KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 3rd Year 1st Term Examination, 2023
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 immediate right column of the questions indicate full marks.
iii) The rightmost column indicates course outcomes.

SECTION A

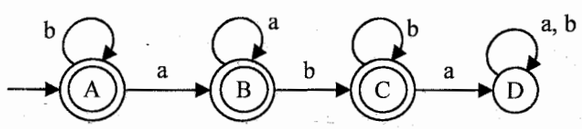
(Answer **ANY THREE** questions from this section in Script A)

1. a) Describe finite automata. Explain the statement, (10) [CO1]
"*L is said to be a language over alphabet* Σ, *only if* $L \subseteq \Sigma^*$."
b) Build a DFA for the following language by describing the steps and transition table– (10) [CO3]
$L = \{w | w$ *is a string that has even number of* "b"*s and third symbol from the right hand side is* "a"$\}$
c) Analyze the following terms: (15) [CO2]
i) The membership problem,
ii) Grammar,
iii) Kleene theorem.

2. a) What does NFA do on reading an input string? Construct an NFA for the given regular expression $1^*00^*1(0+1)^*$. (13) [CO3]
b) Design ϵ-NFA for $L = \{w | w$ *is empty, or if non − empty will end with* 010, *or if non − empty will end with* 101$\}$ and convert it to DFA. (12) [CO4]
c) Prove "For any NFA N, there is a DFA D such that $L(D) = L(N)$. (10) [CO4]

3. a) What is an "Error state" in finite automata? Explain with example(s). (07) [CO1]
b) Explain all the NFA to DFA construction processes and determine the best process among them for the given example– (18) [CO4]
$L = \{w | w$ *starts with* 11 *and ends in* 001$\}$
c) Write regular expression for the language "*all strings which contain no runs of a's* length greater than two over alphabet(a, b, c)." (05) [CO3]
d) Write notes on– inverse homomorphism property of regular languages. (05) [CO1]

4. a) Find regular expression for the following DFA. (10) [CO3]



b) Construct a minimum DFA equivalent to the following DFA described by Table 1. (15) [CO4]

State	0	1
→A	B	C
B	B	D
C	B	C
D	B	E
(E)	B	C

Table 1

	A	B	C	D
B	0			
C	0	0		
D	0	0	0	
E	1	1	1	1

Table 2

Table 2 represents the marking of all pairs of states (P, Q) where $P \in F$ and $Q \notin F$.
Apply Myhill-Nerode theorem's 3rd and 4th steps and design minimum DFA.

c) Prove whether $L = \{www^R | \, w \in (a,b)^*$ *and* $R \geq 1\}$ is regular or not using pumping Lemma. (10) [CO3]

SECTION B

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

5. a) Consider the following production rules for grammar $G1$: (18) [CO3]

$$S \rightarrow aS \mid aSbS \mid c$$

and for grammar G2:

$$\begin{aligned} S_1 &\rightarrow T \mid U \\ T &\rightarrow aTbT \mid c \\ U &\rightarrow aS_1 \mid aTbU \end{aligned}$$

Verify if G1 and G2 are ambiguous [S, S_1, T, U are variables & a, b, c are terminals]

b) Evaluate the problem of checking if a language $L(G)$ generated by a context free grammar (CFG) G is empty or not– is decidable. (10) [CO1]

c) Construct a CFG for the language with regular expression: $(a(bb)^*a(c+\epsilon))$ and show it is right linear. (07) [CO3]

6. a) In province B, messages are sent using sequences of red ('0') and green ('1') flags which can't be void. The rule says any message must feature at least one green on its second half. And importantly, the first half of the message must be al least as long as the second half. (25) [CO4]

i) Design a Pushdown Automata (PDA) that ensures messages are generated following the rules.

ii) Convert the PDA into its equivalent CFG.

b) Determine if the language $\left(L(G_1).L(G_2)\right)^*$ is context free, when it is formed by concatenation and Kleene closure of languages generated by context free grammar G_1 and G_2. (10) [CO2]

7. a) Convert the following grammar to Chomsky Normal Form (CNF): (20) [CO3]

$$\begin{aligned} S &\rightarrow aAa \mid bCbB \mid \epsilon \\ A &\rightarrow CD \mid a \\ B &\rightarrow C \mid b \\ C &\rightarrow CDE \mid \epsilon \\ D &\rightarrow A \mid B \mid ab \end{aligned}$$

