

L-3/T-1/CSE

Date : 23/09/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2011-2012

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

Full Marks: 280

Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) Discuss the different implementation issues and consequences of Composite Pattern. (14)
(b) Write a Java code fragment based on Singleton Pattern. There should be class called Base, which can be inherited by other classes. Define two classes called Derived1 and Derived2 that will inherit Base. The maximum number of instances of Derived1 and Derived2 that can be created is 5 and 10 respectively. Write a main function where two arrays of Derived1 and Derived2 are created respectively and show the Singleton implementation. (18 $\frac{2}{3}$)
(c) Discuss the different types of document standards with respect to quality management. (6)
(b) What is process based quality? Describe process based quality briefly. (8)

2. (a) Read the following scenario carefully: (18 $\frac{2}{3}$)
A car rental company called "ABC Car Rentals" provides rent-a-car services to its customers. To rent a car from the company a customer must first visit its office. He then provides the time and duration to a company employee at the office. The employee checks the system and shows the customer available car models. The customer chooses a car model. The employee checks if that model is available for the given time. If not then the customer is asked to choose again. After the car model is fixed the employee asks the customer for his national id number and other necessary information. The information is entered into the system by the employee. The specific car is also booked for that particular time given by the customer. The employee then informs the customer about the rental cost and asks him to pay half the cost in advance. If the customer is unable to pay the cost then the booking is cancelled.
Now give the use case narrative for the use-case "Rent a Car" given this scenario.
(b) Define resilient and non-resilient systems. (6)
(c) What are the different types of messages in a sequence diagram? Discuss them briefly with examples. (12)
(d) What is a CRC card? Discuss its usages. (10)

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3. (a) What are the different types of events in a state chart diagram? (8)
- (b) An insurance company provides life insurance policies to its customer. A customer can purchase a policy worth Tk 3,50,000 for the duration of 5 years. After purchasing a policy the customer must pay monthly installments of Tk 5000 to the company. If a customer fails to pay the installment he becomes a defaulter. A defaulter must pay an extra Tk 500 for each month he did not pay to become a regular client again. If a customer fails to pay 6 consecutive installments then his policy is cancelled by the company. If the customer dies within the given time period then the company pays the nominee Tk 3,50,000. If the customer does not die during the period then the customer is paid Tk 3,50,000 by the company.. (14 $\frac{2}{3}$)
- Now draw the state chart diagram of a customer for this system.
- (c) What are the different phases of constructing a new system? Describe them. (16)
- (d) What are the different installation strategies while implementing a new system? (8)
4. (a) What are the different types of System Design Approaches? Describe the different types of Model Driven Approaches. (18 $\frac{2}{3}$)
- (b) What is three-tiered or n-tiered client/server computing? Discuss its various aspects. (12)
- (c) What are the four essential elements of a Design Pattern? Discuss them briefly. (8)
- (d) What are the difference between the usage of bar charts and column charts? When do we use radar charts and scatter charts? (8)

SECTION – B

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

5. (a) Classify each of the following statements according to its most appropriate requirement category by indicating 1, 2, 3, 4, 5, 6 or 7, where the numbers denote the following categories: (10)
- 1 - The sentence is a performance requirement.
 - 2 - The sentence is a portability requirement.
 - 3 - The sentence is a security requirement.
 - 4 - The sentence is a usability requirement.
 - 5 - The sentence is an availability requirement.
 - 6 - The sentence is a maintainability requirement.
 - 7 - The sentence is a domain requirement.

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

Statement	Category
i) The system must authenticate the user at each new session.	
ii) On average, no more than 2 failures requiring a system restart shall occur within a month of operation.	
iii) At most 5% of the source code shall be operating system specific.	
iv) The methods of the system shall have a maximum cyclomatic complexity of 6.	
v) The system shall be able to run with all functionality enabled within 250 MB of internal memory and 2 GB of external memory.	
vi) The rocket shall reach a speed of 11.2 km/s in order to evade earth gravity.	
vii) The system shall be operational on Windows XP, Windows Vista, and Windows 7.	
viii) The system shall require less than five mouse clicks to add a weekly meeting to a user's calendar.	
ix) After a 2 hours training period, a regular user shall be able to add a new customer within 3 minutes.	
x) The Olympics Ticketing System shall be able to process 100 ticket requests per minute at peak load.	

(b) What is agile software development? Briefly describe different stages of extreme programming.

(18 $\frac{2}{3}$)

(c) Compare and contrast the Scrum approach to project management with conventional plan-based approaches. The comparisons should be based on the effectiveness of each approach for planning the allocation of people to projects, estimating the cost of projects, maintaining team cohesion, and managing changes in project team membership.

(18)

6. (a) CSE department of BUET has got a very exciting project of modifying an existing banking solution. The solution is now working in different branches of many banks. But it has one major disadvantage that it does not use any centralized database. Now the task is to do a complete requirement analysis, design and redevelopment of the banking solution so that it can support online (any branch) banking. The project may need a complete technological up gradation. Also, CSE department has the problem of losing skilled personnel as teachers frequently leave for higher studies. Identify the risks associated in this project and describe how you plan to cope up with these.

