BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **CSE 311** (Data Communication I)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

All the symbols have their usual meanings unless explicitly mentioned.

1. (a) How is the bandwidth of a signal calculated? Accordingly calculate the bandwidth of the unit impulse function, $\delta(t)$ defined below. **(5+7)**

$$\delta(t) = 0 \qquad t \neq 1$$

$$\int_{-\infty}^{\infty} \delta(t)\,dt = 1$$

(b) Explain 'Linearity' and 'Time invariance' properties of a 'Linear Time Invariant (LTI)' system. **(10)**

(c) A low-pass filter transfer function H(f) is given by **(13)**

$$H(f) = \begin{cases} (1 + k\cos 2\pi fT)\, e^{-j2\pi f t_d} & |f| < B \\ 0 & |f| > B \end{cases}$$

A pulse g(t) band-limited to B Hz is applied at the input of the filter. Show that the output

$$y(t) = g(t - t_d) + \frac{k}{2}[g(t - t_d - T) + g(t - t_d + T)$$

2. (a) List three advantages of digital communication over analog communication. **(5)**

(b) A signal band limited to 4000 Hz is transmitted by a PCM system. The signal is sampled at twice the Nyquist rate and the sampled pulses are passed through a uniformly spaced quantizer with sixteen levels. Finally, the quantized samples are encoded as binary signals. Calculate the output data rate (in bits/sec) of the PCM system. **(8)**

(c) Explain the 'Aliasing effect' that occurs during sampling of practical signals. How can 'Aliasing effect' be eliminated? **(8+2)**

(d) Consider a PCM system that implements μ-law companding with $\mu = 255$. Total number of levels in the quantizer is $L = 256$. Now, what will be the total root-mean-square (rms) quantization error for the following set of sample values of some signal: {–2.4, 0.6, 5}. Assume the maximum and the minimum values of the signal are 5 and –5, respectively. Show detailed calculation steps. **(12)**

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3. (a) Draw the block diagrams of transmitter and receiver of a Differential PCM (DPCM) system. Draw the block diagram of a linear predictor for DPCM. **(8+5)**

(b) Draw the block diagrams of the modulator and the demodulator of a Delta Modulation (DM) system that use integrator-amplifiers and comparators. **(8)**

(c) What is 'slope overload noise' in a Delta Modulation (DM) system? How to determine the step size of a DM modulator such that 'slope overload' does not occur for a given input signal m(t)? **(5+9)**

4. (a) What is Time Division Multiplexing (TDM)? Describe briefly how the following two issues are addressed in a system using TDM: (i) Synchronization between the sender (multiplexer) and the receiver (demultiplexer), (ii) asynchronicity among incoming channels in the multiplexer. **(3+6+6)**

(b) Why does 'Inter-Symbol Interference(ISI)' occur in a digial transmission system? Explain how Nyquist first criterion for pulse shaping can be used to eliminate ISI. Does the pulse $p(t) = \text{sinc}(\pi R_b t)$ satisfy the criterion? If so, what is the maximum pulse rate achievable with p(t)? Explain. Accordingly, how much bandwidth (in Hz) would be required to transmit 4000 pulses per second using p(t). Given, bandwidth of p(t) is $\frac{R_b}{2}$. **(5+6+4+3+2)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

Give your answer to the point avoiding unnecessary writings.

Try to draw as many figures as possible and explain with block diagrams.

5. (a) For a base signal of $m(t) = cos100t \times cos200t$ **(3+3+3+3+3=15)**

(i) Draw spectrum of $m(t)$

(ii) Draw spectrum of DSB-SC for $2m(t)cos100t$

(iii) Draw spectrum of DSB+C for $2(1 + m(t))cos1000t$

(iv) Draw spectrum of LSB-SC from the figure of (ii).

Just mention the transmission bandwidth required for DSB-SC, DSB+C and VSB+C modulation techniques.

(b) Show that the bandwidth requirement of WBFM is $\approx 2(\Delta f + 2B)$ Hz, where Δf refers to peak frequency deviation. What was the fallacy behind bandwidth estimation of FM? **(8+5)**

(d) Explain the modulation and demodulation procedure of Differential Phase Shift Keying (DPSK)? **(7)**

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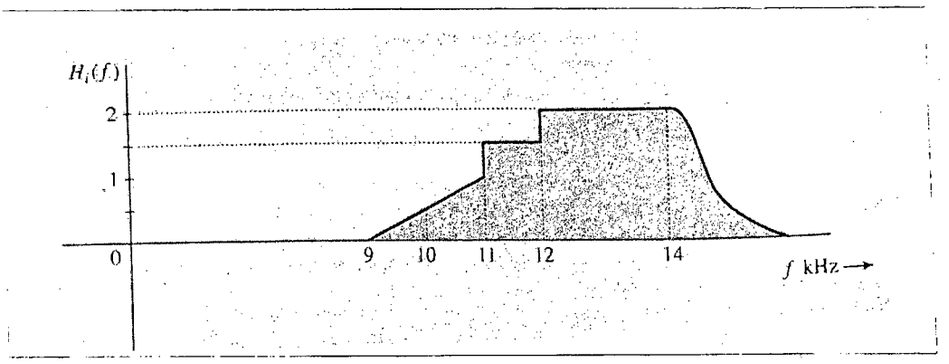
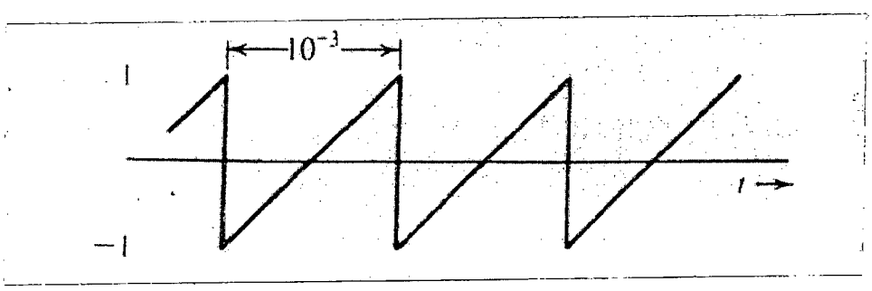
6. (a) A vestigial filter $H_i(f)$ has a transfer function shown below. The carrier frequency is f_c = 10 kHz and the baseband signal bandwidth is 4 kHz. Draw the corresponding transfer function of the equalizer filter, $H_o(f)$. [Hint: $H_o(f) = \frac{1}{H_i(f + f_c) + H_i(f - f_c)}$.] **(10)**



