KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 3rd Year 1st Term Examination, 2018
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) What is Finite Automata (FA)? Write down its applications.   (06)
    b) Define the terms with example(s): (i) Alphabet, (ii) Power of alphabet and (iii) Language.   (09)
    c) Differentiate between DFA and NFA. What is the significance of using extended transition   (09)
       function?
    d) Give an NFA to recognize the following language over the alphabet $\{a, b\}^*$:   (11)
       $A = \{ \omega \mid \omega$ has at least two non-consecutive b's $\}$.
       e.g. bbb $\notin$ A, bbaa $\notin$ A, babaab $\in$ A.

2. a) Find the equivalent DFA for the following NFA: (10)
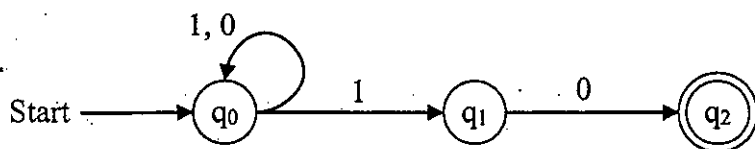

    b) Design ε – NFA, NFA and DFA for accepting decimal numbers.   (13)
    c) Let M be the DFA having alphabet $\{a, b\}$ and the following transition diagram: (12)
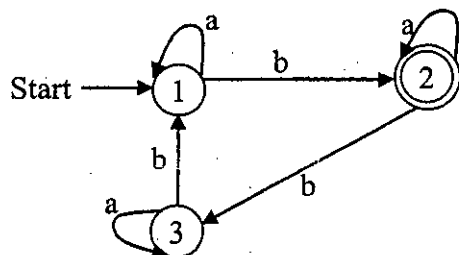
       Give a regular expression for L(M). Try to keep your expression simple (Use any method you
       want).

3. a) What is Kleene closure of a language? Find L^2, L^3 and L^4 of the language, $L= \{1, 01\}$.   (12)
    b) Define ECLOSE. Write inductive definition of ECLOSE. Find ECLOSE of each state of the   (12)
       following FA.
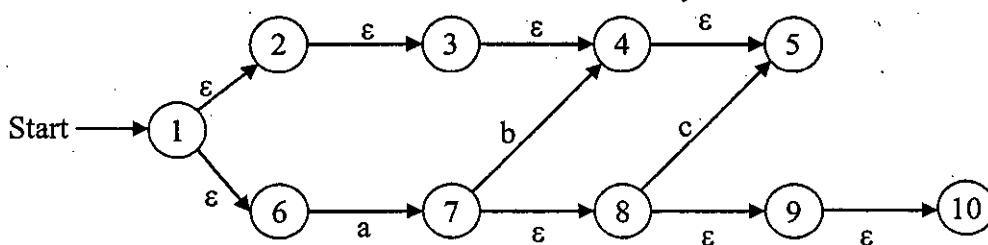
    c) Prove that, for every DFA A there is a regular expression R such that $L(A) = L(R)$.   (11)

4. a) State and explain Pumping Lemma. Using Pumping Lemma, prove that the following   (15)
       languages are not regular.
       (i) $\{0^n \mid n$ is a perfect square$\}$.
       (ii) $\{1^p \mid p$ is a prime number$\}$.
       (iii) $\{0^n \mid n$ is a power of 2$\}$.
    b) Write regular expression/definition for the following languages: (10)
       (i) All strings containing no more than two a's over alphabet $\{a, b, c\}$.
       (ii) The set of strings of 0's and 1's whose number of 1's is divisible by four and whose
            number of 0's is even.
       (iii) All strings of digits with at most one repeated digit.
       (iv) All strings which contain no runs of a's length greater than two over alphabet $\{a, b, c\}$.

c) Consider the following grammar: (10)

$S \to AB | AS$

$A \to aA | \varepsilon$

$B \to BB | AB | bb$

answer these questions:

(i) What's the shortest string it accepts? Are there more than one that length?

(ii) What language does it generate?

(iii) Show that this grammar is ambiguous.

SECTION B

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

5. a) What is CFG? Design a CFG for the following language: (12)

$$L = \left\{ x \in \{0,1\}^* \mid n_0(x) \neq n_1(x) \right\} \text{ where } n_i(x) \text{ is the number of } i\text{'s in the string } x.$$

b) Why is it that the transition function for DPDA's only works for 1 alphabet symbol and 1 stack (05) symbol?

c) Prove the theorem, let L be $L(P_F)$ for some PDA P_F where $P_F = (Q, \Sigma, \tau, \delta_F, q_0, z_0, F)$ then (12) there is PDA P_N such that $L = N(P_N)$.

d) How does PDA differ from $\varepsilon - NFA$? (06)

6. a) Consider the following grammar (26)

$S \longrightarrow AACD$

$A \longrightarrow aAb | \varepsilon$

$C \longrightarrow aC | a$

$D \longrightarrow aDa | bDb | \varepsilon$

and simply safe order

(i) Eliminate ε-production.