(16 $\frac{2}{3}$)

(b) What are the different ways in which software engineers can deal with errors? What are the advantages and disadvantages of these approaches? List and discuss as many ways as you can think of.

(12)

CSE 307

Contd... Q. No. 6

(c) The following Table sets out a number of tasks, their durations, and their dependencies. Draw a bar chart showing the project schedule. (18)

Task	Duration	Dependencies
T1	10	
T2	15	T1
T3	10	T1,T2
T4	20	
T5	10	
T6	15	T3,T4
T7	20	T3
T8	35	T7
T9	15	T6
T10	5	T5,T9
T11	10	T9
T12	20	T10
T13	35	T3,T4
T14	10	T8,T9
T15	20	T2,T14
T16	10	T15

7 (a) Your company is developing software for an on-line stock-trading service. The software contains the following subsystems: a database of stockholder accounts, a web-based client through which customers place orders and request stock prices, an ordering server which processes stock transactions as requested by clients, and a networking system for communicating with an external stock price server (for up-to-the-minute stock prices).

For each of the following test cases, indicate whether it should be run during unit, integration, or system testing.

If you feel a test should be run in more than one testing phase, state the phases and justify your answer. (10)

- (i) Assuming the server is up, do stockholders receive price quotes within 3 seconds even if 200 stockholders request quotes simultaneously?
- (ii) Does the ordering server accept an order only if the stockholder's account has sufficient funds to cover the order?
- (iii) Does the client refuse orders for stocks that do not exist?
- (iv) If the server receives an order to purchase stock and the stockholder has sufficient funds, is the stock eventually purchased?
- (v) Once stockholder's account has been removed from the account database, is that stockholder prohibited from placing orders through the software?

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Contd... Q. No. 7

(b) Draw the control flow graph for the following function. Then determine the cyclomatic complexity and the basis set of independent paths of the CFG. Finally prepare test cases that force execution of each path in the basis set. (25)

```
public double calculate(int amount)
{
    double rushCharge = 0;
    if (nextday.equals("yes"))
    {
        rushCharge = 14.50;
    }
    double tax = amount * .0725;
    if (amount >= 1000)
    {
        shipcharge = amount * .06 + rushCharge;
    }
    else if (amount >= 200)
    {
        shipcharge = amount * .08 + rushCharge;
    }
    else if (amount >= 100)
    {
        shipcharge = 13.25 + rushCharge;
    }
    else if (amount >= 50)
    {
        shipcharge = 9.95 + rushCharge;
    }
    else if (amount >= 25)
    {
        shipcharge = 7.25 + rushCharge;
    }
    else
    {
        shipcharge = 5.25 + rushCharge;
    }
    total = amount + tax + shipcharge;
    return total;
} //end calculate
```

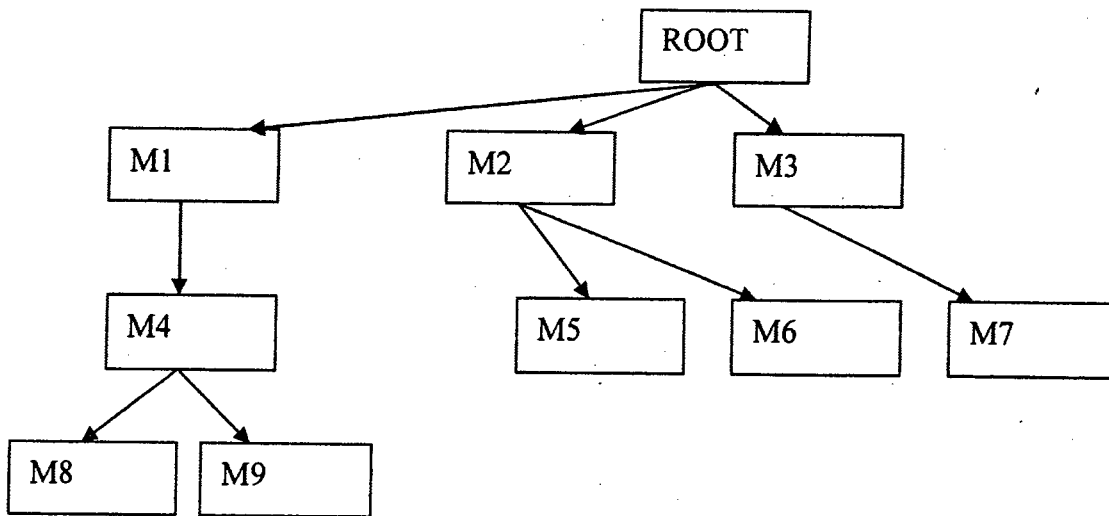
- (c) Briefly describe the techniques of estimating different stages of agile development. (11 ²/₃)
8. (a) You have an impatient, result-oriented client who keeps on changing requirements. Which process model would you adopt to keep the development under control? Why? (10)
- (b) Describe the four phases of the Rational Unified Process (RUP). Mention four ways in which the RUP differs from the Waterfall process model. (12)
- (c) How COCOMO II model for cost estimation can be used at various stages of a project life cycle? (15)

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Contd... Q. No. 8

(d) The structure chart below illustrates the hierarchy of modules in a software sub-system:

(9²/₃)



Describe the sequence of module tests for integrating the modules using the depth first top-down approach.