(b) Show that for M-ary FSK, the minimum frequency separation to ensure orthogonality among the FSK symbols is: $\delta f = \frac{1}{2T_b}$, where T_b denotes the symbol duration. **(11)**

(c) Show that, for a real time function f(t), the signal, $f_{LSB}(t) = f(t)\cos\omega_c t + f_h(t)\sin\omega_c t$ represents a lower sideband SSB-SC signal $f_h(t)$ represents Hilbert Transform of f(t) and ω_c is the carrier frequency in rad/sec. **(14)**

7. (a) A baseband signal m(t) is shown below. Sketch the $\varphi_{FM}(t)$ and $\varphi_{PM}(t)$ for this signal m(t) if $\omega_c = 2\pi \times 10^6$, $k_f = 2000\pi$ and $k_p = \frac{\pi}{2}$. (Mention only the maximum and minimum frequency. No need to put extra effort on drawing.) **(10)**



(b) What is Pilot Carrier? Explain with diagram how Phase Locked Loop (PLL) maintains Phase and Frequency synchronization? **(2+10)**

(c) Explain with diagram how 4-bit information is passed at a time with 16-QAM? **(10)**

(d) Describe a trivial demodulation procedure of FM signal? **(3)**

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8. (a) Draw the signals obtained after encoding the bit stream '10010110' by each of the following digital line coding techniques, **(6+9)**

   – Polar NRZ-L

   – Manchester

   Analyze these techniques in terms of the following characteristics.

   (i) Synchronization capability

   (ii) Bandwidth requirement

   (iii) DC value suppression

   (b) Explain how offset QPSK reduces maximum phase shift from π to $\frac{\pi}{2}$ without reducing bit rate? Explain how phase continuation is maintained during MSK, what are the prerequisites for carrier frequency to work with MSK. **(6+8)**

   (c) What is baseline wandering? Describe how 'Scrambling' solves the synchronization problem with Bipolar-AMI. **(2+4)**

L-3/T-1/CSE **Date : 21/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **CSE 303** (Database)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Discuss the applications where you will use RAID level 1 and RAID level 5. **(5)**

   (b) The file containing fixed length records of student relation with attributes student id, name, department code, level and term has been shown in Figure 1. Show the file structures after deletion of record 3 for the following cases: **(6+9)**

   (i) Move record 4 to space occupied by record 3, record 5 to record 4, and so on.

   (ii) Move record 8 to the space occupied by record 3.

   (iii) Mark record 5 as deleted and move no records. Use a header and record pointer.

   Give the comparative advantages and disadvantages among the three cases.

   (c) The relation student (student id, name, student code, level, term) is given in Figure 1 and department (department code, location, floors, type) has been given in Figure 2. Department code is the primary key of department table and foreign key in student table. **(15)**

   (i) Show the multitable clustering file structure for the given relations. Explain why is it more expensive to execute the query "select * from department" in this structure.

   (ii) Show the multitable clustering file structure with pointer chain for these two relations. How is the query in (i) executed faster in this structure?

2. (a) Create the following indices structures for the relation given in Figure 1. **(5×4=20)**

   (i) A sparse index on student id for search key values – {1204001, 1205001, 1205010}.

   (ii) A secondary index on department code.

   Now perform the following operation using the above indices and show the resulting structures.

   (iii) Delete the record with student id 1205010.

   (iv) Insert the record {1205011, N114, EEE, 3, 1}.

   (b) Discuss the basic principles of B+ tree index structure. **(10)**

   (c) Given the relation employee (emp_id, name, gender, status) in Figure 3. Create bitmap indices on gender and status. **(5)**

3. (a) The hash values of the search keys on 'name' attribute of Figure 3 has been given in Figure 4. Create step by step dynamic hash index structure for 'name'. Assume a bucket can contain only one record and overflow bucket can be used. **(15)**

   (b) Let t_r and t_s are the time to transfer a block of data in a disk rubsystem and k_0 seek a block in the disk respectively. Estimate the query processing cost for the following cases: **(10)**

   (i) A primary B+ tree index and equality on key.

   (ii) A primary B+ tree index and comparison on key.

Contd P/2

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Contd ... Q. No. 3

(c) Let relation r_1 (A, B, C) and r_2 (C, D, E) have the following properties: r_1 has 20000 tuples, r_2 has 45000 tuples, 25 tuples of r_1 fit on one block, and 30 tuples of r_2 fit on one block. Estimate the number of block transfers and seeks required, using each of the following join strategies for r_1 and r_2. **(10)**

(i) Nested loop join (ii) Block nested loop join.

4. (a) Explain external sort-merge with an example. Show that the total number of block transfers for external sorting of a relation r is **(15)**

$$b_r \left(2 \left\lceil \log_{M-1} C \, {}^{b_r}\!/_{M} \right\rceil + 1 \right)$$

where b_r is the number of blocks of relation r and M is the size of the main memory buffer.

