

**SECTION – A**

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

1. (a) What are the tradeoffs of locking with multiple granularities? (5)
- (b) Why does two-phase locking not work for B+tree index structure? Write down the rules for accessing tree-structured data that ensures serial order of the transactions in a schedule. (5+10)
- (c) Consider the following schedule involving transactions T1, T2, and T3: (10)
 

r1(A),r2(B),r3(C),r1(B),r2(C),r3(D),w1(A),w2(B),w3(C)

Now insert shared locks, exclusive locks, and unlock actions in appropriate places. Tell what happens when the schedule is run by a scheduler supporting shared and exclusive locks.
- (d) Define the following terms: conflict-equivalent and conflict-serializable. (5)
  
2. (a) Write down the steps of two-phase multiway merge sort. Consider a system where the block size is B bytes, memory size is M bytes, and the record size is R bytes. Then maximum how many records can be sorted by using two-phase merge sort? If the number of records is greater than the maximum possible records, how many can you sort them? (5+5+5)
- (b) What are the different ways to improve the performance of a disk based system? (5)
- (c) Find a RAID level 6 scheme with 15 disks, four of which are redundant. (15)
  
3. (a) Write down the pros and cons of an Elevator algorithm. (5)
- (b) Show the steps of duplicate elimination using a two-pass algorithm. Derive the relationship between number of records and memory size in this algorithm. (7+8)
- (c) The Megatron 747 disk has the following characteristics: (4+3)
  - Four Platters providing 8 surfaces
  - There are 8192 tracks per surface
  - There are 256 sectors per track
  - There are 512 bytes per sector
  - The disk rotates at 3840 rpm, it makes one rotation in every  $1/64^{\text{th}}$  of a second (15.6 milliseconds)
  - The average seek time to move the heads to the desired track is 6.5 milliseconds
  - Transfer rate is 10 megabytes per second

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**Contd ... Q. No. 3(c)**

Now, Answer the following questions:

- (i) What is the capacity of a single track and what is the size of the entire disk?
  - (ii) What is the average read time of 4096 bytes of data?
  - (d) What do you mean by ACID properties of a DBMS? Give real-life examples (one for each property) showing the necessities of these properties. (8)
4. (a) Show the state of the linear hashing if you insert eight items: 0000, 0011, 0010, 0101, 1010, 1011, 1110, and 1111. Now, show the state after inserting new items 1101 and 0111 into the hashtable. (10+4)
- (b) Compare Hash-based index, B+-tree index, and Bitmap index. (6)
- (c) The following is a sequence of undo/redo-log records written by two transactions T and U: <START T>; <T,A,10,11>; <START U>; <U,B,20,21>; <T,C,30,31>; <U,D,40,41>; <COMMIT U>; <T,E,50,51>; <COMMIT T>. (12)
- Describe the action of the recovery manager, including changes to both disk and the log, if there is a crash and the last log record to appear on disk is:
- (a) <START U>, (b) <COMMIT U>, (c) <T,E,50,51>, (d) <COMMIT T>.
  - (d) What is the I/O complexity of needed loop join? (3)

**SECTION – B**

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

5. (a) A library keeps records of current loans of books to borrowers. Each borrower is identified by a borrower number and each copy of a book by an accession number (library may have more than one copy of any given book). The name and address of each borrower is held so that communications, such as overdue load reminders, can be sent when necessary. The information held about books is the title, author's name/s, publisher's name, publication date, international standard book number (ISBN - a unique book identifier), purchase price, classification (reference or fiction), and number of pages. A given book may be written by a number of authors, however the library regards a book as only being published by a single publisher. The library assigns its own unique in-hours codes for authors and publishers. (18)
- A book may cover a number of different subjects, and the borrowers can use an on-line catalogue system to select texts by subjects as well as title and author's name. There is a restriction on the number of books a borrower may have on load at any time and the loan period. These limits depend on the borrower's classification (junior, adult, or organisation).

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**Contd ... Q. No. 5(a)**

When a book is borrowed, the return date is automatically recorded based on the current date and borrower's classification. Other borrowers, pending their return, may reserve books out on loan. The date on which the reserve was placed is recorded. A special borrower's status flag is maintained - borrowers who hold overdue books or who have reached their loan limit, are flagged to prevent further borrowings.

Draw a **Entity-Relationship (ER) diagram** to represent Library data requirements described above.