Saifur
6/10/13

L-3/T-1/CSE

Date : 06/10/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2011-2012

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**.

1. (a) Draw the signals obtained after encoding the bit stream- '010100110' by each of the following two digital line coding techniques: (i) Polar NRZ-I and (ii) Bipolar-AMI.

Analyze these two techniques in terms of the following characteristics.

(5+10+5)

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

Describe how 'Scrambling' solves the synchronization problem with Bipolar-AMI.

- (b)(i) Ten voice sources, each covering the frequency range from 20 Hz – 20 KHz are each to be transmitted using PCM technique as shown in Figure 1(b). Each signal is sampled at a rate of 44,000 samples/sec. Each sample is quantized and coded into 12 bits. The 10 PCM streams are then time-multiplexed into one composite PCM signal. (Neglect control and framing bits in the TDM frame that might be required). The composite PCM stream is fed to a 16-QAM modulator with carrier frequency, $f_c = 100$ MHz. Sinusoidal roll-off shaping with $r = 0.1$ is used. Find the transmission bandwidth at the output of the modulator.

(10)

- (ii) Consider again the problem in part (i) above. This time, a frame at the output of the time-division multiplexer is defined to be 1.25 ms long. 10 control bits are added per frame. What is the required transmission bandwidth at the output of the modulator?

(5)

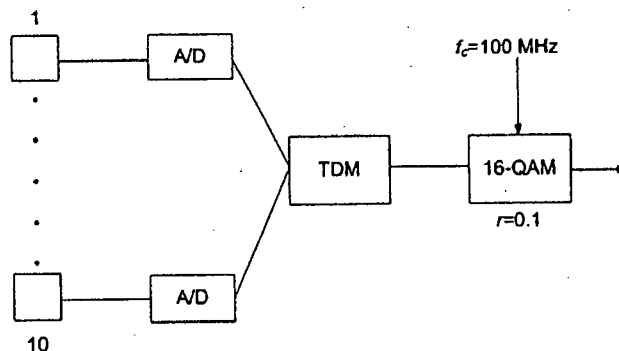
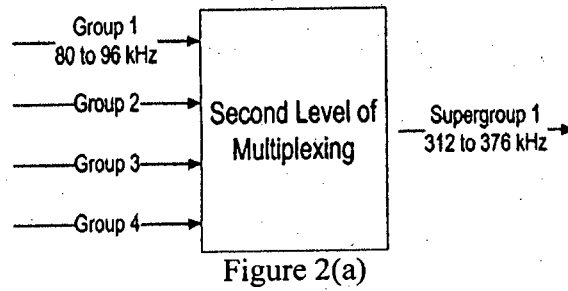


Figure 1(b)

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2. (a) Consider the second level of a two-level FDM hierarchy as shown in Figure 2(a). At this level, four groups (from level 1, not shown in the figure) each in the range 80 to 96 kHz are combined to generate a supergroup in the range 312 to 376 kHz using SSB (upper sideband) modulation. Explain the supergroup generation process using suitable diagram. Specify the frequency values that must be used at multiplier for each group/channel.

(10)



- (b) Explain how 'Frequency Modulation (FM)' and 'Phase Modulation (PM)' are related. Define narrowband FM and wideband FM. An FM signal can be demodulated by passing it through an ideal differentiator followed by an envelope detector. Explain why this method works.

(8+5+12)

3. (a) (i) ^{of} One of the methods of coherent/synchronous detection of OOK signals is to multiply the incoming signal by the carrier frequency, as locally generated at the receiver, and then low pass-filtering the resultant multiplied signal. What happens when the local carrier is not exactly at the same frequency and same phase as the incoming carrier? Explain.

(ii) There is another method for synchronously demodulating OOK signals that does not require exact frequency and phase synchronization. In this method, the incoming signal is sampled at the carrier frequency rate and then the sampled signal is passed through a low-pass-filter. Explain why this method works.

(12+8)

(b) Draw the diagram of an envelope detector circuit. Why envelope detection cannot be used with PSK signals? Describe an asynchronous/non-coherent demodulation technique for PSK signals.

(3+3+9)

4. (a) Consider a 'Quaternary PSK (QPSK)' signal where the four phase angles are: $\pm\pi/4$, $\pm3\pi/4$. What is the maximum phase-shift at symbol transition point of the given QPSK signal? Describe how each of the following two techniques reduces the value of maximum phase-shift: (i) Offset QPSK and (ii) $\pi/4$ - shifted QPSK.