(b) A concurrent schedule of transactions T_1, T_2 and T_3 is given in Figure 5. Find the equivalent serial schedule by using conflict serializeability. Show the steps. **(10)**

(c) Show and explain lock compatibility matrix with examples. **(5)**

(d) After system crash, the following log records are found. **(5)**

<T_0, start>

(T_0, commit>

(T_1, start>

(T_1, C, 800, 600>

Describe the recovery actions for the above log records.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Consider the following information about a university database. Professors have an SSN, a name, an age, a rank, and a research speciality. Projects have a project number, a sponsor name (e.g., NSF), a starting date, an ending date, and a budget. Graduate students have an SSN, a name, an age, and a degree program (e.g., M.S. or Ph.D). Each project is managed by one professor (known as the project's principal investigator). Each project is worked on by one or more professors (known as the project's co-investigators). Professors can manage and/or work on multiple projects. Each project is worked on by one or more graduate students (known as the project's research assistants). When graduate students work on a project, a professor must supervise their work on the project. Graduate students can work on multiple projects, in which case they will have a (potentially different) supervisor for each one. Departments have a department number, a department name, and a main office. Departments have a professor (known as the chairman) who runs the department. Professors work in one or more departments, and for each department that they work in, a time percentage is associated with their job. Graduate students have one major department in which they are working on their degree. Each graduate student has another, more senior graduate student (known as a student advisor) who advises him or her on what courses to take. Draw an **Entity-Relationship** (ER) diagram to represent data requirements described above. **(18)**

Contd P/3

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Contd ... Q. No. 5

(b) Show an example where a table is in 3NF, but not in BCNF. Then, modify the design to satisfy BCNF. **(10)**

(c) Why does it yield current values when derived attributes are not stored in database? Discuss with an example. **(7)**

6. (a) Normalize the following table by drawing dependency diagram and identifying all dependencies to derive up to 3NF. Show the schema in 3NF. **(13)**

Date	Time	Customer Name	Contact Number	Event	Person in charge	Total persons	Price
12 Aug, 10	12.30 PM	Maria Indrawan	04222223333	Lunch	Dora Smith	6	60
12 Aug, 10	12.30 PM	John Smith	04113333333	Master Class	Simon Becket	1	120
12 Aug, 10	7.00 PM	Mary Joe	95671290	Dinner	Linda Dee	2	150
13 Aug, 10	12.30 PM	Lindsay Smith	99031001	Lunch	Dora Smith	4	60
13 Aug, 10	12.30 PM	Sunshine Dee	99021900	Lunch	Dora Smith	2	60

(b) Show an example of specialization hierarchy in the context of ERD with disjoint and overlapping subtypes. **(9)**

(c) Why roles are used for assigning privilege to users? Create three users U_1, U_2 and U_3 and assign INSERT and UPDATE priviledges to them on T1 and T2 tables, respectively. Do this by assigning the users a role of "Admin". Then transfer these priviledges to another role named "SuperAdmin". Finally, revoke UPDATE privilege from "Admin". **(13)**

7. (a) Flights(flno: integer, from: string, to: string, distance: integer, departs: time, arrives: time, price: real) **(25)**

Aircraft(aid: integer, aname: string, cruisingrange: integer)

Certified(eid: integer, aid: integer)

Employees(eid: integer, ename: string, salary: integer)

For the schema above, write SQL to implement the following queries:

(i) Find the names of aircraft such that all pilots certified to operate them have salaries more than $80,000.

(ii) For each pilot who is certified for more than three aircraft, find the eid and the maximum cruisingrange of the aircraft for which she or he is certified.

(iii) Find the names of pilots whose salary is less than the price of the cheapest route from 'Los Angeles' to 'Honolulu'.

(iv) Find the aids of all aircraft that can be used on routes from 'Los Angeles' to 'Chicago'.

(v) Identify the routes that can be piloted by every pilot who makes more than $100,000.

(b) Discuss with example the difference between string and weak relationships in the context of relational database modeling. How does security concern arise by the choice of primary key? **(7+3=10)**

Contd P/4

CSE 303

8. (a) Suppliers(sid: integer, sname: string, address: string) **(20)**

Parts(pid: integer, pname: string, color: string)

Catalog(sid: integer, pid: integer, cost: real)

For the schema above, write down the **Relational Algebric** expression for the following

(i) Find the sids of suppliers who supply some red or green part.

(ii) Find the sids of suppliers who supply some red parts are at the address 221 Packer Street.

(iii) Find the sids of suppliers who supply some red parts and some green parts.

(iv) Find the sids of suppliers who supply every part.

(b) Should a primary key have any semantic meaning? Explain your answer. **(6)**

(c) What is materialized View? Discuss the restrictions on trigger in brief. **(3+6=9)**

Record 0	1205001	N11	CSE	3	1
Record 1	1205004	N12	CSE	3	1
Record 2	1205007	N13	CSE	3	1
Record 3	1205010	N14	CSE	3	1
Record 4	1205013	N15	CSE	3	1
Record 5	1205016	N16	CSE	3	1
Record 6	1204001	N21	EEE	3	1
Record 7	1204002	N22	EEE	3	1
Record 8	1204003	N23	EEE	3	1

Figure 1: File containing records of relation *student(student id, name, department code, level, term)*

CSE	ECE BUILDING	12	A
EEE	ME BUILDING	6	B

Figure 2: File containing records of relation *department(department code, location, floors, type)*

E001	Abid	Male	Full Time
E002	Arif	Male	Full Time
E003	Sajid	Male	Full Time
E004	Rafiq	Male	Part Time
E005	Shahid	Male	Full Time
E006	Sajid	Male	Full Time
E007	Karim	Male	Part Time
E008	Zahid	Male	Full Time

Figure 3: File containing records of relation *employee(emp_id, name, gender, status)*

Name	16 bit hash code *h*(Name)
Abid	0001111100001111
Arif	0010111100001111
Sajid	0011111100001111
Rafiq	0100111100001111
Shahid	0101111100001111
Karim	1001111100001111
Zahid	0111111100001111

Figure 4: The list of names of figure 3 and corresponding 16 bit hash codes.

Transaction T_1	Transaction T_2	Transaction T_3
READ (A)		
	WRITE (B)	
	READ (B)	
WRITE (A)		
		WRITE (C)
		READ (C)
		READ (B)
	READ (C)	
READ(B)		
		READ (A)

Figure 5: A concurrent schedule of transactions T_1, T_2 and T_3.

L-3/T-1/CSE Date : 26/01/2016

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **CSE 305** (Computer Architecture)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Describe SISD, SIMD, MIMD and MISD architectures with block diagrams. **(10)**

   (b) Consider a bus-based shared memory multiprocessor system. It is constructed using processors with speed of 10^6 fetches/sec, and a bus with a peak bandwidth of 10^5 fetches/sec. The caches are designed to support a hit rate of 90%. **(4)**

   (i) What is the maximum number of processors that can be supported by this system?

