

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
 B.Sc. Engineering 3rd Year 1st Term Examination, 2015  
 Department of Computer Science and Engineering  
 CSE 3101  
 Theory of Computation

TIME: 3 hours

FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.

ii) Figures in the right margin indicate full marks.

**SECTION A**

(Answer **ANY THREE** questions from this section in Script A).

1. a) Give a comparative discussion about alphabet, language, and power on alphabet. (09)
- b) Give the formal definition of Deterministic Finite Automata (DFA). Design a DFA that accepts the following language L over the alphabet {0,1}. (14)  
 $L = \{ w \mid w \text{ contains the symbol } 1 \text{ at most three times} \}$   
 Also give the transition diagram of that DFA.
- c) Write down the properties of Nondeterministic Finite Automata (NFA). How can you test the membership of a string? Use example. (12)
2. a) Define  $\epsilon$ -NFA. Draw an  $\epsilon$ -NFA that searches KUET and STUDENT from a test document. (08)
- b) Convert the following NFA into DFA using subset construction method. (14)

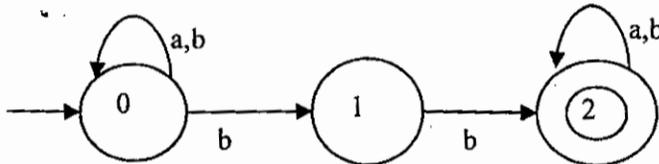
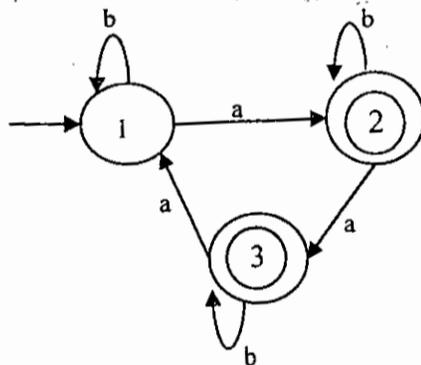


Fig. 2(b)

- c) Convert regular expression  $(a+b)b^*(a+b)^*$  to an  $\epsilon$ -NFA. Show the steps. Also Describe the extended transition function  $\hat{\delta}$  for  $\epsilon$ -NFA with suitable example. (13)
3. a) Let M be the DFA having alphabet {a, b} and the following transition diagram: (15)



Give a regular expression for  $L(M)$ . Try to keep your expression simple. (Use any method you want)

- b) What is Kleene Closure of a language? Find  $L^2$  and  $L^3$  of the language  $L = \{1, 01\}$ . (08)
- c) Write regular expression/definition for the following languages: (12)
  - (i) All strings containing no more than three a's over alphabet {a, b, c}
  - (ii) The set of strings of 0's and 1's whose number of 0's is divisible by three and whose number of 1's is odd.
  - (iii) All string of digits with at most one repeated digit.
  - (iv) All Strings which contain no runs of a's length greater than two over alphabet {a, b, c}
4. a) State pumping lemma. Using pumping lemma, show that the language of palindrome is not regular. (11)
- b) Design a Context Free Grammar (CFG) for the language  $\{ X^a Y^b Z^c \mid a=b \text{ or } b \neq c, \text{ where } a, b, c \geq 0 \}$  (09)
- c) Define ambiguous grammar. Use string aabbb to find out whether the following grammar is ambiguous or not. If yes, give an equivalent unambiguous grammar. (15)  
 $S \rightarrow BS \mid \epsilon$   
 $B \rightarrow Bb \mid aBb \mid ab$

## SECTION B

(Answer ANY THREE questions from this section in Script B)

