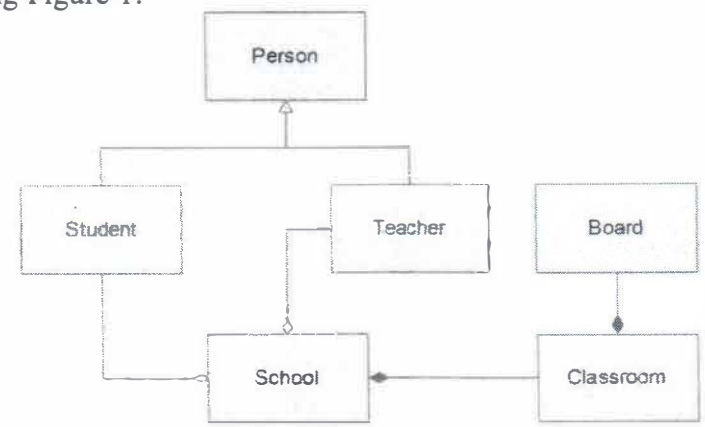

Figure 1: ERD for Question 1(d)

2. a) Describe Cross Site Scripting (XSS) with example. How can this attack can be prevented in web based systems? 3+3

   b) Capability Maturity Model (CMM) is a framework to analyze the approach and techniques followed by any organization to develop a software product. Briefly describe the organizational characteristics based on which CMM model analyzes the standard of an organization. 6

   c) What is Six Sigma? How is it used to assure industry level software quality? 5

   d) Define and draw Waterfall and Agile Software Process model. Discuss the advantages and disadvantages of each model. 4+4

3. a) Define Test Coverage. "100% coverage does not mean 100% tested." – Explain the assertion. 2+3

b) What is Cyclomatic Complexity? Given the code listing in Figure 2, compute the cyclomatic complexity, and identify the basic path set that can cover all the branches of the program. 1+7+6

```
int perform (int[ ] numbers, int N) {
      int i, count, sum, mean;
      i=count=sum=0;

      while (i<N && numbers[i]!=-1) {
            if (numbers[i]>=0 && numbers[i]<=1000){
                  count+= 1;
                  sum+= numbers[i];
            }
            i+= 1;
      }
      if (count>0 && sum>0)
            mean = sum/count;
      else
            mean = -1;
      return mean;
}
```

Figure 2: Code listing for Question 3(b)

c) Quality Engineering process has three activities – Pre-QA, In-QA and Post-QA activities. Briefly describe and draw the overall Quality Engineering Process. 3+3

4. a) State the differences between Black Box and White Box Testing. Following are fields that a user fills out while registering to a system: 2+12

Username: must be between 6 and 12 characters long, must start with a letter and include only letters and digits.
Age: must be a number greater or equal to 18 and less than 65.
City: must be one of Dhaka, Chittagong, Khulna or Sylhet
Postalcode: must be 6 characters long, start with a letter and alternates between letters and digits.

i. List valid and invalid equivalence classes for each input fields with examples.
ii. Besides for each field identify the boundary values.

b) Consider, in a website a user is prompted to upload a profile picture with certain conditions like – the image should be in '.jpg' format, the file size should be less than 32kb and the resolution should be exact 157×177. If any of the conditions fails the system will throw corresponding error message stating the issue and if all conditions are met photo will be updated successfully. 5

Draw the decision table for testing all possible situations a user can face while uploading the profile picture.

c) What are Quality Control (QC), Quality Assurance (QA) and Total Quality Management (TQM)? How can you advance your organization from QC to TQM? 3+3

5. a) Design patterns are known solution to existing problems. Abstract Factory pattern is applicable where multiple families of object components are involved while object creation.Demonstrate the Abstract Factory pattern with an example code. 10

b) Explain the quotation – "Don't unit-test GUIs. It's more trouble than it's worth." If so, how can we test GUI code? 2+1

c) XYZ company has completed the development of a website for Education Board Result Management System. Before releasing the product online, they have to perform rigorous testing. The company have decided to test following scenarios before product release: 8

i. At any particular time, generally 1000 users hit the website simultaneously. The system should behave normally, if concurrently 1000 users search for the results.

ii. During result publication hours, huge number of users may hit the system. If more than 1000 users query for result concurrently, the system may behave abnormally. After such a case, the system should resume properly with no data lose.

iii. Hackers may try to corrupt the system by sending 10,000 requests at a second.

iv. After result publication, most users tend to generate and download result reports.