   (ii) What hit rate is needed to support a 20-processor system?

   (c) Compare the characteristics of typical CISC and RISC architectures. **(8)**

   (d) Show the time-space diagram for pipelining in a superscalar processor. Briefly describe the architecture of a typical superscalar RISC processor with necessary block diagrams. Mention the differences between a superscalar processor and a VLIW processor. **(3+8+2)**

2. (a) List out the key characteristics of computer systems. What do you mean by the principle of locality of reference? Discuss the role of the principle of locality of reference in designing memory hierarchy. **(6+3+3)**

   (b) Write short notes on (i) flash storage and (ii) holographic data storage. **(4+4)**

   (c) Answer the following questions for a memory system that uses 32-bit address at the byte level, and a cache that uses a 64-byte line size. **(15)**

   (i) Assume a direct cache with a tag field in the address of 20 bits. Show the address format and determine the number of addressable units, the number of blocks in main memory, and the number of lines in the cache.

   (ii) Assume an associative cache. Show the address format and determine the number of addressable units, the number of blocks of main memory, the number of lines in the cache and the size of the tag.

   (iii) Assume a four-way set-associative cache with a tag field in the address of 9 bits. Show the address format and determine the number of addressable units, the number of blocks in main memory, the number of lines in a set, the number of sets in the cache, and the number of lines in the cache.

Contd P/2

CSE 305

3. (a) What are pipeline hazards? Explain a structural pipeline hazard with a time-space diagram. What type of pipeline hazards occurs in the following code segment? How can it be overcome? **(10)**

```
lw    $t1,  0($t0)
lw    $t2,  4($t0)
add   $t3,  $t1, $t2
sw    $t3,  12($t0)
lw    $t4,  8($t0)
add   $t5,  $t1, $t4
sw    $t5,  16($t0)
```

(b) Briefly describe different dynamic branch prediction techniques for dealing with control hazards. **(10)**

(c) Perform the necessary modification of the single-cycle data path in Figure 1 for pipeline implementation by inserting pipeline registers and a forwarding unit. Describe the modification step by step and draw the final modified datapath with all necessary control signals. **(15)**

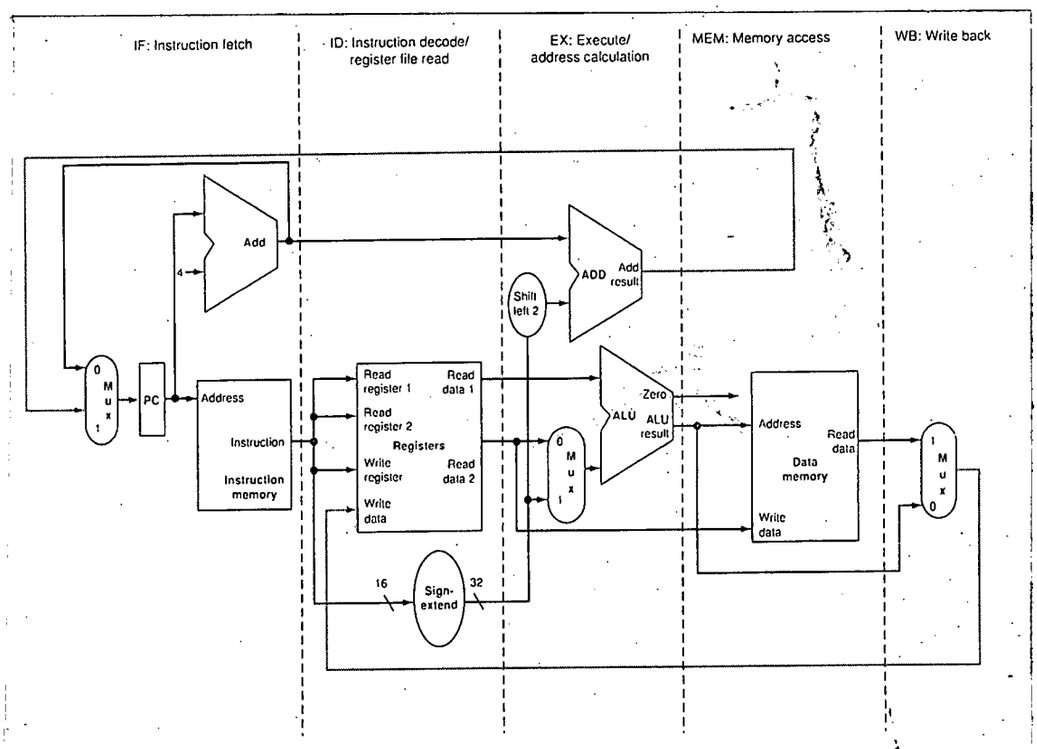

Figure 1: Figure for Question 3(c)

4. (a) Show the components of an I/O module using a block diagram and describe the functions of each component. **(8)**

(b) Describe the operation of a vector interrupt structure with daisy chain interface for detecting and managing interrupting I/O devices. **(10)**

Contd P/3

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Contd ... Q. No. 4

(c) Mention the advantages of DMA transfer over programmed I/O and interrupt-driven I/O. Briefly describe a DMA transfer structure with necessary diagrams. **(4+8)**

(d) The access time of the cache M_1 of a single cache memory system is 6ns/bit during hit and that of the main memory M_2 is 900ns/bit during miss. Calculate the block transfer time and the access efficiency of the memory system at the hit ratio 0.8. **(5)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) "Computer architects have invented several great ideas in the last 60 years of computer design. These ideas are so powerful that they have lasted long after the first computer that used them, with newer architects demonstrating their admiration by imitating their predecessors". These ideas include: **(20)**

    1. Design for Moore's Law
    2. Use abstraction to simplify design
    3. Make the common case faster
    4. Performance via parallelism
    5. Performance via pipelining
    6. Performance via prediction
    7. Hierarchy of memories
    8. Dependability via redundancy

    You are given several design features of MIPS and other modern computing systems in the following. Now, please **identify** that which of the above great ideas are behind these design decisions.