5. a) Define Push Down Automata (PDA). Construct push down automata for the following (15)  
languages. Acceptance either by empty stack or by final state.  
(i)  $L = \{a^n b^n \mid n \geq 0\}$   
(ii) Equal number of 0's and 1's.  
b) For PDA, distinguish between acceptance by final state, and by empty stack. (08)  
c) Prove that "If  $L$  be  $L(P_F)$  for some PDA  $P_F$  where  $P_F = (Q, \Sigma, \Gamma, \delta_F, q_0, z_0, F)$  then there is a (12)  
PDA  $P_N$  such that  $L = N(P_N)$ ".
6. a) Define instantaneous description of a Turing Machine (TM). What is the role of checking (08)  
off symbols in TM?  
b) Design a Turing Machine (TM)  $M$  to implement the function "Subtraction". Simulate the (14)  
action for the input 00000100.  
c) Convert the following grammar to a PDA that accepts the same language by empty stack. (13)  
 $S \rightarrow 0S1 \mid A$   
 $A \rightarrow 1A0 \mid S \mid \epsilon$   
Simulate the action for the input 0011 on the new PDA.
7. a) Define Chomsky Normal Form (CNF). Find a grammar in CNF equivalent to (10)  
 $S \rightarrow aAbB$   
 $A \rightarrow aA/a$   
 $B \rightarrow bB/b$   
b) Consider the following grammar (25)  
 $S \rightarrow a|aA|B|C$   
 $A \rightarrow aB|\epsilon$   
 $B \rightarrow Aa$   
 $C \rightarrow cCD$   
 $D \rightarrow ddd$   
and simply safe order  
(i) Eliminate  $\epsilon$ -production.  
(ii) Eliminate Unit Productions.  
(iii) Eliminate Useless Symbols.  
(iv) Put the grammar into CNF.
8. a) State Pumping lemma and its advantages? (06)  
b) Show that the following languages are not context-free: (10)  
(i)  $L = \{w \in \{a, b, c\}^* : w \text{ has equal numbers of } a\text{'s and } b\text{'s and } c\text{'s}\}$   
(ii)  $L = \{a^n b^m a^n : n \geq m\}$   
c) Prove that context free languages are closed under (i) Homomorphism (ii) Reversal (09)  
d) Define DPDA. Let  $\Sigma = \{0, 1\}$ , consider the problem of testing whether a PDA accepts (10)  
some string of the form  $\{w \in 0^* 1^*\}$ . Is this problem decidable? Prove your answer.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
B.Sc. Engineering 3rd Year 1<sup>st</sup> Term Examination, 2015  
Department of Computer Science and Engineering  
CSE 3109  
Database Systems

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.  
ii) Figures in the right margin indicate full marks.

**SECTION A**

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define attribute and domain of attribute with example. (07)  
b) Consider the following two entity sets (18)  
Employee(ssn, name, address)  
Dependents(pname, age)  
The entity sets are related via a relation policy(amount). Employee is a strong entity set and Dependents is a weak entity set.
  - (i) Define weak entity set and strong entity set.
  - (ii) Draw the ER diagram and hence the schema diagram to represent the system.
  - (iii) Create the system using DDL.
- c) What is the role of mapping cardinality for designing a good candidate key? Explain with example. (10)
2. a) When do you prefer the secondary index instead of primary index? (06)  
b) What are the characteristics of leaf nodes and non leaf nodes of a B+ tree index structure? Explain with necessary figures. (10)  
c) Give the formal definition of referential integrity. How does cascading implement the referential integrity? (09)  
d) What is assertion? Create an assertion for the following statement- (10)  
"The sum of all loan amounts for each branch must be less than the sum of all account balances at the branch."
3. a) Define trigger. Why do you need trigger? (15)  
"A banking system does not allow any negative balance. Instead of negative balance, the system creates a new loan account with the loan amount and a loan number identical to the account number and sets the account balance to zero." Create a trigger after update on the account.  
b) "Functional dependency is the generalization of the super key." Justify the statement. (10)  
c) What is the purpose of database normalization? Consider the schema R(a, b, c, d) having functional dependencies  $F = \{ac \rightarrow bd, ad \rightarrow b\}$ . Determine whether R is in BCNF or NOT? Explain your answer. (10)
4. a) When do you prefer – (06)
  - (i) BCNF over 3NF
  - (ii) 3NF over BCNF
- b) Consider the patient schema PDB(patno, pname, appno, time, doctor) and functional dependencies  $F = \{patno \rightarrow pname, patno\ appno \rightarrow time\ doctor, time \rightarrow appno\}$ . Find the super key of the schema. (10)  
c) Define multivalued dependency and 4th normal form. (07)  
d) How can you specify the attributes in a DTD? Define a DTD for a Banking schema using account(account no, branch name, balance) and customer (Customer ID, customer name, customer city). (12)