(3+8+8)

(b) Describe how the following modulation techniques differ: (i) Normal AM, (ii) DSB-SC (Double-Sideband Suppressed-Carrier), (iii) SSB-SC (Single-Sideband Suppressed-Carrier) and (iv) VSB-SC (Vestigial-Sideband Suppressed-Carrier). Describe a scenario where Normal AM is required.

(8+8)

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SECTION - B

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

5. (a) The Fourier integral $F(\omega)$ of a non-periodic function $f(t)$ is defined as:

(8)

$$F(\omega) = \int_{-\infty}^{\infty} f(t) e^{-j\omega t} dt$$

Accordingly, find the Fourier integral of the function $f(t)$ shown in Figure 5(a).

- (b) Find the Fourier integral of function $g(t)$ shown in the Figure 5(b) from the Fourier integral of function $f(t)$ shown in Figure 5(a), and then the Fourier integral of function $h(t)$ shown in Figure 5(c) from the Fourier integral of function $g(t)$ using suitable properties of Fourier integral.

(8+6)

- (c) How is the bandwidth of a real time signal calculated? Accordingly which of the three functions $f(t)$, $g(t)$, and $h(t)$ shown in Figures 5(a), 5(b), and 5(c) respectively, has the lowest bandwidth? Explain your answer.

(5+8)

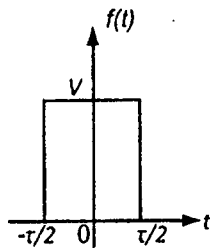


Figure 5(a)

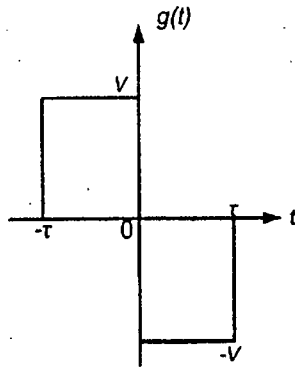


Figure 5(b)

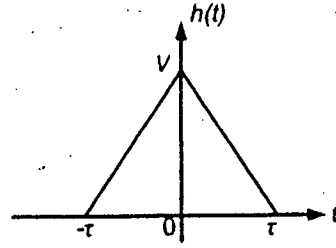


Figure 5(c)

6. (a) Explain the 'Linearity' and 'Time invariance' properties of a 'Linear Time Invariant (LTI)' system. Let $g(t)$ be output response of an LTI system with transfer function $H(\omega)$ to an input signal $f(t)$. Let $F(\omega)$ and $G(\omega)$ be the Fourier transform of $f(t)$ and $g(t)$ respectively. Show that, $G(\omega) = H(\omega)F(\omega)$.

(9+9)

- (b) An LTI system is called 'distortionless' when for any input function $f(t)$, the output of the system $g(t)$ is expressed as: $g(t) = Af(t - t_d)$, where A and t_d are constants. According to this definition, find out the transfer function $H(\omega)$ of a distortionless LTI system. Under what conditions, the RC circuit shown in Figure 6(b) can be approximated as a distortionless system.

(9+8)

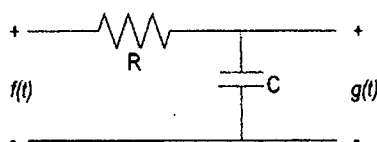
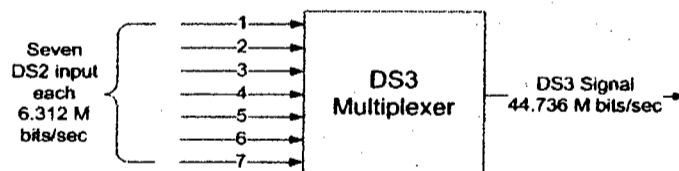


Figure 6(b)

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7. (a) In a PCM system, the input signal is limited to $\pm V$ volts. After sampling, the sampled signals are quantized into M uniformly spaced levels. For this system, show that, the mean power output SNR, $S_o/N_o = M^2 - 1$. (12)
- (b) In a PCM system, explain how quantization with non-uniform spacing of levels can be achieved without actually changing the uniform level spacing in the quantizer. (8)
- (c) Describe how 'Delta Modulation (DM)' system works with suitable block diagrams of both transmitter and receiver. (15)
8. (a) How does 'Inter-Symbol Interference (ISI)' occur in a digital transmission system? Explain how ISI can be eliminated using pulse shaping. (5+8)
- (b) Describe briefly how the following three issues are resolved in a Time Division Multiplexing (TDM) system. (i) Synchronization, (ii) Difference in the bit rates of the incoming channels, and (iii) Small variation in bit rate of an incoming channel. (9)
- (c) Consider a DS3 multiplexer as shown in Figure 8(c) that combines seven DS2 digital streams into one DS3 stream. Each incoming DS2 stream has a nominal bit rate of 6.312 Mbps. The bit rate of the output DS3 signal is 44.736 Mbps. Each DS3 frame contains 4704 data bits and 56 control bits. What is the maximum fractional increase over the nominal rate for each input channel that can be accommodated by the multiplexer? DS3 multiplexer allows one bit per frame to be stuffed per input signal channel. Is this sufficient to accommodate expected variation in the input rate? Explain your answer. (8+5)