    1. In MIPS datapath, there is an adder which computes the value of **(PC+4)**, where PC means Program Counter. For branch addressing the MIPS address is actually relative to this **(PC+4)** rather than **(PC)**. This form of branch addressing is called PC-relative addressing.
    2. In the past, most PCs (personal computers) and server systems used separate SRAM (static random access memory) chips for either their primary, secondary, or even tertiary caches. Today, all levels of caches are integrated onto the processor chip, so the market for separate SRAM chips has nearly evaporated.
    3. A fast multiplication hardware, "unrolls the loop" by using 31 adders rather than using a single 32-bit adder 31 times.
    4. Procedures or Functions allow programmers to concentrate on just one portion of the task at a time, parameters act as an interface between the procedure and the rest of the program and data, since they can pass values and return results.
    5. Modern computers use a technique called prefetching. In prefetching, a block of data is brought into the cache before it is actually referenced. Many microprocessors use hardware prefetching to access the block needed in the future that may be difficult for software to notice.

Contd P/4

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Contd ... Q. No. 5

(b) Assume a processor with 2 GHz clock rate is executing a program that requires the following instructions. **(15)**

Instructions	FP	INT	L/S	BRANCH
Instruction Count ($\times 10^6$)	160	110	10	16
CPI	2	1	5	2

(i) Calculate the execution time of the program.

(ii) By how much must we improve the CPI of **FP** instructions if we want the program to run two times faster?

(iii) By how much must we improve the CPI of **L/S** instructions if we want the program to run two times faster?

6. (a) A simple recursive C function and it's corresponding MIPS assembly code is given below. Note that, the later one is not complete. Please complete it with appropriate expressions. **(15)**

```
int recurseSum(int n){
   if(n<1) return 0;
   else return n+recurseSum(n-1);
}
```

```
recurseSum:
[    ] $t0, $a0, 1
beq $t0, $zero, Recurse
add $v0, $zero, $zero
jr [    ]
Recurse:
addi $sp, $sp, [    ]
sw $ra, [    ]
sw [    ], 0($sp)
addi $a0, $a0, -1
jal recurseSum
lw [    ], 0($sp)
lw $ra, [    ]
[                ]
add [    ], $a0, $v0
jr [    ]
```

(b) What support does MIPS instruction set architecture provide for synchronization? **(5)**

(c) A simple MIPS assembly code snippet and it's corresponding MIPS machine code are given below. Note that, the later one is not complete. Please complete it with appropriate decimal values. **(15)**

```
Loop:   sll $t1, $s2, 2
        add $t1, $t1, $s6
        lw $t0, 0($t1)
        beq $t0, $s5, L1
        j Exit
L1:     addi $s2, $s2, 1
        j Loop
Exit:
```

6000	0	0	18	9		0
6004	0				0	32
6008	35			0		
6012	4	8	21			
6016						
6020	8	18	18	1		
6024	2					
6028						

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7. (a) Please draw the illustrations at the five MIPS addressing modes. **(15)**

   (b) MIPS instruction set architecture supports *beq* and *bne* instructions, however, does not support other branching instructions like *blt*, *bge*, etc. What is the reason behind this design decision? How could you program these instructions (*blt*, *bge*, etc.) in MIPS instructions? **(5+5)**

   (c) What is the problem in the following code snippet? How can you solve this problem? **(5+5)**

Address	Instruction
005000	`beq, $s0, $s1, 30500`

8. (a) The following table illustrates the various combinations of two operands for binary addition-subtraction. Please identify the overflow conditions in that table. Then, formulate the overflow boolean variable as a logical function of various input variables (You don't need to simplify the function). **(8+4)**

O	S_A	S_B	S_R	V
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Here,

$$\text{Operation, } O = \begin{cases} 0, & A + B \\ 1, & A - B \end{cases}$$

$$\text{Sign bit if Operand A, } S_A = \begin{cases} 0, & A \geq 0 \\ 1, & A < 0 \end{cases}$$

$$\text{Sign bit of Operand B, } S_B = \begin{cases} 0, & B \geq 0 \\ 1, & B < 0 \end{cases}$$

$$\text{Sign bit of Result R, } S_R = \begin{cases} 0, & R \geq 0 \\ 1, & R < 0 \end{cases}$$

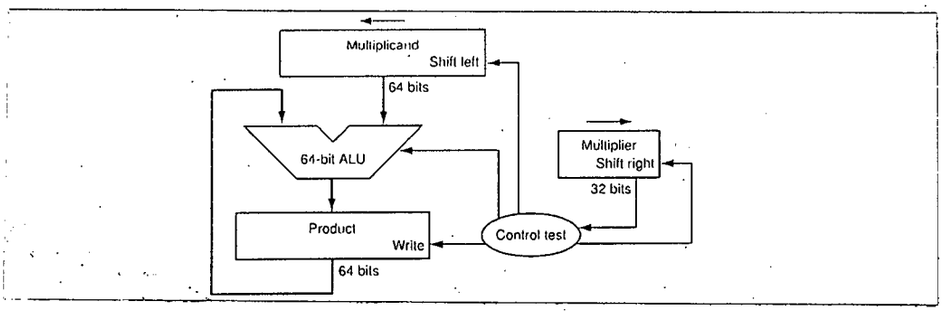
$$\text{Overflow, } V = \begin{cases} 0, & \text{Overflow occured} \\ 1, & \text{No overflow possible} \end{cases}$$