**SECTION B**

(Answer **ANY THREE** questions from this section in Script B)

5. a) Define different database users. Mention the purposes of using a database system. (07)  
b) Consider the following relational database where the primary keys are underlined. (20)  
BRANCH(BRANCH\_NAME, BRANCH\_CITY, ASSETS)  
CUSTOMER(CUSTOMER\_NAME, CUSTOMER\_STREET, CUSTOMER\_CITY)  
LOAN(LOAN\_NUMBER, BRANCH\_NAME, AMOUNT)  
BORROWER(CUSTOMER\_NAME, LOAN\_NUMBER)  
ACCOUNT(ACCOUNT\_NUMBER, BRANCH\_NAME, BALANCE)  
DEPOSITOR(CUSTOMER\_NAME, ACCOUNT\_NUMBER)

Draw the schema diagram and give an expression using relational algebra for each of the following queries:

- (i) Find all loan numbers with loan value greater than \$10,000.
  - (ii) Find the names of all depositors who have an account with a value greater than \$6,000.
  - (iii) Find the names of all depositors who have an account with a value greater than \$6,000 at the 'uptown' branch.
- c) "It is possible for tuples to have a null value." How do you handle this null values for (08) arithmetic and logical operations in a relational database?
6. a) What are the aggregate functions? How are the functions handled in relational algebra? (12)
- b) Discuss the trade-off between a sub query operation and join operation. (07)
- c) What is a view? What are the advantages of view? How does a view execute? (08)
- d) Let the following relational schema is given - (08)
- R(A, B, C)  
S(D, E, F)
- the relations r(R) and s(S) are also given. Give an expression in SQL that is equivalent to each of the followings:
- (i)  $\pi_{AB}(r) \bowtie \pi_{BC}(r)$
  - (ii)  $\pi_{A,F}(\sigma_{C=D}(r \times s))$
  - (iii)  $\sigma_{B=17}(r)$
  - (iv)  $\rho_T(\sigma_{A=D}(r \times s))$
7. a) Discuss the ACID properties required for maintaining data integrity. (13)
- b) How does precedence graph determine whether two concurrent transaction are serializable or not? Explain with example. (08)
- c) Discuss the working principle of a lock manager to execute lock with example. (09)
- d) When do you kill a transaction? (05)
8. a) What are the functions of commit and rollback for transaction management in SQL? Explain (08)
- b) Explain the differences between primary key and unique key. (06)
- c) What is the purpose of cursor? Create a cursor to find the name and roll no. of the student (08) having "First class" in the CGPA field.
- d) Write a function in PL/SQL that takes the birth date in its parameter and return the age. (13)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
B.Sc. Engineering 3rd Year 1st Term Examination, 2015  
Department of Computer Science and Engineering  
CSE 3119

Software Engineering & Information Systems

TIME: 3 hours

FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.

ii) Figures in the right margin indicate full marks.

**SECTION A**

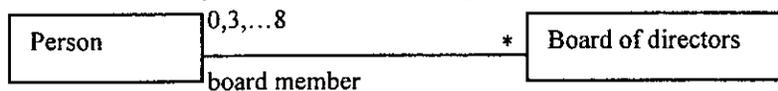
(Answer **ANY THREE** questions from this section in Script A)

1. a) What is a system? Describe the important characteristics of an open system. (12)  
b) Write a short essay on the relationship between DSS and decision making. (12)  
c) Distinguish between initial investigation and feasibility study. In what way are they related? (11)
2. a) Describe about the multifaceted role of the analyst. (12)  
b) Explain why is it difficult to determine the user requirements. (13)  
c) Draw the Data Flow Diagram of the existing Safe Deposit Billing System. (10)
3. a) Summarize the advantages and limitations of interviews and questionnaires. (12)  
b) What points should the analyst consider in constructing a data dictionary? Explain. (13)  
c) Write the differences between (i) Technical feasibility and (ii) Behavioral feasibility. (10)
4. a) What development activities are carried out during the structured analysis? Discuss. (13)  
b) What are the steps taken to validate and prepare a system for final implementations? (13)  
c) What is the goal of input design and output design? (09)