SECTION - A

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

1. (a) What are the components of a computer? Mention the task of each of these components. (7.5)
- (b) Briefly describe ISA classes with examples and block diagrams. (10)
- (c) Suppose we have two implementations of the same instruction set architecture. Computer A has a clock cycle time of 250 ps and a CPI of 2.0 for some program, and computer B has a clock cycle time of 500 ps and a CPI of 1.2 for the same program. Which computer is faster for this program and by how much? (Show all steps of calculations.) (7)
- (d) Suppose a program runs in 10 seconds and the program spends 50% of its time executing floating point instructions. We improve the floating point unit by a factor of five. How big is the speedup? (6)
- (e) What are the problems with measuring performance in terms of MIPS (million instructions per second)? (4.5)
2. (a) What are the MIPS design principles? Mention one use of each of these design principles in MIPS ISA. (4+4)
- (b) Which instructions and registers are used in procedure call in MIPS hardware? What are the purpose of using these registers and instructions? (7.5)
- (c) If branch target is too far to encode with 16-bit offset, how does the assembler rewrite the following code: BEQ \$s0, \$s1, L1? (3.5)
- (d) Describe MIPS addressing modes. (10)
- (e) Give three examples of complexity of IA-32. (6)
3. (a) Consider the following set of instructions: ADD, SW, JUMP. Draw the single cycle datapath and control that can execute the above set of instructions. Minimize the number of hardware used as much as possible, i.e., there should be no redundant hardware in your design. (Note that explanation is not required.) (15)
- (b) Write the purpose of using ALU unit for R-type, load/store, and branch instructions. (6)
- (c) Briefly describe the properties of hard-wired and microprogrammed control unit design. (6)

CSE 305

Contd ... Q. No. 3

(d) Consider the following MIPS instructions:

- (i) LW \$6, 36(\$1)
- (ii) ADD \$5, \$5, \$5

What do these instructions perform in EX and MEM stages. Assume that the pipelined datapath has 5 stages: IF (Instruction Fetch), ID (Instruction decode and register file read), EX (Execution op address calculation), MEM (Data memory access), and WB (Write Back).

4. (a) What are the values stored in IF/D and ID/EX pipeline registers? (8)

(b) What is a pipeline hazard? What are the different types of pipeline hazards? (6)

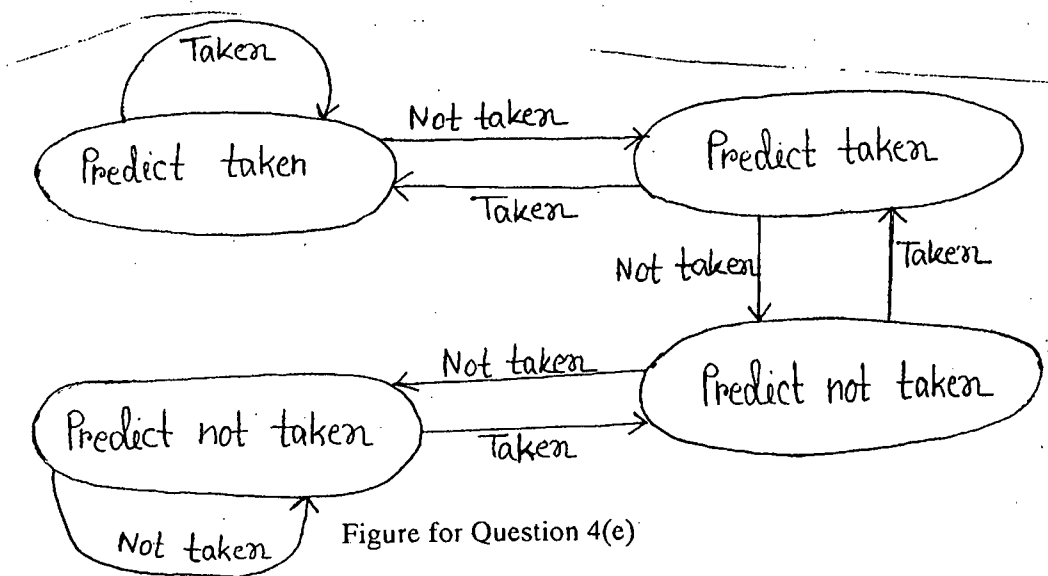
(c) Give an example of double data hazard. (2+6)

(d) Consider the following sequence of instructions: (3)

- LW \$1, 40(\$6)
- ADD \$6, \$2, \$2
- SW \$6, 50(\$1)