For each of the above test scenarios identify and justify which testing type needs to be applied.

d) Is there any code smell in the following code snippet of Figure 3? If yes, describe methods to remove this smell. 4

```
public class Report{
      void printReport(Profile profile){
      string name = profile.GetFirstName() + " " +
      profile.GetLastName();
      System.out.println("Name is: "+name);
      string department = profile.GetDepartmentName();
      System.out.println("Department is: "+ department);
      double salary = profile.getBaseSalary() +
      profile.getBaseSalary() *.30;
      double tax = salary * .05;
      System.out.println("Salary is: "+salary+"and Tax is:"+ta
      }
}
```

Figure 3: Code listing for Question 5(d)

6. a) How is SQL Injection carried out to attack web systems? What precaution needs to be taken to prevent it? 3+2

b) What is Refactoring? What are the two advices we need to follow before refactoring? 2

c) What is the difference between Stub and Driver? Describe with example. Write a code sample where Mock testing is used. 4+4

d) Observer Pattern defines a one-to-many dependency between objects so that when one object changes state, all its dependents are notified and updated automatically. Briefly describe observer pattern with an example. 10

7. a) State the difference between Singleton and Flyweight pattern. 3

b) What is Unit Testing? Do we write unit tests for all methods of code repository, Why? 2+2

c) Developers are always sensitive about their written code. A developer has written a calculator class that can calculate the average of array of integers. However, with time the requirement changes and now, the client wants to calculate the average of list of integers. Explain how the developer can adapt with the new requirement by applying the appropriate design pattern. 7

d) What is Long Method smell? Describe three mechanisms for reducing this code smell. 1+6

e) Briefly Explain Refused Bequest. Which design pattern can provide the solution for refused bequest and How? 4

8. a) Explain the terms – Test Driven Development (TDD), Sanity Testing, Scalability, Lazy Instance. 8

b) Define Oddball Solution with example. State the difference between literal and semantic code duplication. 2+2

c) Managers, Postman, Firefighters and Computer Engineers all are workers. All of them generally follow a similar daily routine like get up from sleep, get food, go for work, do work, return home, relax and get sleep. However, their way of working and relaxing will be different based on their job types. Having this scenario, apply and demonstrate Template Pattern such that code duplicity can be reduced. 7

d) Identify the code smells from the following code snippet in Figure 4: 6

```
Public void Course{

    string courseName;
    int id;

    public Course(String name, int id){
       this.courseName = name;
       this.id = id;
      }
    List<Student> students = new ArrayList<Student>();

    void EnrollStudent(string name, int id, string date, strir
department, string city, string country, string brithdate){
        students.add(new Student(name, id, city, "","000000",
department, date, country, birthdate));
   }
   void findStudentByDepartment(string dept){
      foreach(Student s: students){
         if(s.department.Equals(dept){
            System.out.println(s.id);
         }
      }
   }
   void findStudentByCity(string city){
      for(int i=0; i< students.size();i++){
         if(students.get(i).city == city){
            System.out.println(s.id);
         }
      }
   }
}
```

Figure 4: Code listing for Question 8(d)

B.Sc. Engg. CSE 5th Semester (52) 24 May 2019

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION **WINTER SEMESTER, 2018-2019**