(b) What are the advantages and disadvantages of storing derived attributes in tables? (8)

(c) How to insert a tuple without causing constraint violation in the following table? (9)

*Person(id, name, father)*

where **foreign key father references person**

6. (a) Why the normalization technique is used in database design? Normalize the following table by drawing dependency diagram and identifying all dependencies to derive up to 3NF. Show the schema in 3NF. (15)

Attribute Name	Sample Value	Sample Value	Sample Value	Sample Value	Sample Value
INV_NUM	211347	211347	211347	211348	211349
PROD_NUM	AA-E3422QW	QD-300932X	RU-995748G	AA-E3422QW	GH-7781
SALE_DATE	15-Jan-2010	15-Jan-2010	15-Jan-2010	15-Jan-2010	16-Jan-2010
PROD_LABEL	Rotary Sander	0.25-in drill bit	Band Saw	Rotary Sander	Power drill
VEND_CODE	211	211	309	211	157
VEND_NAME	NeverFail, Inc	NeverFail, Inc	BeGood, Inc.	NeverFail, Inc.	ToughGood
QUANT_SOLD	1	8	1	2	1
PROD_PRICE	\$49.95	\$3.45	\$39.99	\$49.95	\$87.75

(b) Which considerations should be applied while choosing the primary key of a relation? Discuss with example how the multi-valued attribute problem in database design can be solved. (5+7=12)

(c) Create three users U1, U2, and U3 and assign them SELECT and DELETE privileges respectively on T1 and T2 tables. Do this by assigning the users a role of "Admin". Then transfer these privileges to another role named "Supcr Admin". (8)

7. (a) Patient (ID, FIRSTNAME, SURNAME, ADMISSION\_DATE, DR\_ID, ward-no)  
 AILMENT (AILMENTID, NAME, PATIENTID)  
 Ward (ward\_no, ward\_name)  
 Doctor(ID, SURNAME, FIRSTNAME, no\_of\_patient, AILMENTID)

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**Contd ... Q. No. 7(a)**

For the schema above, write SQL to implement the following queries: (25)

- (i) List the surnames of all patient of 'Dr. Jones'.
- (ii) List all the doctors who specialize in the ailment suffered by the patient whose surname is 'Thomas'.
- (iii) List the ward number and ward name of the ward/s which have the most patients?
- (iv) Provide a list of all patient who have not suffered any ailment.
- (v) Show the Doctor's name who have the third highest no\_of\_patient.

(b) What are the three anomalies in relational database? Discuss them. (10)

8. (a) EMPLOYEE (EMPLOYEEID, LASTNAME, FIRSTNAME, PHONE, HIREDATE, JOBID, SALARY, DEPARTMENT)  
JOB (JOBID, JOBTITLE, MINSALARY, MAXSALARY)  
DEPARTMENT (DEPARTMENTID, DEPARTMENTNAME, MANAGERID)

For the schema above, write down the *Relational Algebraic* expression for the following: (20)

- (i) List the average salary of each department.
- (ii) List the FIRSTNAME and JOBTITLE of employee 'John'.
- (iii) Increase all salary more than 10000 by 5% and less than 10000 by 4%.
- (iv) Delete all employees from EMPLOYEE table who earn less than 1000 as salary.

(b) Show an example where a table is in 3NF, but not in BCNF. (5)

(c) What is materialized View? Discuss four instances when trigger can be applied. (4+6=10)

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**SECTION – A**

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

1. (a) State the principle of temporal locality and the principle of spatial locality. (3+3)
- (b) Assume a two-way set associative cache with four blocks. The current state of the cache is empty. Assuming an LRU replacement policy, how many hits does the address sequence 0, 2, 4, 0, 2, 4, 0, 2, 4 exhibit? Show the state of the cache after every address access. (9)
- (c) State three conditions required for a cache/memory to be coherent. (9)
- (d) What is the limitation of a processor that does not have a TLB but uses the virtual memory technique? (5)
- (e) What is the size of the tag field for a direct-mapped cache with 2<sup>n</sup> blocks and the following configuration: 32-bit byte address and the block size: 2<sup>m</sup> words (Assume 1 word = 4 bytes). (6)
  
2. (a) Suppose a single shared memory processor has 20 GB of main memory. Five clustered computers each have 4 GB. The OS occupies 1 GB. How much more space is there for users with shared memory? (5)
- (b) Determine the total network bandwidth and dissection bandwidth for ring and fully connected topologies. Assume that the number of processor is  $P$ . (8)
- (c) Differentiate UMA shared memory multiprocessor from NUMA shared memory multiprocessor. (5)
- (d) A virtual memory system has the following parameters: (7)
  - Virtual address (bits): 32
  - Physical DRAM installed: 4 GB
  - Page size: 8 KB
  - PTE size (byte): 4

How many page table entries are needed? How much physical memory is needed for storing the page table?
- (e) Write down the procedure to handle a TLB page miss. (10)
  
3. (a) Write down the steps for the addition of two binary floating point numbers. (10)
- (b) Show the IEEE 754 binary representation of the number  $-0.75_{10}$  in single precision. (10)
- (c) Draw a block diagram of hardware organization and corresponding flowchart for the multiplication of two 32-bit binary unsigned integer numbers, where there is no separate multiplier register. (15)