Assume that there is no forwarding in this pipelined processor. Estimate data hazards with "nop" instruction. (4)

(e) Consider the following repeating pattern of branch outcome: T, T, NT, T. What is the accuracy of the two-bit predictor for this sequence of branch outcomes? What is the accuracy of the two-bit predictor in steady state if this pattern is repeated forever? Assume that the 2-bit predictor starts off in the bottom left state (predict not taken) of the figure given below. (7)



(f) Why does the MIPS implementation use EPC and Cause registers for processing an exception? What is an imprecise exception? (4+3)

CSE 305

SECTION - B

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

5. (a) Draw the flow diagram of floating point addition. Also write down the condition of overflow or underflow during a floating point addition. (8+2)
- (b) What are the 'direct mapped', 'set associative', and 'fully associative' cache schemes? (6)
- (c) Assume there are three small caches, each consisting of 4 one-word blocks. One each is fully associative, another one is 2-way set associative, and the third one is direct mapped. Find the number of misses for each cache organization given the following sequence of block addresses: 0, 4, 0, 2, 6, 8. (15)
- (d) What is a split cache? How is it different from the multilevel cache system? (2+2)
6. (a) Draw diagrams of the first and refined versions of the multiplication hardware. Discuss the improvement of the refined version over the first version. (5+5+5)
- (b) Assume the miss rate of an instruction cache is 2% and the miss rate of a data cache is 4%. If a processor has a CPI of 6 without any memory stalls, determine how much faster a processor would run with a perfect cache that never misses. Assume a main memory access time of 100 ns (including all the miss handling) and the processor clock rate is 4 GHz. (10)
- (c) Write down the steps to handle a cache miss. (5)
- (d) Discuss the components of disk data access time. (5)
7. (a) (i) What do you understand by the 'virtual memory' scheme? (3)
- (ii) Explain the purpose of a 'page table' and a 'page table register' in this scheme. (4+2)
- (iii) Draw the mapping from a 32-bit virtual address to a 30-bit physical address using a page table. (6)
- (iv) With a 32-bit virtual address, 4 kB pages and 4 bytes per page table entry, compute the total size of a page table. (5)
- (b) Draw the state diagram of a simple cache controller. (10)
- (c) What are the 'synchronous' and the 'asynchronous' bus system? (5)
8. (a) Assuming a cache of 16k blocks, a 4-word block size and a 32 bit address, find the total number of tag bits for a 4-way set associative cache. Also find the total size of the cache. [byte offset = 2 bits, 1 word = 32 bits, and 1k = 2^{10}]. (10)
- (b) Briefly describe the 'shared memory multiprocessor' and the 'message passing multiprocessor' systems. (6+6)

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Contd ... Q. No. 8

(c) Suppose a single shared memory processor has 20 GB of main memory. Five clustered computers occupy 4 GB each and the OS occupies 2 GB. How much more space is there for users with shared memory? (8)

(d) What are processor memory bus and back-plane bus? (5)

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10/09/13

L-3/T-1/CSE

Date : 08/07/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2011-2012

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) Consider the following relations:

(5×5=25)

Emp (eno, ename, title, city)

Proj (pno, pname, budget, city)

Works (eno, pno, resp, dur)

Pay (title, salary)

where the primary keys are underlined, and Emp.title is a foreign key to pay.title, works.eno is a foreign key to Emp.eno and Works.pno is a foreign key to Proj.pno. Answer the following questions for this schema.

(a) Write SQL statements to answer the following queries:

(i) For each city, how many projects are located in that city and what is the total budget over all projects in the city?

(ii) For each project, what fraction of the budget is spent (in total) on salaries for the people working on that project? Sort your answer by the value of the budget.

(iii) Remove the work assignment of all persons to any projects for which more than any 2 persons share the same responsibility.

(iv) List all projects located in Toronto city and include for each one the number of persons working on the project.

(v) Find the names of projects whose budgets are greater than all projects located in Waterloo city.

(b) Express the following queries using relational algebra:

(5×2=10)

(i) Find names of employees whose salary is more than \$ 1000.

(ii) List all projects where at least one person with 'Programmer' title is working on it.

(You can print a project name more than once).

2. (a) What are redundancy, deletion and update anomalies?

(10)

(b) Consider a relation with schema R (A, B, C, D) and FDs

$AB \rightarrow C$, $AD \rightarrow B$, $B \rightarrow D$. Find all non-trivial FDs that follow from the given FDs.

(10)

Contd P/2

CSE 303

Contd ... Q. No. 2

(c) The following schema has been designed for an address book application: **(4+3+3+5)**

R (SSN, Name, PhoneType, PhoneNumber)

A person can have different types of phone numbers (e.g. Mobile, Home or Office). The following set F of functional dependencies hold on R:

SSN → Name

SSN, PhoneType → PhoneNumber

SSN, PhoneType → Name

PhoneNumber → SSN, Name, PhoneType

- (i) What are the keys for R?
- (ii) Is R in BCNF? Why or why not?
- (iii) Can you remove any dependency without violating equivalency of F?
- (iv) Decompose R into BCNF (if it is already not in BCNF).