(ii) Eliminate Unit production.

(iii) Eliminate useless symbols.

(iv) Put the grammar in CNF.

b) Convert the following grammar to a PDA that accepts the same language by empty stack. (09)

$S \longrightarrow 0S1 | A$

$A \longrightarrow 1A0 | S | \varepsilon$

7. a) What is meant by a Turing Machine (TM) with two way infinite tape? Give example(s). (05)

b) Show that context free languages are closed under union operation but not under intersection. (09)

c) Design a TM M to implement the function "Multiplication" using the subroutine copy. (14) Simulate the action for the input 001000.

d) Write about halting problem of TM. (07)

8. a) What do you mean by tractable and intractable problem? Give example(s). (06)

b) What is non-regular grammar? Construct a left-linear grammar for the language (10)

$L = \{0^n 1^m \mid n > 0, m > 1\}$.

c) Use Pumping Lemma to show the followings: (11)

(i) $a^n b^m c^p$ is context free for $n \geq 0$, $m \geq 0$ and $p = n$.

(ii) $a^n b^m c^p$ is not context free for $n \geq 0$, $m = 2n$ and $p = m + n$.

d) Define instantaneous description of a TM. What is the role of checking off symbols in TM? (08)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 3rd Year 1st Term Examination, 2018
Department of Computer Science and Engineering
CSE 3103
Peripherals and Interfacing

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 address space? Which features of an MPU determine the size of its address space? (06)
   b) Distinguish between memory-mapped-I/O and I/O-mapped-I/O. (08)
   c) What are the trade-offs of choosing between standard and system memories? --- (06)
   d) The problem is more severe in the case of I/O interfacing. Why? (06)
   e) What are the varieties of synchronous mode of data transfer? Draw the flowcharts for each of (09)
      them and explain in brief.

2. a) Give the sequence of operation of the DMA mode of data transfer with the help of a flowchart. (07)
   b) Design an interface circuit for realizing a keyboard consisting of 32 keys. (08)
   c) Depict the methodology of the cyclic redundancy checking scheme with example. (08)
   d) What are the events that are communicated by the mouse driver to the system? (06)
   e) Write the basic working principle of a dot-matrix printer. (06)

3. a) How is a character displayed on the CRT display? Explain in brief. (06)
   b) What is USB system? Draw a net sketch to show the simple hardware for a USB device. (08)
   c) How is an MPU based system prototype designed and developed by MDS system? (10)
   d) What are the main functions of IOP? Describe the communication between IOP and CPU with (11)
      necessary figure.

4. a) What are the components that are expected to be contained with an I/O port? (07)
   b) Draw the control word format of 8255A for I/O Mode. (05)
   c) Design an interface circuit using the 8255A where the chip is selected when A_{15} is high. In (11)
      this design:
      i) Identify the port addresses.
      ii) Identify the Mode 0 control word to configure port A and port C_U as input ports, and port
          B and port C_L as output ports.
      iii) Write a program to read the DIP switches and display the reading from port A at port B
           and from port C_U at port C_L.
   d) Write down the following modes of operation in 8254: (12)
      i) Hardware retrigger able one shot.
      ii) Square wave generator.
      iii) Software triggered strobe.

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

5. a) Define peripheral and interfacing. What are the types of peripherals? Explain with example. (07)
   b) What is bus arbitration problem? Briefly explain bus arbitration resolver schemes. (12)
   c) How does closely coupled configuration differ from coprocessor configurations? Explain with (11)
      necessary figures.
   d) Write down the applications of different types of Optocoupler. (05)

6. a) Write short notes on stand-alone, real-time, networked and mobile embedded system. (12)
   b) Design a microprocessor based system to control the temperature of a boiler by switching (13)
      heater ON and OFF. Use DIP switch to set temperature and LED display to show current
      temperature.
   c) Why is Op-amp called differential amplifier with high gain? How can it be used as summing (10)
      amplifier and integrator?