DURATION: 3 Hours **FULL MARKS: 150**

CSE 4551: Computer Graphics and Multimedia Systems

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

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1 a) Given an **up** vector (2,3,1) and a **look** vector (1,2,1), construct a 3D co-ordinate system (u,v,w) based on these camera-specification vectors. 10

b) Consider the co-ordinate system from part (a). Consider also, that for an arbitrary perspective view volume, we have set the far plane at depth 5. Consider a width angle of 64 degrees and an aspect ratio of 16:9 (width:height). Lastly, consider a center of projection **P** (100,150,100). Firstly, deduce the height angle. Then, given this information, write down the correct **sequence** of translation, rotation, and scaling matrices to transform this arbitrary perspective frustum to the canonical perspective frustum. There is no need to calculate the final product. 8

c) Consider the information from parts (a) and (b). Consider also that for the arbitrary frustum the near plane was at depth 2. Write down the unhinging transform that takes our perspective frustum and turns it into a parallel view volume. 3

d) Prove, using vigorous demonstration and with values of your choice, that an unhinging transform matrix works. 4

2 a) What is the basic idea behind the Painter's algorithm? Mention its primary limitation. 4

b) Explain backface culling with the aid of a diagram. What condition must hold for backface culling to be effective? 5

c) Demonstrate the idea behind the z-buffer algorithm with the aid of an example. Discuss advantages and limitations. 12

d) What is Z-Fighting? Given the following perspective frustums, rank the scenarios according to the severity of z-fighting they are likely to experience. Explain why. (Figures are not drawn to scale, so please avoid purely visual assessment. A, B, and C are independent setups with no connection to each other.) 4

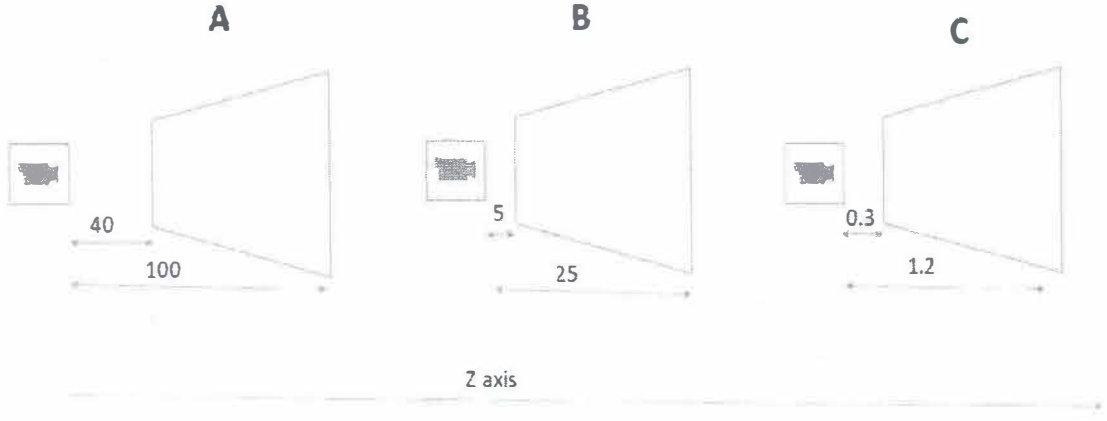

Figure 1: Three different perspective frustum setups – A, B and C.

3 a) Name the two main types of oblique projections. Now, match the following images to the correct type of oblique projection. Provide reasoning. 5

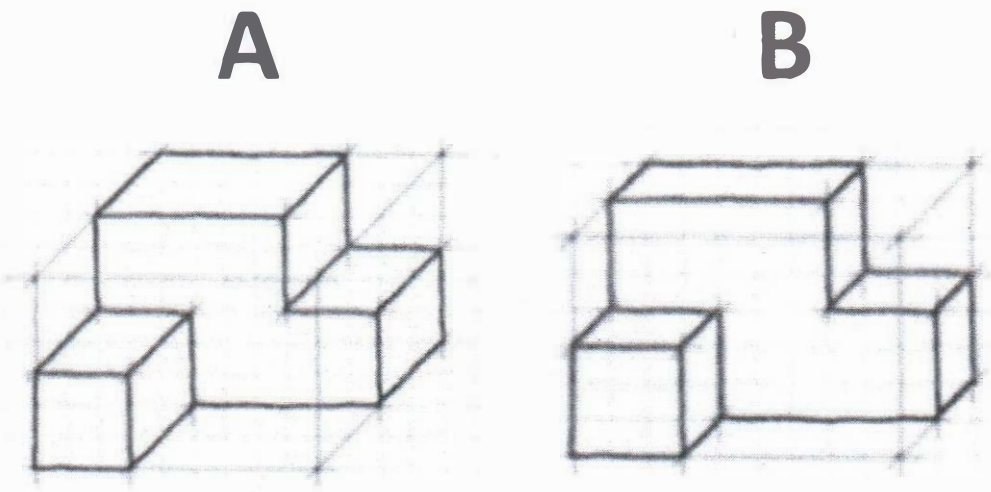

Figure 2: The same scene projected obliquely in two different ways.