[A, B, C, D, E are variables & a, b are terminals]

b) Find the CFG for the following languages: (10) [CO3]

i) $L(G) = \{a^n b^m c^m d^{2n} \mid n \geq 0, m \geq 0\}$,

ii) $L(G) = \{a^n b^m \mid 0 \leq n \leq m \leq 2n\}$.

c) Compare a multi-tape Turing Machine to a standard single Turing Machine analyzing structure and computational power. (05) [CO2]

8. a) Design a Turing Machine (TM) with tape symbols 0, 1 and B that, given a string as input, replaces all but the leftmost 1 on the tape with 0s. All other symbols remain unchanged. Demonstrate the TM for input "0011110". (15) [CO2]

b) Analyze why the Halting problem of Turing Machine is undecidable. (08) [CO2]

c) Explain Reduction. Describe the procedure to check if a problem is NP-complete. (07) [CO1]

d) Is it true that the language accepted by a PDA by empty stack or by that of final state are different languages? Explain. (05) [CO1]

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 3rd Year 1st Term Examination, 2023
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 immediate right column of the questions indicate full marks.

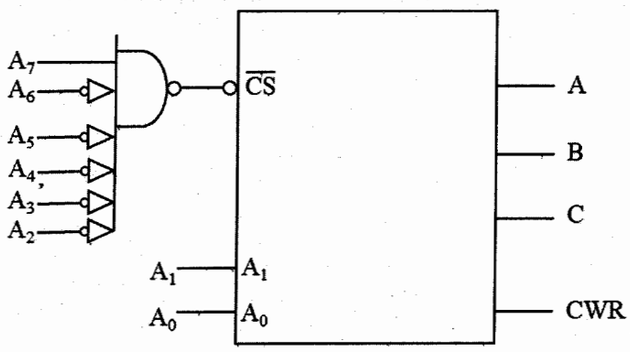
SECTION A

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

1. a) What is peripheral? Mention a short list of general purpose peripherals. (06)
   b) what is address space? Which feature of an MPU determines the size of its address space? (07)
   c) What is fully decoded addressing scheme? Compare the advantages and disadvantages of this scheme with the linear selection scheme of address decoding. (09)
   d) What is the problem of asynchronous mode of data transfer? How is it solved by interrupt driven mode of data transfer? Draw the flowchart of interrupt driven mode of data transfer. (13)

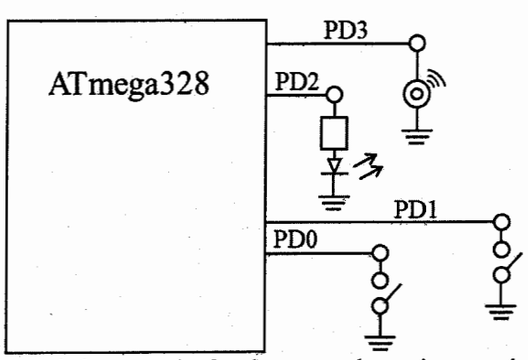
2. a) Mention the name of the components that an I/O port should carry. (06)
   b) What is Baud Rate? Describe the different types of serial communication with neat sketch. (10)
   c) What is raster scan? Show how the character 'C' is formed on a CRT screen in 5 × 7 matrix format. (10)
   d) How do LED displays work? What are the different types of LED displays? (09)

3. a) Data are to be read from two byte wide input ports at addresses AA and A9 and then output as a word to a word wide output port at address B000. Write the sequence of instructions to perform this operation. (06)
   b) Describe the operating modes of 8255A with neat sketch. (07)
   c) Write a BSR control word subroutine to set bits PC7 and PC3 and reset them after 10 ms. Use the schematic as follows and assume that a delay subroutine is available. (11)



   d) Write a program in assembly language for 8086 microprocessor which will lighten the columns of a matrix display (from Column 0 to Column 7 and continue). (11)

4. a) How is data read/write operation performed in the magnetic material of a floppy disk? (07)
   b) Show the hardware circuit for a single bit error detection using odd parity and explain how it works. (08)
   c) Write the instructions in C for an Arduino to turn on a lamp (PD2) and buzzer (PD3) if the key is in the ignition (PD0 is closed) but seat belt is not latched (PD1 is open) [see the following diagram]. (10)



   d) Show the key idea to control the speed of a dc motor by using a microprocessor unit with a neat sketch. (10)

SECTION B

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

5. a) Explain a microprocessor based system (with block diagram) for "Attendance Management System". (11)
   b) Write short notes on the following modes of operations in 8254. (12)
      i) Interrupt on terminal count.
      ii) Rate generator.
      iii) Square wave generator.
   c) Suppose you have two different scenarios for 8254 and these are as follows. (12)

      Scenario 1:
      A programmer wants to check the count value and the status of a selected counter.
      Scenario 2:
      A programmer wants to latch the count of a selected counter.