7. a) Define process control system. What are the major operations of a process control system? (07)
   b) What is the importance of transducer? What are the desirable properties of transducer? (13)
      Describe a displacement transducer with proper diagram.
   c) Design a 6 bit DAC by using weighted registor network and verify it. (08)
   d) What are the applications of servo motor, stepper motor and DC motor in embedded systems? (07)

8. a) Describe the successive approximation approach of analog to digital conversion process with necessary figures and flowchart. What is the advantage of this approach over counter based approach? (12)

   b) Write down the applications of sonar sensor, gyroscope and accelerometer. (08)

   c) Show the necessary hardware design to control the speed of a DC motor. (08)

   d) Describe random switching and zero cross switching of solid state relay with proper diagram. (07)

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SECTION A

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

1. a) Define relationship set and degree of relationship set. For a binary relationship set, explain the (10) mapping cardinalities.

   b) Consider the following concepts in an E–R model. (15)
      i) M:M relationship
      ii) Total and Partial Participation
      iii) Generalization and Specialization
    - How are they represented in E–R model?
    - Represent the logical model into a Physical model.

   c) Find the Physical Schema of the following E–R diagram. (10)
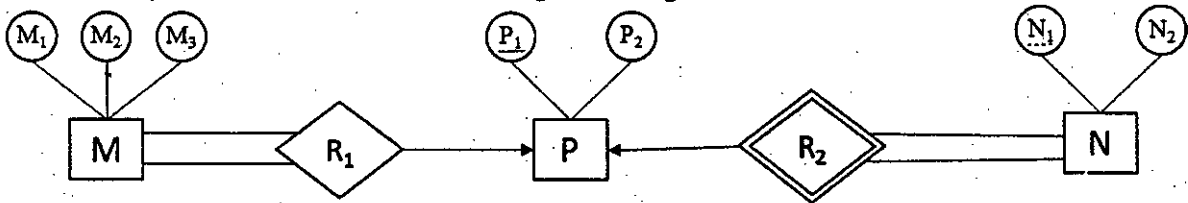
2. a) What are the advantages of database systems over file based systems? (06)
   b) Why do you use index in databases? What are the metrics to evaluate an index? (08)
   c) Define sparse index. How can you design a sparse index using page block size? (08)
   d) What are the properties of leaf and non leaf nodes of a B^+ tree index structure? Explain. (13)

3. a) What are the guidelines to select an index? (05)
   b) Define functional dependency. How can you explain functional dependency as a generalization of superkey? (10)
   c) What is closure of attributes? How can you calculate closure of attributes? Given (12)
    $R = (A, B, C, G, H, I)$
    with functional dependencies
    $F = \{A \to B, A \to C, CG \to H, CG \to I, B \to H\}$.
    Do you think (AG) and (BG) are the keys of R?
   d) What are the goals of relational database design? How can you achieve it using 3NF? (08)

4. a) What is database security and integrity? Differentiate between domain constraint and integrity constraint. (10)
   b) How can you check the referential integrity on database update for the purpose of database modification? (12)
   c) Define DTD. 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). (13)

SECTION B

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

5. a) Define Data model and list different types of Data models. Explain the basic structure of Relational Data model. (08)
   b) Consider the following relational database where the primary keys are underlined. (13)

    Branch (Branch _id, Branch _name, Branch _city)

    Customer (Customer _id, Customer _name, Customer _city)

    Loan (Loan _number, Branch _id, Amount)

    Borrower (Customer_id, Loan_number)

    Account (Account _number, Branch _id, Balance)

    Depositor (Customer_id, Account_number)

Draw the Schema Diagram and give an expression using Relational Algebra for each of the following queries: (i) Delete all loans from 'Khulna' city, (ii) Find the customer names who have loans at 'Fulbarigate Branch', (iii) Find the customer names who have account at 'Dhaka' city.

c) "Data type is a physical thing while Domain is a logical thing" – justify the statement. (07)

d) What do you mean by database management system? What are the classification of database (07) users?

6. a) What is view? "View makes complex query simple" – justify the statement with example. (09)

b) What is join operation? Why do you need join operation? Explain different types of join (10) operations.

c) Consider the Relational Database given in question 5(b). Give an expression in SQL for each (16) of the following queries:

i)	$Customer \leftarrow Customer \cup \{105, "Farid", NULL\}$
ii)	$\prod_{Customer\_name} (Customer \bowtie Borrower)$
iii)	$_{Branch\_id} \mathcal{G}_{Avg(Amount)} \left(\sigma_{Loan.Loan\_number=Borrower.Loan\_number} (Loan \times Borrower) \right)$
iv)	$\prod_{Account\_number} \left(\sigma_{Branch\_id = \prod_{Branch\_id} \left(\sigma_{Branch\_city="Khulna"} (Branch) \right)} (Account) \right)$

7. a) What is PL/SQL? Discuss the trade-off between Anonymous block and Named block in (07) PL/SQL.