Contd P/6

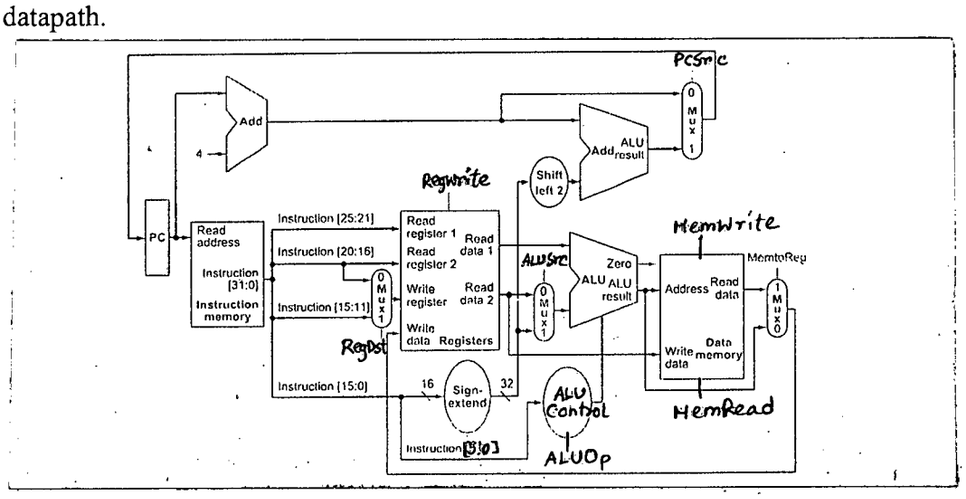
CSE 305

Contd ... Q. No. 8

(b) In the following figure, a multiplication hardware is given. Now draw the flowchart of a the sequential version of multiplication algorithm for this hardware. Please note that, this simple hardware is not register-optimized, therefore, draw a register-optimized refined version of this hardware. **(8+5)**



(c) A simple MIPS datapath and its respective control signals are illustrated below. Please design the control bits corresponding to the instruction "`beq rs, rt, address`" for this datapath. **(10)**



Control Signal	0	1
RegDst	Write register address = rt	Write register address = rd
RegWrite	-	Write register
ALUSrc	ALU Second Operand = Read data 2	ALU Second Operand = lower 16-bit of instruction
MemRead	-	Read data from memory
MemWrite	-	Write data into memory
MemtoReg	Register Write Data from ALU	Register Write Data from data memory
PCSrc	PC=PC+4	PC=branch target
ALUOP1	not dependent on function	dependent on function
ALUOP0	addition	subtraction

L-3/T-1/CSE Date : 30/01/2016

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **CSE 309** (Compiler)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Explain clearly, with necessary justifications, the lexical errors (in any) that will occur for each of the following C/C++ statements. You need to consider both the cases where the lexical analyzer uses and does not use panic mode recovery strategy. Then provide the list of tokens that may be generated in both the cases. You may use your own token names. **(20)**

   (i) `int float double int float float;`

   (ii) `;) (){}))))cse dhaka buet`

   (iii) `int 12345cse, dhaka;`

   (b) Comment with reasoning on whether the following grammars are LL(1) or not. **(15)**

   (i) $S \rightarrow ABc, A \rightarrow a \mid \epsilon, B \rightarrow b \mid \epsilon$

   (ii) $S \rightarrow ACB, A \rightarrow a \mid B \mid \epsilon, B \rightarrow b \mid \epsilon, C \rightarrow c \mid \epsilon$

   (iii) $S \rightarrow X, X \rightarrow aXBA \mid bAXB \mid c, A \rightarrow a, B \rightarrow a \mid \epsilon$

   (iv) $A \rightarrow C \mid \epsilon, C \rightarrow CE, C \rightarrow \epsilon, E \rightarrow \epsilon$

   (v) $S \rightarrow S(S) \mid \epsilon$

2. (a) Explain the scenario in lexical analysis where we need to look ahead at least one additional character. **(7)**

   (b) Describe how the use of sentinels at the end of buffers in buffer pair scheme in lexical analysis speeds up the input process. **(9)**

   (c) Which characteristic(s) of a programming language is (are) affected by the length of buffer in buffer pair scheme in lexical analysis? How? **(7)**

   (d) Why is analysis portion of a compiler normally separated into lexical analysis and syntax analysis phases? What is wrong with using the parser only to accomplish all the tasks currently performed by the lexical analyzer and syntax analyzer? **(12)**

3. (a) Write down, with necessary explanations, in the context of Lex lexical analyzer generator, the type of lexemes that will be matched by the following regular expressions. **(15)**

   (i) {cse}{token}

   (ii) [csetoken]

   (iii) csetoken

   (iv) (csetoken)+

   (v) csetoken+

   (b) Eliminate left-recursion from the following grammar: **(20)**

   $S \rightarrow Sc \mid Ta \mid b$

   $T \rightarrow Tc \mid Sd \mid d$

   $U \rightarrow Ua \mid Td \mid Sb \mid b$

Contd P/2

CSE 309

4. (a) Explain in detail the following statements. **(5+10)**

(i) "Java language processors combine compilation and interpretation".

(ii) "The front end of a compiler is concerned about the source language, while the back end of the compiler is concerned about the target machine. The intermediate representation, between the two, is concerned neither about the source language, nor about the target machine".

(b) Answer the following questions for predictive parsing. **(8+3+4+5)**

(i) During construction of a parsing table M, for each production rule $A \rightarrow \alpha$ of the grammar, if ϵ is in FIRST(α), we add $A \rightarrow \alpha$ to $M[A, b]$, for each terminal b in FOLLOW(A). Why? Explain clearly in light of the parsing mechanism.

(ii) What does multiple entries in a parsing table mean? Is the corresponding grammar LL(1)?

(iii) During a parsing, if w is the input that has been matched so far, and S is the start symbol for the corresponding grammar, with, $S \overset{*}{\Rightarrow} w\alpha\beta\gamma$, what will be the stack contents? Also, comment on the nature of symbols in w and stack contents regarding being terminals/non-terminals.

(iv) During parsing, if the input pointer is pointing to the symbol a, and top stack symbol in X, with the entry $M[X, a]$ being $X \rightarrow UVW$, explain how stack contents will be altered. Why?