      As a programmer, how you can choose a scenario for a particular command mode? Justify your answer.

6. a) Differentiate between 8 bit ISA bus and 16 bit ISA bus with updated signals. (10)
   b) State the application of "Thermoresistive Transducer" with respect to computer science domain. (12)
   c) Mention some applications of ADC and DAC. Design an 8-bit ADC and discuss the operational principles using a flowchart. (13)

7. a) Explain different types of opto-couplers with examples. (08)
   b) Explain the logical operations of the following Operational Amplifiers. (10)
      i) Summing amplifier.
      ii) Difference amplifier.
      iii) Integrator.
      iv) Comparator.
   c) Differentiate between Flash memory vs DRAM based SSDs. (10)
   d) What is 'Keybounce' problem? How can this problem be solved? (07)

8. a) Explain the following modes of operations of a Mouse. (12)
      i) Reset mode.
      ii) Stream mode.
      iii) Remote mode.
      iv) Wrap mode.
   b) Explain the logical operations of the following printers. (08)
      i) Daisy-wheel printer.
      ii) Thermal printer.
   c) What are the bit definitions of data packet sent by PS/2 mouse? Explain in brief. (09)
   d) Write short note on sensitivity property of a transducer. (06)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 3rd Year 1st Term Examination, 2023
Department of Computer Science and Engineering
CSE 3109
Database Systems

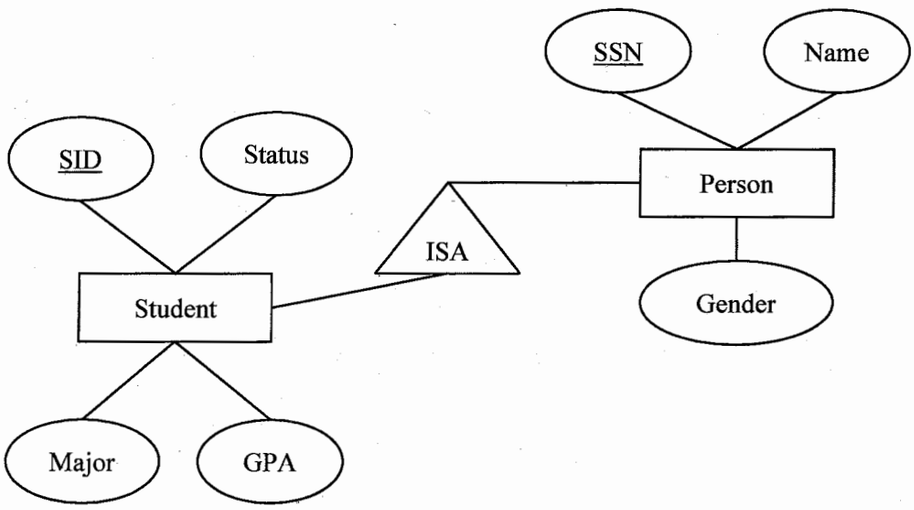
TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the immediate right column of the questions indicate full marks.
iii) The rightmost column indicates course outcomes.

SECTION A

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

1. a) Define data model. Make a comparison between two-tier and three-tier database architecture. (05) [CO1]
   b) Define relationship set and degree of relationship set. For a binary relationship set, explain the mapping cardinalities. (08) [CO1]
   c) Transform the following ERD into a relational schema and hence write the SQL statements to create the schema. (12) [CO1]



   d) How do you handle composite and multivalued attribute in a relational schema? Explain with example. (10) [CO2]

2. a) What are the factors that affect choosing physical storage media? Make a classification of physical storage media. (08) [CO2]
   b) Define disk block. How does disk block create a tradeoff between sparse index and dense index? Explain. (08) [CO2]
   c) What is bitmap index? When do you apply bitmap index? Consider the following schema `Student(Roll,Name,Sex,Result)`. Result contains only `Pass` or `Fail`. Design a bitmap index to answer the following query. (12) [CO2]
   ```
   select * from Student where Sex = 'F' and Result = 'Pass'.
   ```
   d) Suppose a key value is 9 bytes, pointer size (both page pointer and record pointer) is 7 bytes and disk block size is 512 bytes. How many key values you can enter in a leaf node and non leaf node of the B+ tree? (07) [CO2]