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- 4. (a) Why does RAID 0 improve disk performance? (5)
- (b) Write down the steps of handling an interrupt. (12)
- (c) What happens if the interrupt enable bit of the Cause register is not set when handling an interrupt? What value could the interrupt mask value take to accomplish the same thing? (3+3)
- (d) What is "DMA stale data problem"? How can it occur in a system with caches? (12)

**SECTION – B**

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

- 5. (a) What is Moore's Law? What do you mean by response time and throughput? (6)
- (b) Consider two different implementations of the same instruction set architecture. There are four classes of instructions, A, B, C and D. The clock rate and CPI of each implementation are given in the following table: (15)

Implementation	Clock Rate	CPI Class A	CPI Class B	CPI Class C	CPI Class D
P1	3 GHz	1	2	3	4
P2	2 GHz	2	2	2	2

Given a program with 200 instruction divided into classes as follows:

10% class A, 20% class B, 50% class C and 20% class D.

- (i) Find the clock cycles required in both cases.
- (ii) Which implementation is faster?
- (iii) What is the global CPI for each implementation?
- (c) What do you mean by Amdahl's law? Write down the equation. Suppose a sample program takes 100 seconds to complete. The division operation accounts for 80 seconds. How much improvement in division operations' performance can give 4x overall improvement? (8)
- (d) Consider the following information for two different computers. (6)

Computer	Number of Instructions	Clock Rate	CPI
A	10 Billion	4 GHz	1
B	8 Billion	4 GHz	1.1

- (i) Which one has the highest MIPS rating?
- (ii) Which one is faster?
- 6. (a) What are the four design principles used for MIPS instruction set design? What are the steps for starting a Java application? (8)
- (b) Write down the MIPS code and corresponding machine code for the following C code. (12)

A [3] = A [1] – A [2];

Consider the base address of A is in \$s0. The op-code for load word is 35, and for store word is 43. The (op-code, function-code) for addition is (0, 32), and for subtraction is (0, 34). Registers \$t0 to \$t7 are numbered from 8 to 15, and \$s0 to \$s7 are numbered from 16 to 23.

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**Contd ... Q. No. 6**

(c) Write down the MIPS code for the following C procedure: (12)

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

Consider n in \$a0 and result in Sv0.

(d) If branch target is too far to encode with 16-bit offset, how does the assembler rewrite the following code: (3)

```
beq $s0, $s1, L1
```

7. (a) Briefly describe the two instructions used for synchronization in MIPS. Write down the MIPS code to do the following atomically: (8)

```
A[0] = X
```

Consider the base address of A is in \$s1 and X is in \$s2.

(b) Describe MIPS addressing modes. (4)

(c) Consider the following set of instructions: (14)

```
add, sw, beq
```

Draw the complete single cycle datapath (not pipelined) and control that can execute the above set of instructions.

(d) What are the five states of MIPS pipeline? Consider the following information for load word (lw) instruction (9)

Instruction	Instruction Fetch	Register read	ALU op	Memory access	Register write
lw	200 ps	100 ps	200 ps	200 ps	100 ps

Consider the following program:

```
lw $1, 100($0)
lw $2, 200($0)
lw $3, 300($0)
```

What is the speedup for the pipelined datapath over the single cycle datapath for this program? What will be the speedup if we add 1,000,000 more load word (lw) instructions?

8. (a) Draw the complete MIPS pipelined datapath and control for load word (lw) instruction with pipelined registers. (15)

(b) Consider the following MIPS code: (7)

```
add $s0, $t0, $t1
sub $t2, $s0, $t3
lw $s1, 20($t1)
sub $t4, $s1, $t2
```

How many data hazards are there? Describe the techniques to eliminate data hazards in the above code.

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**Contd ... Q. No. 8**

(c) What do you mean by data hazard for branches? Give examples with MIPS code for each of the following cases of data hazards for branches: (9)

- (i) Needs no stall to resolve
- (ii) Needs one cycle stall to resolve
- (iii) Needs two cycle stalls to resolve

(d) Consider the following code: (4)

```
outer:  
    // some code  
inner:  
    // some code  
beq $t0, $zero, inner  
    // some code  
beq $t1, $zero, outer
```

What is the problem with the above code if we use 1 bit branch predictor? How you can solve that? Explain

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**SECTION – A**

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

1. (a) Give an example of **S-attributed definition**. Give another example of **L-attributed definition**. Using these two examples illustrate how every S-attributed definition is also an L-attributed definition, however, every L-attributed definition is not an S-attributed definition. (12)

- (b) For the following SDD, give annotated parse tree to evaluate the expression,  $5*4*3$ . (12)

PRODUCTION	SEMANTIC RULES
1) $T \rightarrow FT'$	$T'.inh = F.val$ $T.val = T'.syn$
2) $T' \rightarrow * FT'_1$	$T'_1.inh = T'.inh \times F.val$ $T'.syn = T'_1.syn$
3) $T' \rightarrow \epsilon$	$T'.syn = T'.inh$
4) $F \rightarrow \text{digit}$	$F.val = \text{digit.lexval}$