3. A database schema consist of four relations:

Product (maker, model, type)

PC (model, speed, ram, hd, price)

Laptop (model, speed, ram, hd, screen, price)

Printer (model, color, type, price)

Answer the following questions for this schema:

- (a) Suggest suitable keys and foreign keys of the above relations. **(5)**
- (b) Write the following check constraints: **(5)**
 - (i) The model number of a product must be a 7 digit number
 - (ii) A PC with a processor speed less than 2.0 GHz must have at least 512 MB ram or sell for less than \$ 800.
- (c) Delete all laptop made by manufacturer that does not make printers. **(5)**
- (d) Assume that, manufacturer A bought manufacturer B. Change all products made by B so that they are now made by A. **(5)**
- (e) Write the following assertions: **(3×5=15)**
 - (i) The price of a laptop must be larger than the average price of PCs made by the same manufacturer.
 - (ii) A manufacturer of a PC must also make Laptop(s).
 - (iii) If a PC has a greater processor speed than a laptop then the PC must also have a higher price than the laptop.

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4. (a) You have been asked to design an employee tracking database for a company. They want to track information about employees, the employee's job history, and their certifications. Employee information includes first name, middle initials, last name, social security number, address, city, state, zip, home phone and email address. Job history would include job title, job description, pay grade, pay range, salary and date of promotion. For certifications, they want certification type and date achieved. An employee can have multiple jobs over time, (i.e., Analyst, Sr. Analyst, QA Administrator). Employees can also earn certifications necessary for their jobs.
- (i) Draw an ER diagram for this application. Be sure to mark the multiplicity of each relationship of the diagram. Decide key attributes and identify them on the diagram. Please state all assumptions you make in your answer. (15)
- (ii) Translate your ER diagram into a relational schema. Select approaches that yield the fewest number of relations; merge relations where appropriate. Specify the key of each relation in your schema. (10)
- (b) Distinguish between 'cross join', 'natural join' and 'outer joins'? When (left or right) outer joins are useful? Give example. (10)

SECTION – B

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

5. (a) What are the key properties of a DBMS? (8)
- (b) Show the major components and their interactions in a DBMS. Briefly explain the functionalities of major components. (15)
- (c) What do you mean by the ACID properties in a DBMS? Give one example of each property of the ACID. (12)
6. (a) What are the different types of disk failures? How does a DBMS handle a disk crash? (8)
- (b) Find a RAID level 6 scheme with ten disks, such that it is possible to recover from the failure of any three disks simultaneously. You should use as many data disks as you can. (15)
- (c) What are the differences between RAID levels 1, 4, 5 and 6? (12)
7. (a) Write down the key properties of a B+-tree. (8)
- (b) Draw a B+-tree for the following keys: 2, 3, 5, 7, 14, 16, 20, 34, 38, and 40. Assume a 2-order B+-tree where a node must have 2 to 4 keys. Re-construct the tree if you delete 3, 5, and 7 from the original tree. (9+6)

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Contd ... Q. No. 7

(c) Suppose in a B+-tree, pointers are 4 bytes long and keys are 12 bytes long. How many keys and pointers will a block of 16,384 bytes have? For a one million records table, what would be the expected length of the index? (12)

8. (a) Define serial, serializable, conflict-serializable, and two-phase locking in terms of database transactions. (8)

(b) What is deadlock in database transaction? Give an example. (3)

(c) What is the precedence graph of the following schedule? (12)

$r_1(A); r_2(A); r_1(B); r_2(B); r_3(A); r_4(B); w_1(A); w_2(B);$

Is the above schedule conflict serializable? If so, what are all the equivalent serial schedules?

(d) 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 the disk and log, and the last log record to appear on disk is (i) <COMMIT U> and (ii) <T,E,50,51>.

S. Rahman
29.09.13

L-3/T-1/CSE

Date : 29/09/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2011-2012

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) Write regular definitions for the following languages: (15)
 - (i) Comments, consisting of a string surrounded by /* and */, without an intervening */, unless it is inside double-quotes (").
 - (ii) All strings of lowercase letters that contain the five vowels in order.
 - (iii) Define a regular expression for the unsigned number (integer or floating point) of the C language. Few examples are .02, 12, 12.3, 12., 32.23E+2, 23.5E-3.