3. a) What are the goals of a good database design? How does normalization help to achieve the design goals? (08) [CO1]
   b) Define functional dependency. Explain functional dependency as a generalization of super key. (08) [CO1]
   c) Define closure of attributes. What are the applications of closure of attributes? Given $R(A,B,C,G,H,I)$ and $F = \{A \rightarrow B,\ A \rightarrow C,\ CG \rightarrow H,\ CG \rightarrow I,\ B \rightarrow H\}$. Do you think (AG) and (BG) are the keys of R? (09) [CO1]
   d) Suppose that you decompose the schema $R = (A,B,C,D,E)$ into $R_1(A,B,C)$, $R_2(A,D,E)$. Show that decomposition is lossless join decomposition if $F = \{A \rightarrow BC,\ CD \rightarrow E,\ B \rightarrow D,\ E \rightarrow A\}$. (10) [CO1]

4. a) When do you choose 3NF over BCNF for database design? Consider the schema $R(A, B, C, D)$ having functional dependencies $F = \{AC \rightarrow BD,\ AD \rightarrow B\}$. Is R in BCNF or 3NF? Explain. (09) [CO1]

   b) Define semi-structured data model. Explain the features of semi-structured data model with example. (10) [CO2]

   c) Make a comparison of relational data with XML and JSON data format. (08) [CO2]

   d) What is Document Type Definition (DTD)? Define a DTD for the following banking schema. (08) [CO2]

```
Account(Account-No, Branch-Name, Balance)
Customer(Customer-ID, Name, City)
```

SECTION B

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

5. a) Define the terms with example: (10) [CO2]
      i) Data-definition language.
      ii) Data-manipulation language.
      iii) Primary key, Foreign key.