- (c) In the context of semantic analysis, what is **scope**? Draw the spaghetti stack interpretation of symbol tables to disambiguate scopes explicitly for the following code snippet. (3+8=11)

```

public class Base {
    public int a = 0;
}

public class Derived extends Base {
    public int b = 10;
}

public class Test extends Derived {
    public int a = 20;
    public void show ( ) {
        int a = 30;
        System.out.println(a);
        System.out.println(this.a);
        System.out.println(super.a);
    }
}

```

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2. (a) Translate the expression,  $d = (a + b) + -c$ ; into three-address code using the following SDD. Show the corresponding annotated parse tree with annotations for attributes, **addr** and **code**. Then illustrate the quadruples and triples representation of the generated three-address code. (10+10=20)

PRODUCTION	SEMANTIC RULES
$S \rightarrow id = E ;$	$S.code = E.code \parallel$ $gen(top.get(id.lexeme) '=' E.addr)$
$E \rightarrow E_1 + E_2$	$E.addr = new Temp()$ $E.code = E_1.code \parallel E_2.code \parallel$ $gen(E.addr '=' E_1.addr '+' E_2.addr)$
$E \rightarrow - E_1$	$E.addr = new Temp()$ $E.code = E_1.code \parallel$ $gen(E.addr '=' 'minus' E_1.addr)$
$E \rightarrow ( E_1 )$	$E.addr = E_1.addr$ $E.code = E_1.code$
$E \rightarrow id$	$E.addr = top.get(id.lexeme)$ $E.code = ''$

- (b) What is the main problem of using the triples representation of three-address code? How can we solve this problem? Explain with examples. (3+2=5)

- (c) Draw the short circuit code corresponding jumping diagram and write the corresponding semantic rule for the following control-flow construct. (10)

**S**  $\rightarrow$  **for** (**S**<sub>1</sub>; **B**; **S**<sub>2</sub>) **S**<sub>3</sub>

3. (a) Write short notes with examples on – type system, string type systems, weak type systems, partial ordering of types. (10)

- (b) The following code computes Fibonacci numbers recursively. (8+7=15)

```
int fibonacci (int n) {
    if (n<2) return 1;
    return fibonacci (n-1) + fibonacci (n-2);
}
```

Show the complete activation tree for it. What does the control stack look like when the third call of **fibonacci(1)** is about to return? Show only the arguments and return values in an activation record. (Assume that the initial call is **fibonacci(5)**).

- (c) What is the major problem of using Reference Counting as a garbage collection framework? Explain with example. (10)

4. (a) Determine the costs of the following instruction sequence: (10)

```
LD R0, x
ADD R1, #3, #2
LD R2, *200 (R0)
ADD R0, R1, R2
ST x, R0
```

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**Contd ... Q. No. 4**

(b) For the following three-address code sequence, identify the basic blocks and construct the corresponding flow graph. (8+7=15)

- 1) `c = 0`
- 2) `i = 0`
- 3) `j = 0`
- 4) `t1 = 8 * i`
- 5) `t2 = t1 + j`
- 6) `t3 = 8 * t2`
- 7) `mat[t3] = c`
- 8) `c = c + 1`
- 9) `j = j + 1`
- 10) `if j < 8 goto (4)`
- 11) `i = i + 1`
- 12) `if i < 8 goto (3)`

(c) In the context of machine independent semantics preserving code optimization, write short notes with example on – copy propagation, dead code elimination, and induction variable elimination. (2+3+5=10)

**SECTION – B**

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

- 5. (a) Write a regular expression for each of the following sets of binary strings. (6)
  - (i) Binary strings with no consecutive 0s or 1s
  - (ii) Binary string interpreted as decimal number is divisible by 3
- (b) Write a syntactically correct C program that can not be compiled successfully by a C++ compiler. (6)
- (c) Briefly explain how the Java language processor works. What is a just-in-time compiler? (6)
- (d) Briefly describe the roles of following components in the context of a compiler. (9)
  - (i) Preprocessor
  - (ii) Linker
  - (iii) Loader
- (e) Discuss about different types of errors in the context of a compiler. Suggest some recovery mechanisms for lexical errors. (8)
- 6 (a) Explain the two-buffer scheme of input buffering corresponding to lexical analysis. (6)
- (b) Write the algorithm corresponding to non-recursive predictive parsing using stack. (7)
- (c) Describe the roles of the analysis part of a compiler. (6)

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**Contd ... Q. No. 6**

(d) Eliminate left recursion from the following grammars: (12)

(i)  $A \rightarrow Aap \mid Bbq \mid c$

$B \rightarrow Bxp \mid Ayq \mid z$

(ii)  $T \rightarrow PQ$

$P \rightarrow RQ \mid q$

$R \rightarrow Tp$

$Q \rightarrow q$

(c) Write a short note on three-address instructions. (4)

7. (a) Explain the following terms. (6)

(i) LL(k) grammar

(ii) Recursive-descent parser

(iii) Lexeme

(b) The following grammar encounters both left factoring and left recursion problem. (12)

$F \rightarrow FBa \mid cDS \mid c$

Using this grammar show that, left factoring after removing left recursion yields the same grammar as removing left recursion after left factoring.