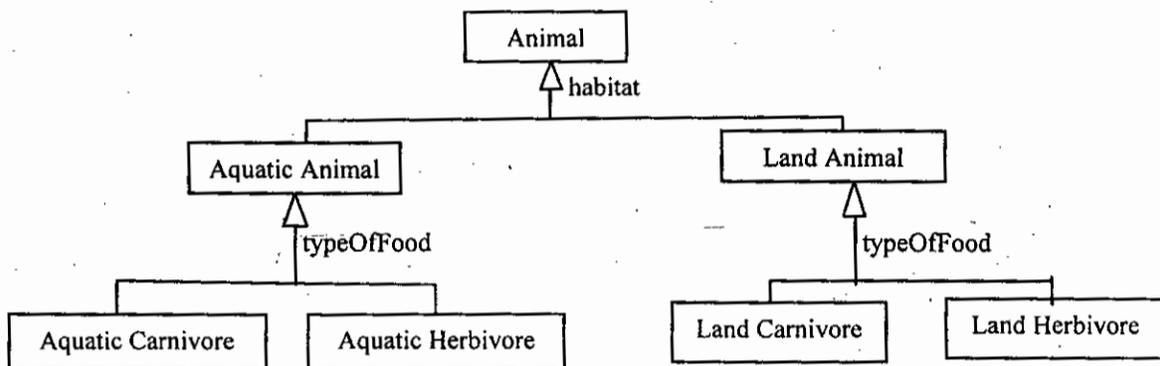
**SECTION B**

(Answer **ANY THREE** questions from this section in Script B)

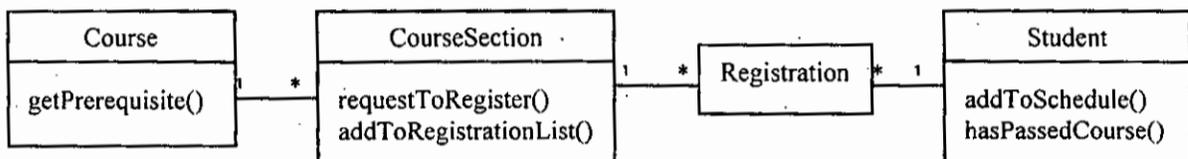
5. a) What is software engineering? Briefly discuss about software development life cycle. (10)  
b) Why do we use abstract classes and methods? Explain with an example. (08)  
c) Define the following terms: (09)  
i) Object oriented paradigm  
ii) Dynamic binding  
iii) Fat client  
d) What is the necessity to use reusable components? State some risk factors to implement reusable components. (08)
6. a) Define brainstorming and prototyping. (05)  
b) What is class diagram? Give an example. (05)  
c) Distinguish the followings: (08)  
i) Generalization and Specialization  
ii) Association and Aggregation  
d) An example of association is given in the following figure. Explain this association. (04)



- e) In the following figure, we can see a class hierarchy. If we add Amphibian animal or Omnivore animal in the class hierarchy, then many characteristics will be repeated in many classes and code should be changed frequently as number of classes will increase. So, we want to distinguish between the various roles that animals play in their life and separate it for ease of use. Association is better rather than inheritance in this situation. Which design pattern will solve this problem? Solve this problem with appropriate design pattern. Use required definitions and diagrams for explanation.



7. a) Differentiate between usability and utility. Write down usability principles. (10)  
 b) What is sequence diagram? From the class diagram in the following figure, draw a sequence diagram with appropriate symbol and properties. (15)



- c) What is type use coupling? Explain it with java.util.List interface. (10)  
 8. a) What is model-view-controller architectural pattern? Explain it with a suitable example. (10)  
 b) What is glass box testing? In a testing scenario you encountered the following loop: (10)  
 for(double x=0.0; x!=2.0; x+=0.2)  
 Is this loop finite or infinite? Explain your answer.  
 c) Discuss the following terms briefly: (09)  
 i) Project management  
 ii) Algorithmic model  
 iii) Deadlock  
 d) What are the bad aspects of waterfall model? Explain briefly. (06)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
B.Sc. Engineering 3rd Year 1st Term Examination, 2015  
Department of Computer Science and Engineering  
ECE 3115  
Data Communication

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.  
ii) Figures in the right margin indicate full marks.