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What is context-sensitive analysis? What is the purpose of context-sensitive analysis? Explain S-attributed and L-attributed definitions with examples. **(10)**

(b) Consider the following syntax directed translation rules to generate three-address code: **(10)**

Productions	*Semantic rules*
$S \rightarrow$ **id** := E	S.code := E.code || *gen*(**id**.place ':=' E.place); S.begin := S.after := nil
$S \rightarrow$ **while** E **do** S_1	S.begin := *newlabel*() S.after := *newlabel*() S.code := *gen*(S.begin ':') || E.code || *gen*('if' E.place '=' '0' 'goto' S.after) || S_1.code || *gen*('goto' S.begin) || *gen*(S.after ':')
$E \rightarrow E_1 + E_2$	E.place := *newtemp*(); E.code := E_1.code || E_2.code || *gen*(E.place ':=' E_1.place '+' E_2.place)
$E \rightarrow E_1 * E_2$	E.place := *newtemp*(); E.code := E_1.code || E_2.code || *gen*(E.place ':=' E_1.place '*' E_2.place)
$E \rightarrow$ **id**	E.place := **id**.name E.code := ''
$E \rightarrow$ **num**	E.place := *newtemp*(); E.code := *gen*(E.place ':=' **num**.value)

Contd..... P/3

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Contd ... Q. No. 5(b)

Assume, the function '*newtemp()*' generates the temporary variables like t_1, t_2, etc and the function 'newlabel()' generates new label consistently. Generate three address code according to the above semantic rules for the following strings:

i := i + j*k
while i do
i := 2 * n + k

(c) Consider the following syntax-directed definition: **(15)**

$F \rightarrow 0.B$	$F.val = B.val$
$B \rightarrow 0B_1$	$B.\ val = B_1.val/2$
$B \rightarrow 1B_1$	$B.\ val = B_1.val/2 + 1/2$
$B \rightarrow 0$	$B.\ val = 0$
$B \rightarrow 1$	$B.\ val = 1/2$

The numeric value of a binary fraction $0.b_1b_2 \ldots b_n$ is calculated as $\sum_{i=1}^{n} b_i 2^{-i}$. Each non-terminal has a synthesized attribute 'val' that is used to store its value.

(i) Show the annotated parse tree for the sentences:

0.101011

(ii) Show the dependency graph of the annotated parse tree generated in question 5(c)(i).

(iii) Find a topological order of the dependency graph generated in question 5(c)(ii).

6. (a) (i) Given the environment ρ is a set of <*name*, *type*> pairs, as follows: **(10)**

ρ = {<**x**, *integer*>, <**y**,*integer*>, <**z**,*char*>, <1,*integer*>, <2,*integer*>}

Prove that **x := x + y + 2** is typed correctly using Post system.

(ii) Provide type checking post-system expressions for the production '$S \rightarrow$ 'S_1 ; S_2' using proper notation. Also provide semantic rule for the type checking.

(b) What is a semantics-preserving transformation of compiler optimization? Explain each of the following transformation with example: **(10)**

(i) Common-sub-expression elimination,
(ii) Strength reduction
(iii) Backward copy propagation
(iv) Constant folding

(c) Given the following expression: **(15)**

((a – b) – ((a – b) * (a + b))) + ((a – b) * (a + b))

(i) Construct AST
(ii) Construct the DAG
(iii) Construct three address code for AST
(iv) Construct three address code for DAG

Assume the following grammar for this question.

$E \rightarrow E + T \mid E - T$
$T \rightarrow T * F$
$F \rightarrow (E) \mid$ **id**

Contd P/4

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7. (a) What is type inference? Find out the type inference rule for the following "append" function written in ML functional language: **(10)**

fun *append*(*x*, *y*) = **if** *null*(*x*) **then** *y* **else** *cons*(*hd*(*x*), *append*(*tl*(*x*), *y*))

(b) What are name equivalence and structural equivalence? Explain with examples. **(10)**

(c) What is backpatching in translating short-circuit code? How backpatching is used to translate the short-circuit code? Explain with translation grammar along with translation schemes. **(15)**

8. (a) What is peephole optimization? Explain two of such optimization techniques with examples. **(10)**

(b) What is global register allocation in code generation? Give an overview of the algorithm for global register allocation with examples. **(10)**

(c) What are register descriptor, address descriptor, and spilling? Assume the system has only two registers, provide the status of register descriptor, address descriptor, and the variable spilled for the following code: **(15)**

Statements	Code Generated	Register Descriptor	Address Descriptor	Spilled Variable
t := a - b	**MOV a, R_0** **SUB b, R_0**			
u := a - c	**MOV a, R_1** **SUB c, R_1**			
v := t + u	**ADD R_1, R_0**			
d := v + u	**ADD R_1, R_0** **MOV R_0, d**			

L-3/T-1/CSE **Date : 04/02/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **CSE 307** (Software Engineering and Information System Design)

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What are the quality attributes for software product revision? Define three metrics to measure one of these attributes. **(6⅔)**

   (b) Your goal is to reduce the number of errors in coding. Define three matrices for this goal using goal oriented software measurement. **(8)**

   (c) Describe the significance of token, glue token and super glue token to define cohesion and coupling. **(7)**

   (d) Describe a scenario of reviewing the code for a method implementing quick-sort. Mention the participants and sample of the queries made by the reviewers in the review process. **(10)**

   (e) A software development is being done in seven phases. Each of the first four phases generate 25 errors. In the 2nd, 3rd and 4th phase, 40% errors of the previous phase are paused through without amplification and 60% errors of the previous phases are passed with an amplification by the phase number. The final three phases are testing phases without generating any error. The DRE of these three phases are 60% each. In the first four phases, the DRE of the review is defined by 20%×x, where x is the phase number. Find the remaining errors at the end of software development. **(15)**

2. (a) Demonstrate an example showing that exhaustive testing is nearly impossible. **(6⅔)**

   (b) Consider a module that finds the maximum number in an array of n numbers. Identify the test cases for loop testing. **(12)**

   (c) Consider a module which sorts several floating point data in descending order. Write down the code for automated tester that tests the order as well as originality of the data. Here originality means the unsorted input and sorted output are the same set of data. **(13)**

   (d) What are the components of unit test environment? Explain each of them. **(7)**

   (e) Explain different types of integration testing strategies. **(8)**

3. (a) In estimating a software development effort in function point method the following data are collected: **(10)**

	Counts			
	Pessimistic	Most likely	Optimistic	Weight
Number of user inputs	40	30	20	5
Number of user outputs	10	8	7	5
Number of use inquiries	30	20	15	4
Number of files	8	5	4	6
Number external Interfaces	10	8	6	8
Algorithms	20	15	10	6

Contd P/2

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Contd ... Q. No. 3(a)

In the complexity multiplier is 0.75 and a person can implement eight function points in a week, find the estimated budget. Average salary of a developer is Tk. 50,000 per month.