(c) Describe the roles of the lexical analyzer (6)

(d) Describe how you can construct a translator using Yacc. (5)

(e) What advantages are there to a language processing system in which the compiler produces assembly language rather than machine language? Draw a block diagram showing the code optimization phases of a compiler. (6)

8 (a) Briefly discuss the two rules that Lex uses to decide on the proper lexeme to select, when several prefixes of the input match one or more patterns. (5)

(b) Report five semantic errors that the semantic analyzer is expected to recognize. (5)

(c) Consider the following grammar (20)

$S \rightarrow aAa \mid BAa \mid \epsilon$

$A \rightarrow cA \mid bA \mid \epsilon$

$B \rightarrow b$

Construct the predictive parsing table corresponding to this grammar. Then, using this table show the sequence of moves made by the parser on input "beba".

(d) Explain how you can design a symbol table for a case insensitive programming language, where abc, ABC, and aBc refer to the same identifier. (5)

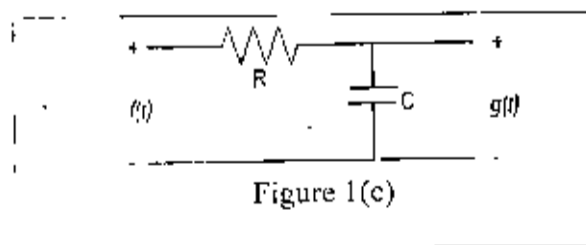
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**SECTION – A**

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

All the symbols have their usual meanings unless explicitly mentioned.

1. (a) What are the advantages of using digital signals over analog signals? Explain. **(5)**
- (b) (i) How is the bandwidth of a signal calculated? **(4+8)**
- (ii) The time-scaling property of Fourier Integral is as follows:  
If  $g(t) \Leftrightarrow G(f)$ , then for any real constant  $a$ ,  $g(at) \Leftrightarrow 1/|a| G(f/a)$ .  
Now which of  $g(t)$  and  $g(at)$  has higher bandwidth when  $a > 1$ ? Explain your answer
- (c) (i) For a Linear Time Invariant (LTI) continuous time system, an input  $x(t) \Leftrightarrow X(f)$  and the corresponding output,  $y(t) \Leftrightarrow Y(f)$  are related as follows:  $Y(f) = H(f)X(f)$  where  $H(f)$  is called the transfer function of the system. Now given an LTI system, how would you empirically find out the transfer function of the system? Explain your answer. **(8)**
- (ii) For a 'Distortionless' LTI system, the amplitude response  $|H(f)|$  must be constant and the phase response  $\alpha(f)$  must be a linear function of  $f$  going through the origin,  $f = 0$ . Now, under what conditions, the RC circuit in Figure 1(c) can be approximated as a Distortionless system. **(10)**



2. (a) State and prove Nyquist's sampling theorem. **(3+10)**
- (b) What are the practical issues in signal sampling and reconstruction according to the proof you have described above? How are those issues handled in practice? **(3+7)**
- (c) Explain how quantization with non-uniform spacing of levels can be achieved without actually changing the uniform level spacing in the quantizer of a PCM system? **(12)**

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3. (a) What are the special features of a Delta Modulation (DM) system in terms of (i) sampling rate, (ii) number of levels in quantizer, and (iii) predictor implementation? (3)
- (b) Draw the block diagrams of the modulator and the demodulator of a Delta Modulation system. (4+4)
- (c) The following set of sampled values of transmitted through the modulator of the DM system you have just drawn above. Compute the values received (at the demodulator) for each of the samples. Also compute the total RMS noise. Assume, step value,  $E = 0.5$ . Make any other assumptions required (6+4)
- Sampled Values: 0.2, 0.3, 0.4, 0.4, 0.8, 1.2, 1.6
- (d) What is the motivation behind making the step value adaptive in a DM system? Explain. How such adaptation can be made. (10+4)

4. (a) (i) Give an example where Time Division Multiplexing (TDM) is required. (5+12)
- (ii) A DM1/2 multiplexer combines four DS1 signals, each of rate 1.544 Mbps and generates a time multiplexed signal of rate 6.312 Mbps. The frame format for such a DM1/2 multiplexer is given in Figure 4(a). Now explain why such framing is required. Particularly, describe the functions of the overhead bits: M, C and F's.