**SECTION A**

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is meant by data communication and why is it important? (05)  
b) Draw the block diagram of a simplified data communication model. (05)  
c) State and explain Nyquist theorem. Explain different transmission impairments in data communication. (10)  
d) Explain bandwidth requirement for errorless reception with necessary waveforms. (06)  
e) A band limited signal is expressed as  $10 + 5 \cos \Pi 10 \times 10^6 t$ . (09)
  - i) Sketch the spectrum of the signal.
  - ii) What will be the required channel band width to transmit this signal?
  - iii) Estimate thermal noise level of this channel when operated at  $30^\circ C$ .
  - iv) What signal power is required to achieve the intended capacity of 20 Mbps in this noisy channel?
  
2. a) What do you mean by guided and unguided transmission medias? (06)  
b) Explain the differences between coaxial cable and optical fiber? What would be the benefits of optical fiber over coaxial cable? (10)  
c) What is crosstalk? Explain the different types of crosstalk. (10)  
d) What is antenna? Explain the ground wave, sky wave and line of sight propagation system. (09)
  
3. a) What is the function of companding? (03)  
b) Mention the difference between differential PSK and quadrature PSK? Explain the QAM modulation scheme. (08)  
c) What is meant by scrambling? Sketch the waveform for the binary sequence 10011101 using the following methods: i) B8ZS, ii) HDB3, iii) Bipolar-AMI, and iv) Differential Manchester. (12)  
d) How many steps are used in PCM system? Explain the quantization noise in PCM system. How can we reduce quantization error in PCM system? (12)
  
4. a) What is spread spectrum system? Briefly explain direct sequence spread spectrum system. (10)  
b) Briefly explain DM technique. Explain the effect of step size on DM. (08)  
c) Compare the performance among ASK, FSK and PSK. (07)  
d) A video signal has a bandwidth of 4.5 MHz. This signal is sampled, quantized and binary coded to obtain a PCM signal. (10)
  - i) Determine the sampling rate if the signal is to be sampled at a rate of 25% above the Nyquist rate.
  - ii) If the samples are quantized into 1024 levels, determine the number of binary pulses required to encode each sample.
  - iii) Determine the data rate (bps) of the encoded signal and the minimum bandwidth required to transmit this signal.

**SECTION B**

(Answer **ANY THREE** questions from this section in Script B)

5. a) What is ARQ? Briefly describe go-back-N ARQ for different contingencies. (10)  
b) What is bit stuffing? Explain the HDLC frame format. (09)  
c) Write short description of different types of stations, link configurations and data transfer modes used in HDLC. (10)  
d) Write down the names of layers of OSI model. (06)
  
6. a) What is multiplexing? Explain different multiplexing techniques in digital communication. (10)  
b) Draw the block diagram of FDM system. (08)  
c) Why synchronous TDM is called synchronous? (07)

- d) In a communication system, there are 11 sources to be multiplexed on a single link. The (10) sources are described as follows:  
Source 1: Analog, 2 KHz bandwidth.  
Source 2: Analog, 4 KHz bandwidth.  
Source 3: Analog, 2 KHz bandwidth.  
Source 4-11: Digital, 7200 bps synchronous.  
Design and draw TDM of these analog and digital sources.
7. a) What is space division switching? Explain the block and non-blocking configuration of (10) circuit switching.  
b) What is the comparison of circuit switching and packet switching? Explain the effect of (12) packet size on transmission frame.  
c) What is the significant role of ISDN? (05)  
d) Briefly describe generic architectural components of a public telecommunication network. (08)
8. a) Write down the elements of ADSL strategy. Draw ADSL channel configuration. (10)  
b) What is frame relay? Write down the differences between frame relay and X.25. (08)  
c) Describe the levels on which functionality of X.25 is specified. (07)  
d) Draw and explain ATM protocol architecture. (10)