b) What are the differences between primary key and unique key? When do you make a key (07) unique?

c) "Procedure does not have return type but can return value" – how? Explain with example. (06)

d) Define Trigger and Cursor. Consider the following two tables 'Product' and Purchase: (15)

Product							Purchase	
Product id	Name	Actual_Price	Total_Sell_Price	Total_Unit_Sold	Profit		P id	Sell_Price
1	A	950	0	0	0		4	500
4	B	400	0	0	0		1	1000
5	C	120	0	0	0		4	520
							5	130
							1	980
							5	150
							1	1050

Now, (i) Create a Trigger after insert on 'Purchase' so that it will update 'Total_Sell_Price' and 'Total_Unit_Sold' field of 'Product' table. (ii) Create a Procedure that will calculate profit for each product and update 'Profit' field of 'Product' table.

8. a) Define Transaction for a Database. Briefly describe the 'ACID' properties of a DBMS. (09)

b) Discuss exclusive lock and shared lock in case of Concurrency Control. Refer to the following (12) table:

Time	T₁	T₂	T₃	X	Y
t_1	Begin_tran.			100	100
t_2	read(X)	Begin_tran.		100	100
t_3	X = X+100	read(Y)	Begin_tran.	100	100
t_4	write(X)	Y = Y+100	read(Y)	200	100
t_5	commit	write(Y)	Y = Y+50	200	200
t_5		commit	write(Y)	200	150
t_6			commit	200	150

Which concurrency problem does it reflect? How can you overcome the problem by using 2-Phase Locking (2PL)?

c) Define Deadlock in a system. When does it occur? (05)

d) What is the working principle of Wait For Graph (WFG)? How can it be used to detect (09) deadlock in transactions? Explain.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 3rd Year 1st Term Examination, 2018
Department of Computer Science and Engineering
CSE 3119
Software Engineering and 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 do you mean by framework? "A framework is intrinsically incomplete" – explain. (10)
   b) Explain about different types of framework with appropriate figures. (12)
   c) Describe how a server program utilizes thread to communicate with two client programs. (13)

2. a) State the "Law of conservation of bugs". Explain Deadlock and live-lock with proper example. (05)
   b) Define OCSF. Differentiate between glass box testing and black box testing. (07)
   c) Define critical races. How critical races can be prevented? Explain with appropriate figures. (13)
   d) What are the principles of effective cost estimation? Explain with short description. (10)

3. a) Define design pattern and why we use it? Explain. (08)
   b) Describe the following patterns briefly: (15)
       i. The Player-Role Pattern.
       ii. The Singleton Pattern.
       iii. The Observer pattern.
   c) Write down the usability principles of UI which should be followed while developing a software. (12)

4. a) Define Generalization, Aggregation, Composition and Propagation with proper examples. (08)
   b) Differentiate between "use case" and "user story". Write down the actor actions and system responses of the following use case: (10)
                    "Open file by typing name"
   c) Describe the following models briefly: (12)
       i. The spiral model.
       ii. The waterfall model.
   d) Find the critical path from the PERT chart in following Figure: (05)
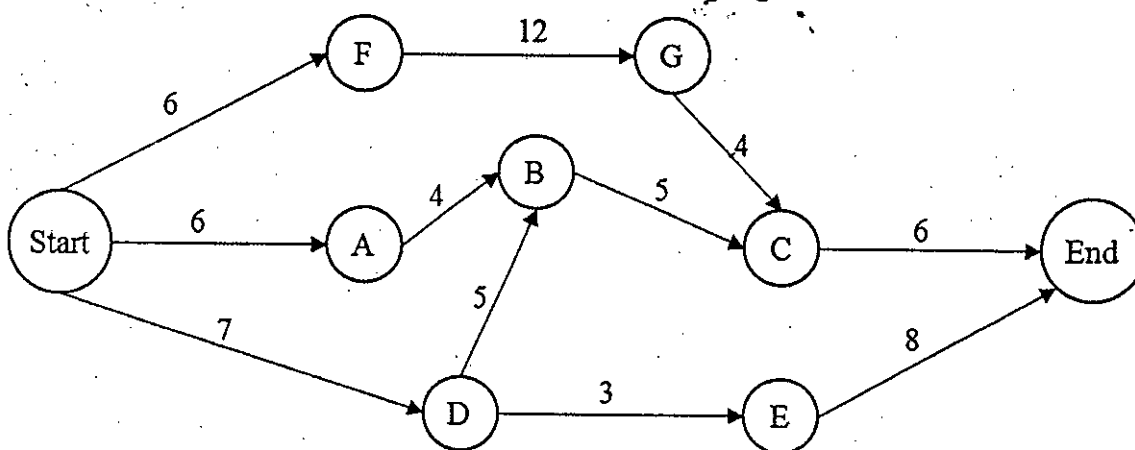
SECTION B
(Answer **ANY THREE** questions from this section in Script B)