b) Explain perspective foreshortening with the aid of an example. What are vanishing points? In the case where the face-normals of the object being projected are perpendicular to the coordinate axes, what is an easy way to estimate the number of vanishing points for the resulting image? 8

c) What are view volumes? Why do we often prefer parallel view volumes over perspective frustums? 5

d) Justify the necessity for both near and far clipping planes. How do the up and look vectors of a synthetic camera help to define the scene? What is the single constraint that up and look vectors must satisfy, with respect to each other? 7

4 a) Derive the expression for the value of **t**, the parametric intersection point between the line and the clipping window, in the Cyrus Beck Line Clipping Algorithm. Figures are not necessary. 5

b) A clipping window has co-ordinates: A(10,20), B(30,20), C(30,10) and D (10,10). A line has endpoints P(8,9) and Q(31,33). Find the final pair of $t_{entering}$ and $t_{leaving}$ values for this problem, using the Cyrus Beck line clipping algorithm. Using these values, find the final clipping points for the line. 10

c) Show how the Cohen Sutherland line clipping algorithm distinguishes between the fact that line AB should be partially clipped and that line CD should be completely removed. 5

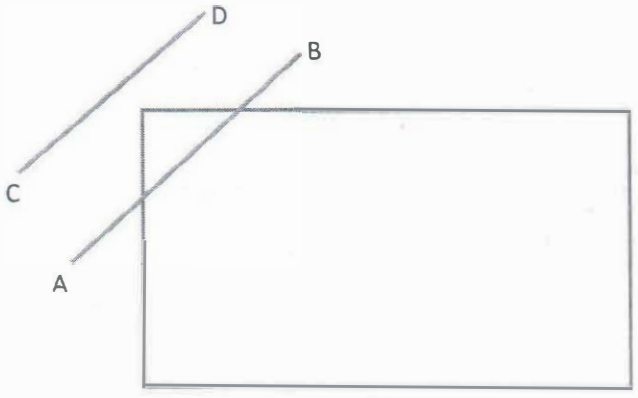

Figure 3: A clipping window and two lines, AB and CD.

d) One of the exit conditions for the Cyrus Beck Algorithm is when a $t_{leaving}$ value is found to be lower than its corresponding $t_{entering}$ value. Show an example scenario where this applies with the aid of a diagram. Using the directions of the vectors and normals, along with the sign of the dot-product check condition, show that when a t-leaving value is indeed generated **before** a t-entering value, that line should be discarded. Exact calculations and co-ordinates are **not** needed. 5

5. a) Derive, from the very beginning, the expressions for the values of d_{start}, ΔE, and ΔSE during the scan conversion of a **circle.** Remember to also use second differences to show how ΔE and ΔSE can be updated efficiently. 10
   b) Scan convert a circle, centered at the origin, and of radius 10 units. Show only the first five points, starting from the y axis. 8
   c) Distinguish between the radial distance decision and the vertical distance decision. The full derivation is **not** necessary. 3
   d) What adjustment needs to made for scan converting ellipses? Show how this is done mathematically. 4

6. a) What is a cumulative transformation matrix? Illustrate with an example. 6
   b) Based on your learning in this course, provide one specific use-case for the dot product and one for the cross product. 6
   c) Suppose you want to rotate an object about any arbitrary point in 2D. Assume that this arbitrary point has co-ordinate (X_p, Y_p). Assume also that the rotation angle is ϕ degrees in the **clockwise** direction. Find a single, final matrix that does this, when it is multiplied to the object's co-ordinates. 6
   d) Transformation matrices for almost all transforms can be derived by locating where the unit vectors in the x and y directions are transformed to. As an example, a reflection in the x axis leaves the x-unit vector, which is (1,0), intact, but transforms the y unit vector from (0,1) to (0,-1). The transformation matrix then becomes $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$, with the first and second columns representing where the x and y vectors are transformed to, respectively. 7