(b) What is a symbols table of a compiler? In which phase or phases is the symbol table used? Explain the symbol table management of a compiler. (15)

(c) Distinguish between a compiler and an interpreter. Which one of these (compiler and interpreter) is suitable for performance? Explain. (5)

2. (a) Explain the differences between top-down parsing and bottom-up parsing. Which one is used in commercial compiler and why? (5)

(b) What are the goals of an error-handling strategy in syntax analysis phase? What are the error-handling strategies in this phase? Explain the Panic-mode recovery with an example. (15)

(c) What is a recursive-descent parsing? When does the recursive-descent parsing not work? Explain. (10)

(d) Explain with an example the reason why the bottom-up parsing does not require a left-factored grammar. (5)

3. (a) What is predictive parsing? Find the parsing table for the following grammar in the context of predictive parsing: (20)
$$E \rightarrow T + E \mid T$$
$$T \rightarrow \text{int} \mid \text{int} * T \mid (E)$$

(b) Consider the context-free grammar $S \rightarrow (L) \mid a$ and $L \rightarrow L, S \mid S$ with string ((a, a), a, (a)). Answer the following: (15)
 - (i) Give a leftmost derivation for the string.
 - (ii) Give a rightmost derivation for the string.
 - (iii) Is the grammar ambiguous or unambiguous? Justify your answer.
 - (iv) Describe the language generated by this grammar.

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4. (a) Given the following grammar: (15)

$$E \rightarrow E + E \mid E - E \mid E * E \mid E / E \mid \text{int}$$

Show two different left-most derivations of the string **int + int * int / int**. Also show the corresponding parse trees. What does this tell you?

(b) How would you change the following grammar: (10)

$$E \rightarrow E + E \mid E - E \mid E * E \mid E / E \mid \text{int}$$

so that all of the binary operations are left associative and the precedence of the operators?

(c) What is a shift-reduce parsing? Explain with an example. (10)

SECTION - B

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

Assume suitable values for any missing data.

5. (a) Consider the following context free grammar (CFG) for arithmetic expressions involving addition (+) operations

$$E \rightarrow TE'$$

$$E' \rightarrow + TE' \mid \epsilon$$

$$T \rightarrow \text{digit}$$

(i) Extend the above CFG so that it can handle expressions having subtraction (-) and multiplication (*) operations. (5)

(ii) Convert the extended CFG of 5(a)(i) into a Syntax Directed Definition (SDD) to evaluate the expressions. (7)

(iii) Depict an **annotated** parse tree for expression 3*5-4 based on the SDD of 5(a)(ii). (8)

(iv) Convert the SDD of 5(a)(ii) into a corresponding Syntax Directed Translation (SDT). (5)

(Assume that all the operations (+, -, *) follow their usual precedence and associative rules.)

(b) Convert the following statements into equivalent three address code sequences (2×5)

(i) do i = i + 1; while (b[i] < v)

(ii) y = p (a, b, c, d, e) + b[i];

(Assume that, b is an array of elements with 16 units of space required for each element and p is a function taking 5 parameters).

6. (a) Define short-circuit code with an appropriate example. (7)

(b) Consider the following CFG for control flow statements.

$$P \rightarrow S$$

$$S \rightarrow \text{id} = \text{num};$$

$$S \rightarrow \text{if (B) S1 else S2}$$

$$B \rightarrow B \parallel B \mid B \&\&B$$

$$B \rightarrow E \text{ relop } E$$

$$E \rightarrow \text{id} \mid \text{num}$$

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Contd ... Q. No. 6(b)

- (i) Convert the above CFG into an SDD so that it can generate equivalent three address codes for the control flow statements. (12)
- (ii) For the statement $\text{if } (x < 100 \parallel x > 200 \ \&\& \ x \neq y) \ x = 0; \text{ else } \ x = 1;$ construct an annotated parse tree based on the SDD of 6(b)(i) by showing values for all necessary attributes. (16)
7. (a) For a language with nested procedure declarations, define nesting depth. How can it be used to manipulate access links while procedure calls are implemented for that language? (4+7)
- (b) Depict the division of tasks between the caller and callee in respect of function calling. (10)
- (c) What is the cost and effect of the following machine instructions (9)
- (i) LD R2, 100(R1)
 - (ii) ST * 100(R1), R2
 - (iii) ADD R1, R1, #100
- (d) Briefly describe the issues that should be considered while designing a code generator. (5)
8. (a) With suitable examples, explain the following terms relating to code optimization based on basic blocks/flow-graphs (3+4+5+6)
- (i) leader statements
 - (ii) global common-subexpression elimination
 - (iii) copy propagation and dead-code elimination
 - (iv) induction variable elimination
- (b) Consider the following grammar for declaration statement. (9)
- $D \rightarrow T \text{ id};$
 - $T \rightarrow B C$
 - $B \rightarrow \text{int} \mid \text{float}$
 - $C \rightarrow [\text{num}] C \mid \epsilon$
- Design an SDT for the above grammar that will compute the type and width of a declared identifier and insert them in a symbol table. Assume, the width of an integer is 4 and that of a float is 8.
- (c) Explain that any SDD having a production $A \rightarrow B C$ with semantic rules $A.s = B.b$ and $B.i = f(C.c, A.s)$ can be neither S-attributed nor L-attributed SDD. Here, s is a synthesized attribute and i is an inherited attribute while b and c can be of any type. (8)
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