5. a) What are the three basic implications of systems concept? (08)
   b) What categories of information are relevant to decision making in business? Relate each category to the managerial level and an information system. (10)
   c) Discuss about SDLC with prototyping with necessary figure. (10)
   d) Draw a diagram for the organization structure. (07)

6. a) Elaborate on the technical and interpersonal skills required of system analysts. When is one skill favored over the other? Why? (13)
   b) What are the several reasons an analyst faces to determine user requirements? Explain. (12)
   c) Write the differences between "open" and "closed" systems. (10)

7. a) How would one conduct an on-site observation? Lay out a plan and specify the pros and cons of this tool. (10)

a) = 10

b) Summarize the advantages and limitations of interviews and questionnaires. (10)
c) Briefly discuss about the categories of cost and benefit. (10)
d) Show the steps in system design process by a flowchart. (05)

8. a) What makes up a feasibility report? How would you change it? Explain. (13)
b) What is the goal of input design and output design? Explain. (10)
c) Explain the activity network for system Testing. (12)

TIME: 3 hours   FULL MARKS: 210

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

1. a) What do you mean by signal and systems? What are the properties of signals? Provide some   (13)
      typical examples of signals/systems concerned.
   b) State and explain Shannon's Channel Capacity theorem. Explain different transmission   (10)
      impairments in data communication.
   c) What is meant by spectrum and bandwidth? Why digital transmission is preferred over analog   (12)
      transmission?

2. a) What do you mean by guided and unguided transmission media? Compare various types of   (12)
      communication media in terms of bandwidth, attenuation and delay.
   b) Write down the differences between coaxial cable and optical fiber. What are the benefits of   (10)
      optical fiber?
   c) What are the fundamental elements/blocks of a PCM? Show that, the quantization noise $= \dfrac{S^2}{12}$ (13)
      where, S = step size. How can you minimize the quantization noise in a PCM system?

3. a) What do you mean by granular noise and slope overload noise? Briefly explain the Adaptive   (10)
      Delta Modulation (ADM) exploiting ADM modulator.
   b) Briefly explain the QAM technique. Also compare its performance with QPSK.   (10)
   c) What is line coding? Sketch the waveforms for the binary sequence 0100000110 using the   (15)
      following methods:
      (i) Manchester, (ii) B8ZS, (iii) HDB3 and (iv) Bipolar-AMI

4. a) Explain asynchronous and synchronous data transmission with their frame formats.   (12)
   b) What is spread spectrum? Draw the block diagram of frequency hopping spread spectrum   (11)
      system.
   c) Determine the minimum bandwidth, baud and bandwidth efficiency for the following bit rates   (12)
      and modulation schemes BPSK, QPSK, 16-PSK, 8-QAM, 16-QAM: (i) f_b = 4800 bps.

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

5. a) What is stuff bit? Explain the HDLC frame format.   (07)
   b) What is OSI? Write down the names of layers of OSI model.   (08)
   c) What is ARQ? Briefly describe the go-back-N ARQ for different contingencies.   (13)
   d) Why is break up of a large block of data into smaller blocks necessary in stop and wait flow   (07)
      control?

6. a) What is piggy backing? Write down the merits of sliding window flow control compared to   (11)
      stop and wait flow control.
   b) Distinguish between ADSL and HDSL.   (08)
   c) In a communication system, there are 11 sources to be multiplexed on a single link. The   (09)
      sources are described as follows:
      S_1 :   Analog, 2 KHz Bandwidth
      S_2 :   Analog, 4 KHz Bandwidth
      S_3 :   Analog, 2 KHz Bandwidth
      S_4-S_{11} :   Digital, 7200 bps synchronous.
      Design and draw TDM of these analog and digital sources.
   d) Describe T1 – carrier system.   (07)

7. a) Write down the names of stations, link-configuration and data transfer modes used in HDLC.   (10)
   b) What is multiplexing? Draw the block diagram of FDM system and TDM system.   (12)
   c) Describe the elements and key features of X.25.   (07)

d) A source has data pattern of 1111100111111101. Write down the data pattern that will be sent (06) using HDLC.

8. a) Why synchronous TDM is called synchronous? (08)
   b) Briefly explain the generic architectural components of a PSTN network. (08)
   c) Compare the blocking and non-blocking characteristics of circuit switching devices. (09)
   d) Draw the datagram approach and virtual circuit approach for packet switching. (10)