$M_0$	[48]	$C_A$	[48]	$F_0$	[48]	$C_A$	[48]	$C_A$	[48]	$F_1$	[48]
$M_1$	[48]	$C_B$	[48]	$F_0$	[48]	$C_B$	[48]	$C_B$	[48]	$F_1$	[48]
$M_1$	[48]	$C_C$	[48]	$F_0$	[48]	$C_C$	[48]	$C_C$	[48]	$F_1$	[48]
$M_1$	[48]	$C_D$	[48]	$F_0$	[48]	$C_D$	[48]	$C_D$	[48]	$F_1$	[48]

Figure: 4(a)

- (b) When does 'Inter-Symbol Inference (ISI)' occur in a digital transmission system? Explain how ISI can be eliminated using pulse shaping. (6+12)

**SECTION - B**

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

You must give your answer to the point avoiding unnecessary writings.

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

Symbols in questions have the usual meanings.

5. (a) Why do you need to modulate baseband signal? (3)
- (b) Show a comparison between DSB-SC, DSB+C (With Carrier), LSB-SC for the following (2+3+3+3+3)
- (1) Modulation for a tone of  $m(t) = \cos 100t$
- (i) Draw basic spectrum of  $m(t)$
- (ii) Draw DSB-SC for  $2m(t) \cos 1000t$
- (iii) Draw DSB+C for  $2(1 + m(t))\cos 1000t$
- (iv) Draw LSB-SC from figure of (ii) by suppressing USB
- (2) Bandwidth used for these modulation techniques.

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**Contd ... Q. No. 5**

(c) Draw the signals obtained after encoding the bit stream '101011001' by each of the following digital line coding techniques: (i) Polar NRZ-1 (ii) Differential Manchester. **(6+12)**

Analyze these techniques in terms of the following characteristics.

- (i) Bandwidth requirement
- (ii) Synchronization capability
- (iii) DC value suppression
- (iv) Error detection capability

6. (a) Show the modulation procedure with block diagram, demodulation procedure with block diagram and bandwidth value only for the following.

(i) PSK (Phase shift keying) **(3+3+1)**

- Modulation
- Coherent Demodulation
- Bandwidth

(ii) FSK (Frequency shift keying) **(3+4+1)**

- Modulation
- Non-coherent Demodulation
- Bandwidth

(iii) DPSK (Differential Phase shift keying) **(3+4+1)**

- Modulation
- Non-coherent Demodulation
- Bandwidth

For modulation case you must give an example binary sequence and draw its modulated signal (approximately).

For Demodulation case explain with either diagram of as few lines as possible.

(b) Draw block diagram for a simple demodulation technique for FM (Frequency Modulation). **(4)**

(c) Three signals, each covering the range 10-15 KHz is to be transmitted simultaneously using Frequency Division Multiplexing (FDM). The resultant signal should cover the range 80-95 KHz. Describe how to generate the desired frequency multiplexed signal. **(8)**

7. (a) (i) Explain the relationship between FM (Frequency Modulation) and MP (Phase Modulation) in term of angle and instantaneous frequency of carrier signal. **(4+7+2+2)**

(ii) Show that the bandwidth of FM signal is infinite.

(iii) Under what condition FM is called Narrowband FM (NBFM).

(iv) Applying the above condition on the above expression of an FM signal, show that a narrowband FM signal can be approximated as:

$$f_{NBFM}(t) \approx A[\cos\omega_c t - k_f a(t)\sin\omega_c t] \quad \text{where } a(t) = k_f \int_{-\infty}^t f(a) da$$

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**Contd ... Q. No. 7**

- (b) Show with figure how phase continuation is maintained during MSK, what are the prerequisites for carrier frequency to work with MSK. **(8+4)**
- (c) On the process of recovering incoming carrier explain the following method briefly. **(3+5)**
- (i) Pilot carrier
  - (ii) Phase locked loop (PLL) (Draw Block diagram)
8. (a) Show that, for a time function  $f(t)$ , the signal,  $f_{SSB}(t) = f(t)\cos\omega_c t + f_h(t)\sin\omega_c t$  represents a lower sideband SSB-SC signal where  $f_h(t)$  represents Hilbert Transform of  $f(t)$  and  $\omega_c$  is the carrier frequency in rad/sec. **(14)**
- (b) Describe how Quadrature Amplitude Modulation (QAM) is performed. Explain why QAM is bandwidth efficient than DSB-SC modulation. **(4+5)**
- (c) For Vestigial Sideband (VSB), derive that output filter  $H_0(\omega) = \frac{1}{H_i(\omega + \omega_c) + H_i(\omega - \omega_c)}$  is used to reform the actual transmission signal that is distorted by transmitter input filter  $H_i(\omega)$ . [Show only the necessary equation] **(8)**
- (d) Describe how 'Scrambling' solves the synchronization problem with Bipolar-AM1. **(4)**
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**SECTION – A**