   Now, **U** is a 2x2 matrix representing a 90-degree anticlockwise rotation around the origin (0,0). **V** is a 2x2 matrix representing a reflection in the line y = -x. The composite matrix **R** is the product of V and U (R = VU). This new matrix **R** can also be considered as one single geometric transformation. Find **R**, and state the **single** geometric transform that it represents.

7. a) What are splines? Provide a brief discussion on the two main types of splines discussed in this course. 5
   b) How is a triangle mesh representation of objects stored in the computer? In this representation, what is a simple way of differentiating between front and back faces? 5
   c) Discuss geometry-based graphics and sample-based graphics in detail. What are some of the benefits and limitations of a sample-based system? 10
   d) Differentiate between vector display hardware and raster displays. What is the main limitation when displaying an image through a raster display? 5

8. a) Explain how the **perspective** normalizing transform derives its
   i) Rotation Matrix
   ii) Scaling Matrix
   10

   b) What kind of parallel projection retains only a single face of the object being projected, after projection? Provide evidence as to how and why. 5

   c) During Visible Surface Determination, we know the depth information only at the vertex locations. How do we efficiently fill in the "in-between" z buffer information? 5

   d) For perspective transformations, one of the major issues is that points converge towards the far clipping plane (z-compression). This makes interpolating pixel properties, such as color, difficult. How do we solve this issue? 5

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B.Sc. TE. (2-Yr) 1st Semester 18 May 2019

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION **WINTER SEMESTER, 2018-2019**

DURATION: 3 Hours **FULL MARKS: 150**

CSE 4573: Microprocessors and Assembly Language Programming

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

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1. a) What is machine language? How can we get machine language from an assembly language? Explain with an example. 10
   b) Briefly explain about multiple interrupt concepts. 8
   c) What are basic differences between `LOOP` and `LEVEL` in assembly language programming? 7

2. a) Derive the contents of the following `MOV` instructions using its coding template and show how the contents of the instructions can be stored in memory: 12
      i. `MOV DX, BX`
      ii. `MOV AAFFh[DI], AH`
      iii. `MOV AX, [1234h]`
   b) Write an assembly language program that will display "Microprocessors and Assembly Language" 10 (ten) times in different lines with line feed and carriage return. 6
   c) Considering following memory segments, offsets and instructions, write the sequence of PUSH/POP operations on stack segment mentioning different Stack Pointer (SP) values. Assume, initially the stack segment is empty. 7

Segment	Offset	Assembly Language
1000h	0100h	`IN AL, 27h`
1000h	0102h	`MOV DL, AL`
1000h	0104h	`MOV AH, 1`
1000h	0106h	**`INT 21h`**
1000h	0108h	`ADD AL, DL`

3. a) Draw the coding template of `IN` instruction. Explain the significance of using '`MOD`' and '`R/M`' in `MOV` coding template. 9
   b) Write the equivalent assembly language code structures using *conditional jump* and *loop* instructions to implement the *if-else*, *for* and *while* loop operations. 9
   c) Suppose, while debugging an assembly language program the values of the registers are: `Flag=FEB9h, IP=0102h, CS=0500h, SP=FFFCh`. Now, if `INT 21h` is requested, derive the memory addresses from where the new `IP` and `CS` can be retrieved; Also show the new `SP` value and steps involved in handling the interrupt by the 8086 microprocessor. 7

4. a) Write short differentiations between the following 8086 assembly language instructions: 9
      i. `ROL and SHL` ii. `LEA and OFFSET` iii. `NOT and NEG`
   b) Narrate the function of using `1`, `2` and `9` under `INT 21h` instruction. 8
   c) Distinguish between Memory-mapped I/O and Isolated I/O. 8