(b) Write down the guide lines for estimating the software project. **(7)**

(c) Write down the reasons behind the failure of software projects. **(6⅔)**

(d) What do you mean by project risk? Explain with example. **(8)**

(e) Consider the following risks shown below for a Banking software development project: **(15)**

Risk	Probability
Employee turnover	30%
Discontinuation of Development platform support	50%
Change of customer requirement	20%
Reduction number of customers in the market	40%
Missing delivery deadline	60%
Regulatory Constraints	70%
Change of technology	55%

Write down the impact of these risks with proper reasoning. Do formal risk analysis and show mitigation plan for the first five risks.

4. (a) Why are framework activities not applicable for any software development project? **(6⅔)**

(b) Compare incremental and spiral model for software development process. **(10)**

(c) Describe unified process for software development. How does the concept of concurrency and evolution applied in unified process? **(10)**

(d) Describe the distinguishing features of scrum model. **(10)**

(e) You are the architect for the software system that controls operation of a microwave oven. Which type of architecture will be most suitable? Explain with proper reasoning. **(10)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) A magazine company's customer sends an order coupon to the company's order entry department. The order entry clerk approves the order and prepares a four-part sales order form. The clerk then enters the order into the sales journal and accounts receivable subsidiary ledger. The first three copies of the sale orders are forwarded to the fulfillment department; the fourth is filed by date along with the order coupon. The fulfillment department determines which reward will be offered to the customer and updates the other to add reward information. The first copy of the order is mailed to the customer, the second is sent to the company's distribution center, and the third is filed numerically. **(20)**

Draw a prototype of the information system of the magazine company.

Contd P/3

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Contd ... Q. No. 5

(b) Discuss the disadvantages of the prototyping technique. **(10)**

(c) What types of UML diagrams do exits? Name each diagram type and describe its main purpose. Classify each of the UML diagram types as static or dynamic. **(10)**

(d) What is the value of the money after 5 years whose present value is $100, assuming a 5% discount rate? **(6 2/3)**

6. (a) What is the difference between Structural and Behavioral patterns? Provide criteria for determining if a new pattern should be considered Structural or Behavioral. The criteria must also explain why the current patterns are classified as they are. **(10)**

(b) Give one design pattern that can be reduce dependence on hardware and/or software platforms. Explain how the pattern reduces a program's dependence on hardware and/or software platforms. **(12)**

(c) A company has decided to open a training school, which will deal with trainees employed in several departments. It is also intended that the training school will accept students of the local university who will pay a small fee. A new system is required to deal with registration, assigning trainees/students to one of the available classes, allocation of resources, (such as classrooms and tutors from the local university) and attendance. A class is always held in the same classroom. The university tutors will be paid for each hour they teach. They always teach in the same classroom but may teach different classes; however the classroom can be used by different tutors at different times. Briefly describe a fact-finding approach for this system. **(15)**

(d) A book is written by an author, published by a publisher, sold by a book store, and read by a reader. Moreover, for a reader to read a book, she must buy it from a book store that is selling it. Draw a use case diagram for this scenario, showing relationships between different use cases. **(9 2/3)**

7. (a) Explain different kinds of feasibility analyses used in information system design. **(15)**

(b) In a Video Rental System a *Customer* makes a *Video request* to the *Rent Video* process. The Rent *Video* process also receives *Video info.* from the *Video Library* data store. The process produces a *Bill* to the *Customer*, and stores the *Rental info.* into the *Rental* data store. **(10+12)**

A *Customer* can *Return Video* by providing *Video* and *Rental info.* The process stores the *Video info.* into the *Video Library* data store and *Rental info.* into the *Rental* data store. As a result, *Return receipt* is delivered to the *Customer*. Note that Data Flow Diagram does not answer in what way and in what order the information is being used throughout a system. If this information is important and worth mentioning, consider to model it with diagrams. Finally, a *Manager* can receive *Rental report* from the *Generate Rental Report* process and the information involved is provided by the Rental data store.

Draw a context diagram and data flow diagram of the Video Rental System.

(c) Explain two different types of interaction diagrams with example. **(9 2/3)**

Contd P/4

CSE 307

8. (a) Describe different types of classes used in a class diagram with example. **(12 2/3)**

(b) Consider, you have a collection of several hundred music CDs. Your friends love to borrow them, often borrowing several at the same time. You don't mind lending the CDs, but it is becoming difficult for you to keep track of which friend borrowed which CD. The difficulty is increased by the fact that you have more than one copy of some CDs. Also you are thinking of introducing a daily fee per CD loaned. For these reasons you would like to build a database, which you could query to find out how many CDs a given friend has; how long the friend has had them and how much he or she owes; who has a particular CD and so on. Draw class and sequence diagram for the above scenario. **(12+10)**

(c) ABC Advertising specializes in using large helium balloons to help business with their marketing. They rely on computer processing and databases to manage the distribution of balloons around the country. Customers can hire their advertising balloon by phoning the state branch of ABC Advertising. **(6+6)**

Whoever answers the telephone, checks the booking file to see if the requested time by the customer is available. The customer contact details, advertising text, balloon type and install instructions are taken down and entered into the customer file. A total price is negotiated and 10% deposit is requested from the customer. This is written into the accounts file.

When the deposit has been received a receipt is sent to the customer and the accounts file is updated. A designer then uses the advertising details to create a number of design and these are sent to the customer. The customer selects the appropriate design and adds comments for any alteration and returns the design to ABC Advertising. The changes are made and the customer file is updated with the design details that will be used.

The balloon is created and an account is produced and sent to the customer. Installation is then completed at the prearranged time. When the full payment has been received from the customer the account file is updated and a statement showing all payment details is sent to the customer.

At the end of the week business transaction report is produced from the customer and account files and this is sent to the head office.

(i) Suggest whether a centralized or distributed information system would be used in the above situation. Give two reasons for your answer.

(ii) ABC Advertising is also developing a web site for online booking. They are also considering adding an online payment section for deposits. Describe a fact finding strategy a System Analyst could use to gather information about the sites requirements.