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

1. (a) You are to analyze the requirements for a government office to automate the filing system. Describe how fact finding, questionnaire and interviews play different roles to elicit requirements. (12)
- (b) Design a typical room JRP (Joint Requirement Planning) session. Mention the roles and responsibilities of different participants. (12)
- (c) Define *extends* and *uses* relationship in *use case diagrams* with proper real life examples. (7 $\frac{2}{3}$ )
- (d) Consider a teller of a bank serving clients to deposit examination fees in a queue. Show the extended version of *use case* for depositing examination fees by a student. (15)
  
2. (a) Why are the following factors considered in selecting software teams: (8)
  - (i) Degree of modularization of the problem
  - (ii) Rigidity of the delivery date
  - (iii) Size of the system to be developed
  - (iv) Quality of the programmers
- (b) Write down the general form of empirical estimation model. How are the equations developed? (8)
- (c) You are a CTO of a bank. Your management has asked you to establish mobile banking for the customers of the bank. You have studied the mobile banking solution market and found the following alternatives: (10 $\frac{2}{3}$ )
  - (i) Building the system by the in house programmer might require 100 Man-Month if it is simple and it might require 150 Man-Month if it is difficult. It is assumed that the probability that the system is difficult to build is 0.65.
  - (ii) Reusing the previously developed system in another good option. The estimated effort for minor and major change requirements to modify the system for mobile banking are 80 Man-Month and 120 Man-Month respectively.
  - (iii) Purchasing an off the shelf mobile banking system Tk. 50 lacs only. But the estimated effort for major and minor customizations are 40 Man-Month and 60 Man-Month respectively with equal probability.

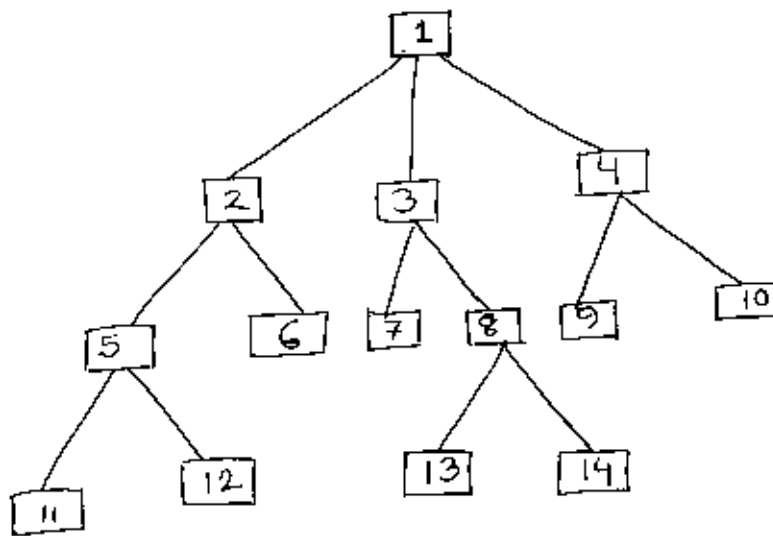
If the cost of average Man Month is Tk. 80 thousand then which alternate should be the wisest decision for the CTO?
- (d) "Reactive Risk Management is not a Risk Management" – Justify with appropriate example and reasoning. (6)

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**Contd ... Q.No. 2**

- (e) Explain the risks associated with the following factors: (6)
  - (i) Reasonableness of delivery date
  - (ii) Sophistication of the customer
  - (iii) Deviation of the product size.
- (f) Explain risk mitigation technique using the risk table. (8)

3. (a) Consider the following call and return architecture of a subsystem: (10)



Show the sequence of tests done in top down integration mentioning the stubs and drivers

- (b) Explain the debugging process with a diagram describing its process. (8)
- (c) Consider a module which sorts a number of floating point data in ascending order. Write down the driver code for generating different sizes of data set. Write down the code for this module. (12)
- (d) Consider a module that sums up  $n$  numbers. Identify the test cases for loop testing. (10)
- (e) Demonstrate equivalence partitioning for reducing the number of test cases with an example. (6<sup>2</sup>/<sub>3</sub>)

4. (a) Consider an aircraft controller with the provision of automatic and manual control. These could be switched whenever pilot wants. There are temperature, pressure and humidity sensors in the aircraft and these information are displayed in the cockpit. The automatic controller decides movement based on the sensor data and GPS system output. But whenever the aircraft is under manual control the system moves based on the pilots input. Write a DFD of the system and generate the architecture of the aircraft controller system. (17<sup>2</sup>/<sub>3</sub>)

- (b) Explain the architecture of software system for the following case: (12)
  - (i) A billing software for Titas Gas Transmission and Distribution Company Ltd
  - (ii) An embedded system software that controls a microwave oven.
  - (iii) Software for Network Interface Card
  - (iv) MATLAB software.