5. a) Draw the bus timing diagram for a microprocessor's operation while it performs a WRITE operation toward an OUTPUT unit. 10
   b) What are the basic differences between MIN and MAX mode of 8086 pin diagram? 6
   c) In how many ways can you define an array using assembly language programming? Give example code for each of them. 9

6. a) Draw a comparative table to differentiate between the features of 8086, 80186 and 80286 microprocessors. 10
   b) 'Utilization of parallel processors can be achieved through parallel programming'. How? Prove with appropriate example. 8
   c) Write the functionalities of IOPL and NT flags for 80286 microprocessor. 7

7. a) What do you mean by Coppermine? How do Coppermine and L2 cache memory differ from each other? 8
   b) How are the main memory of 80386 and Pentium processors segmented? Mention the use of address bus pins for both 80386 and Pentium microprocessors. 9
   c) Write an assembly language program, where a MACRO is used to address a string and a PROCEDURE is used to display that string. 8

8. a) Define Thread and Turbo Mode in the context of multi-core processor system? 10
   b) Differentiate between the features of core i3, i5 and i7 processors. 9
   c) Write short notes on: 6
      i. U-Pipeline
      ii. V-Pipeline
      iii. Floating Point Unit (FPU)

B.Sc. TE (2-Yr) 1st Semester 16 May 2019

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION **WINTER SEMESTER, 2018-2019**
DURATION: 3 Hours **FULL MARKS: 150**

CSE 4585: Computer Networks

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) What is the slot time in CSMA/CD? Explain how the slot time is related to the maximum network length. Explain why a minimum frame size is required for Ethernet. 3+6+4

   b) An Ethernet MAC sublayer receives 3040 bytes of data from the upper layer. Can the data be encapsulated in one frame? If not, how many frames need to be sent? What is the size of the data in each frame? 4

   c) Write short notes on any two of the followings: 4×2
   i. Bluetooth ii. Go-Back-N ARQ iii. Network Allocation Vector (NAV)

2. a) Derive the maximum achievable throughput of a pure ALOHA network. Derive the formula to determine the average transfer delay of a pure ALOHA network. 4+7

   b) What do you mean by vulnerable time? "The vulnerable time in ALOHA depends on the frame transmission time, whereas it depends on the propagation delay in CSMA" - Justify the statement in your own word. 2+7

   c) In CSMA/CA, contention window (CW) changes according to the binary exponential back-off strategy. The initial value of the contention window (CW_{min}) is 64. If a station requires 4 transmission attempts to successfully transmit a frame, what would be the back-off counter value for those transmission attempts? 5

3. a) Name three ICMPv4 query message and three error-reporting messages. Depict the encapsulation process of ICMPv4 error messages. Under what circumstances no ICMPv4 error messages is generated? 3+3+3

   b) Find the class and default mask of the following IPv4 address. Mention the number of possible IP addresses in each IP class. 3 X 2
   i. 11000001.00000010.11111110.00000000 ii. 25.23.12.25 iii. 172.32.25.14

   c) A University is granted the address block 18.15.40.0/24, which contains 256 addresses. The university has six departments and needs to divide the addresses into six sub blocks of 128, 64, 32, 16, 8, and 8 addresses. Design the sub blocks and give the slash notation for each sub block that are assigned to different departments. With the aid of a diagram, show the configuration of the University network and answer the following questions: 10
   i. What are the valid subnets?
   ii. What are the broadcast addresses for each subnet?
   iii. What are the valid hosts in each subnet?

4. a) Both IPv4 and IPv6 assume that packet may have different priorities or precedence. Explain how each protocol handles this issue. 6

   b) In an *IPv4* datagram, the M-bit is 0, the value of HLEN is 5, the value of total length is 200, and the fragment offset value is 200. What is the number of the first byte and number of the last byte in this datagram? Is this the last fragment, the first fragment, or a middle fragment? 6

   c) Mention the benefit of dropping the checksum field from IPv6 header. Does it introduce any potential danger of forwarding erroneous packets by IPv6? Explain. 6

   d) Briefly explain the major functionalities of Address Resolution Protocol (ARP) of TCP/IP protocol suite? 7

5. a) Write short notes on any two of the followings: 2 × 4
   i. Longest Mask Matching ii. Address Aggregation iii. Counting to Infinity (C2I)

   b) How does link state routing differ from distance vector routing? Consider the network given in Figure 1. With the indicated link costs, use Dijkstra's shortest-path algorithm used in link state routing to compute the shortest path from **X** to all network nodes. Prepare the routing table for node **X**. 4+6

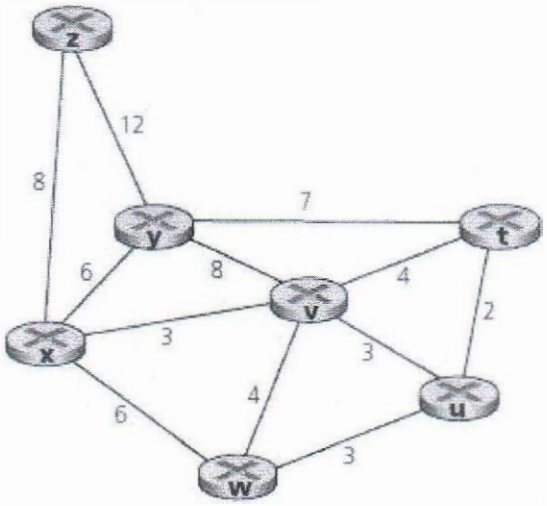

Figure 1: Network for Question 5.b)

   c) What is the C2I (counting to infinity) problem of distance-vector routing? Mention some of the methods to eliminate the problem. 5+2

6. a) A TCP client opens a connection using an initial sequence number (ISN) of 14,534. The TCP server opens the connection with an ISN of 21,732. 4+4
   i. Show the three TCP segments during the **three-way handshaking** connection establishment.
   ii. Show the contents of the segments during the connection termination using **four-way handshaking with half-close**.
   (Use timeline in y-axis for each side to show the **states** and the relative duration of the client and the server.)

   b) Briefly explain the acknowledgement and retransmission policy of TCP error control mechanism. 6+6

   c) Name different control flags in a TCP segment. Mention the minimum and maximum size of a TCP segment header. 3+2

7. a) How does congestion control differ from flow control in TCP? Suppose you have a TCP source, which starts transmission from segment number 15 with initial value of slow start threshold (*ssth*) 65000. The size of the receiver window (*rwnd*) is always larger that the congestion window (*cwnd*). Draw the timing diagram (time axes toward the bottom of the page for both the source and destination) for the transmission of segments at least up to 25. The diagram should include slow start, congestion avoidance, and one packet loss identified by triple duplicate acknowledgment and one by time out. 3+10

   b) Briefly explain the significance of Persistence timer and TIME-WAIT timer in TCP? A host sends five packets and receives three acknowledgments. The time is shown as hour:minute:seconds. 6+6

   i. Segment 1 was sent at 0:0:00.
   ii. Segment 2 was sent at 0:0:05.
   iii. ACK for segments 1 and 2 received at 0:0:07.
   iv. Segment 3 was sent at 0:0:20.
   v. Segment 4 was sent at 0:0:22.
   vi. Segment 5 was sent at 0:0:27.
   vii. ACK for segments 3 and 4 received at 0:0:45.
   viii. ACK for segment 5 received at 0:0:65.

   Calculate the values of RTT_M, RTT_S, RTT_D, and RTO of the retransmission timer of TCP. Given that the original RTO is 6 seconds.

8. a) Mention the major security goals of a computer network. How does symmetric key cryptography differ from asymmetric key cryptography? 2+4

   b) How do the classical ciphers differ from the modern ciphers? Encrypt the message "`successful`" using the Playfair cipher using the key "*Crypto*". 4+4

   c) Organizations with strict security often enforce password policies in order to make password management more secure. What could such policies be? Give examples. Discuss in what ways strict password policies may actually make password management less secure. 6

   d) Write a short note on any one of the followings: 5

   i. Replay Attack ii. Reflection Attack