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**Contd ... Q. No. 4**

- (c) Discuss framework and umbrella activities for software development. (8)
  - (d) Find a suitable software development process for the following case: (9)
    - (i) A scientific software development that require lots of innovation and there are unknown issues.
    - (ii) A quick development of stock brokerage solution for a new instrument.
    - (iii) A large software development with very unstable users.
- Show proper reasoning for each case.

**SECTION – B**

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

- 5 (a) What is a model in the context of information system design? (5)
  - (b) What are the four kinds of things used in UML? (12)
  - (c) What is discovery prototyping? (5)
  - (d) Briefly describe the fact finding methods. (14)
  - (e) What is meant by JRP? Describe its advantages and disadvantages. (10<sup>2/3</sup>)
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- 6. (a) What is meant by agile method? (6<sup>2/3</sup>)
  - (b) Briefly describe different computing layers with respect to application architecture. (10)
  - (c) Briefly describe human engineering guidelines for user interface design. (8)
  - (d) Consider the following problem description: (22)

Consider an online reservation system for a bus company. The bus company includes several buses and realizes trips to different cities. Each bus is identified by its plate number and a separately assigned bus number. The trips are based on a predefined schedule and stop at predefined bus stations. Each bus can have only one trip per day. Each bus includes a driver and one hostess. For long trips, the bus will have a breaks at service and rest areas. There are two types of trips: normal trips and express trips. Express trips do not stop at intermediate stations and get faster at the destination.

Seats can be reserved by customers on the web site of the bus company. The customer has the option to directly pay for the seat through the website. In that case, the seat cannot be cancelled (neither by the customer nor by the company). If the customer has not paid for the seat, the bus company can cancel the seat if the customer does not show up one hour before the trip. When the reservation is cancelled, the seat will become free and can be sold to another customer. Both the customer and the company staff must authenticate themselves for performing operations with the system.

Draw a use case diagram for describing the functional requirements of the above system.

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7. (a) To take CSE 308, a student must go through the following process. When the instructor posts assignment 1, each student must form a team, do the assignment and hand it in. When assignment 2 is posted, each student works on it with her term. When the midterm assignment is made available, each student writes it. After both assignment 2 and the midterm are done with, each student waits for assignment 3, and when it is available, does it with her team. Draw a class diagram (with attributes, where appropriate) that describes entities and relationship relevant to the process. In particular, students are members of teams. Each team has 2 or 3 members. Each team completes 0 to 3 assignments. Each student takes exactly one midterm test. Each assignment and midterm is assigned a mark. (20)

(b) Draw a sequence diagram to represent the following scenario: (16 $\frac{2}{3}$ )

A patient arrives at a Magnetic Resonance Imaging (MRI) center carrying a doctor's referral form. A clerk in the Intake Department reviews the referral form for completeness, checks the Active Doctor file to verify that the doctor is in good standing with the department, and signs the doctor's referral form. The intake department clerk then prepares a 3-part MRI assignment form, which identifies the MRI machine and technician. The third copy of the MRI assignment is mailed to the doctor, the second copy is recorded by date with the referral, and the first copy is forwarded to the Imaging Department. A technician in the imaging department performs the imaging procedure, updates the assignment form to include information about when the procedure was performed.

(c) Distinguish between distributed and centralized architecture. What are the advantages of distributed architecture? (10)

8. (a) What is the present value of \$ 1,000 one year from now, assuming a 10% discount rate? (5)

(b) What is payback analysis? Explain briefly how it works. (10)

(c) Draw context and data flow diagram for the case described below. Data flow diagrams which are impossible to interpret because of all the scratching out and changes are less likely to be treated generously. (31 $\frac{2}{3}$ )

**The Blood Bank Testing Unit.** This is one unit within the College Street Red Cross Blood Donor Centre. On the day following a blood donation, the Blood Bank unit tests all blood for blood type and potential viral agents. They send the results of these tests to the Processing Office (another unit of the Centre). For each tested blood unit, they fill out a form which lists the blood unit number, the blood type, the date and the results of the test. If the tests indicate that the blood may be contaminated with a viral agent, the blood unit is destroyed. This is indicated on the test form. Blood units have a limited shelf life.

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**Contd ... Q. No. 8(c)**

The Blood Bank receives a list every day of those units which have exceeded their shelf life. These are discarded and the list sent back to the Processing Office with a signed indication of the disposal of the units. The Blood also distributes blood to various hospitals requesting blood. Requests usually come in for specific blood types. The Blood Bank prepares refrigerated containers of these unit and distributes them to the hospital vans when they arrive to pick up their supply. The Blood Bank receives a listing for each hospital and the specific units of blood to supply to the hospital from the Processing Office. The order is printed in triplicate. When the order is filled, the lab technician signs the order and returns a copy to the Processing Office. A copy of it travels with the blood to the requesting hospital. The final copy is kept in the Blood Bank records but discarded after one year.

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