   b) Consider the following relational database where the primary keys are underlined. (15) [CO2]

```
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)
Amount(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) Explain the working principle of a query processor. (10) [CO2]

6. a) Write down the domain types in structured query language (SQL). (10) [CO2]

   b) Describe the string operation in SQL with proper examples. (10) [CO3]

   c) What is join operation? Why do you need join operation? Explain different types of join operations. (10) [CO3]

   d) When do you need to create views? (05) [CO3]

7. a) What is PL/SQL? Discuss the tradeoff between Anonymous block and Named block in PL/SQL. (10) [CO3]

   b) Write a SQL function to determine if a number is prime or not. (10) [CO2]

   c) Define trigger and cursor. Consider the following two tables 'T1' and 'T2'. (15) [CO3]

Table: T1

Name	Number
S1	12
S2	13
S3	14

Table: T2

Name	Prime status
S1	No
S2	Yes
S3	No

   Write a trigger when the number is updated in the T1 table; update the T2 table prime status.

8. a) What do you mean by cascading roll-back? How does 2-phase locking protocol avoid cascading roll-back? Explain. (10) [CO4]

   b) Describe the state transition diagram of transaction with proper example. (10) [CO4]

   c) Explain the concurrency control in transaction. Discuss the potential problems caused by concurrency with examples. (15) [CO4]

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 3rd Year 1st Term Examination, 2023
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 immediate right column of the questions indicate full marks.

SECTION A

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

1. a) Briefly explain the simplified data communication model with necessary diagram. (10)
   b) With the help of Fourier analysis, show that a square wave consists of infinite number of sinusoidal waves. (15)
   c) Differentiate between attenuation and distortion. If a signal at the beginning of a cable with −0.3dB/km has a power of 2mW. What is the power of the signal at 5km? (10)

2. a) For full AM modulation, answer the following questions: (16)
      i) Draw transmitter and receiver block diagram,
      ii) Deduce the equation of the modulated signal,
      iii) Find out the required bandwidth mathematically and demonstrate graphically,
      iv) What is the modulation index? What condition may arise when message amplitude is greater than carrier amplitude?
   b) Briefly explain the operation of VCO. Draw FM modulated signal with respect to message signal. (10)
   c) Sketch the waveform for the binary sequence of "1010110010" by using the following line coding techniques: (i) Return to zero (RZ), (ii) Manchester, (iii) Differential Manchester, and (iv) Bipolar-AMI. (09)

3. a) Suppose, you have an 8-QAM modulator, then: (16)
      i) Draw transmitter block diagram,
      ii) Calculate the amplitude and phase of the modulator for input bit sequence 000, 001, 100, 101,
      iii) Draw constellation diagram for the above bit sequences.
   b) Draw complete truth for 8-PSK modulator. Also draw the output modulated signal of an 8-PSK modulator for the bit sequence: 000101. (09)
   c) Briefly explain asynchronous and synchronous data transmission with their frame formats. (10)

4. a) A message signal has a bandwidth of 3kHz. It is to be converted to digital signal by PCM technique. The message was sampled by a rate of 33.33% higher than Nyquist rate. Maximum acceptable quantization error is 0.5% of m_p. What is the minimum required channel bandwidth? (12)
   b) What do you mean by granular noise and slope overload noise? How can ADM overcome these problems? (10)
   c) What are the functions of core and cladding in optical fiber? Classify optical fiber based on light propagation principle. (13)

SECTION B

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

5. a) What is data link control protocol? Briefly explain the requirements for effective data communication between transmitting and receiving stations. (10)
   b) "Sliding window flow control is potentially much more efficient than stop and wait flow control" –give your comments about this statement and also give reasons in favour of your comments. (10)
   c) Why piggy banking is used in sliding window flow control? (08)
   d) Write down the advantages of digital time sequence diagram. (07)

6. a) Give brief description of different types of stations, Link configurations & data transfer modes used in HDLC. (10)
   b) For error detection using Cyclic Redundancy Check (CRC), prove that $T/P = Q$, where symbols have their usual meanings. (08)

c) **Why bit stuffing? A source has a data pattern of 1111110011111010, write the data pattern** (10)
that will be sent using HDLC.

d) Draw the diagram of HDLC frame format. (07)

7. a) What is multiplexing? Draw & explain the block diagram of FDM and TDM system. (13)

b) In a communication system, there are 10 sources to be multiplexed on a single link. The (12)
sources are described as follows:

S_1, S_3 : Analog, 2kHz Bandwidth.
S_2 : Analog, 4kHz Bandwidth.
S_4-S_{10} : Digital, 7.2 kbps synchronous.

Design and draw TDM of these analog & digital sources.

c) Describe the elements and key features of X.25. (10)

8. a) Write down the advantages and disadvantages of frame relay. (08)

b) Briefly explain the generic architectural components of a PSTN network. (08)

c) Compare circuit switching and packet switching methods. (09)

d) Draw the diagram approach and virtual circuit approach for packet switching. (10)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 3rd Year 1st Term Examination, 2023
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 immediate right column of the questions indicate full marks.
iii) The rightmost column indicates course outcomes.

SECTION A

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

1. a) You have heard people discuss systems. What is a system? Discuss/Write the basic implications of system concepts. (12) [CO1]
   b) Why is a database important in MIS? Explain. (10) [CO2]
   c) Write a short essay on the concept and uses of DSS. Include a brief discussion on the relationship between DSS and decision making. (13) [CO2]

2. a) What is the difference between analysis and design? Can one begin to design without analysis? Why? (13) [CO2]
   b) Distinguish between initial investigation and feasible study. In what way they are related? (12) [CO2]
   c) Draw a diagram for a system development life cycle with prototyping. (10) [CO3]

3. a) What are the steps taken to validate and prepare system for final implementation? (10) [CO1]
   b) What is the purpose of input design and what does an operator need to know during entering data? (12) [CO1]
   c) Mr. X is leading a project. If someone gives a suggestion to do better to him, then he receives it cordially. Now say: (13) [CO2]
      i) What type of system is it? Write some important characteristics of it.
      ii) Except this type of system, how many systems are there that you know? Explain.

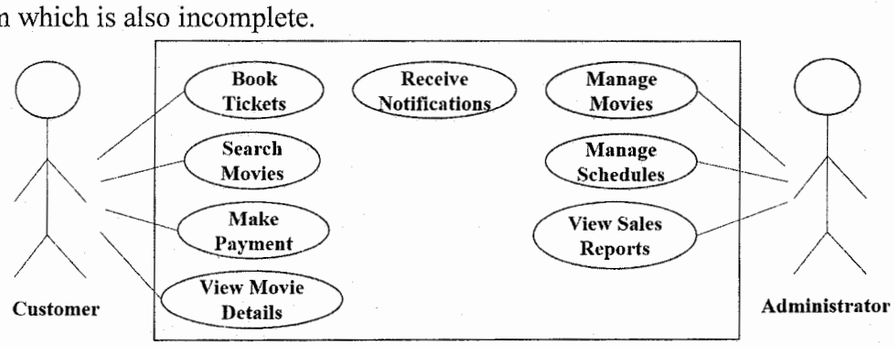
4. a) What do you mean by information gathering? Write the phases during information gathering tools. (13) [CO3]
   b) Draw a system flow-chart of a payroll system. (10) [CO2]
   c) What does an analyst take to do systems analysis? Explain. (12) [CO1]

SECTION B

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

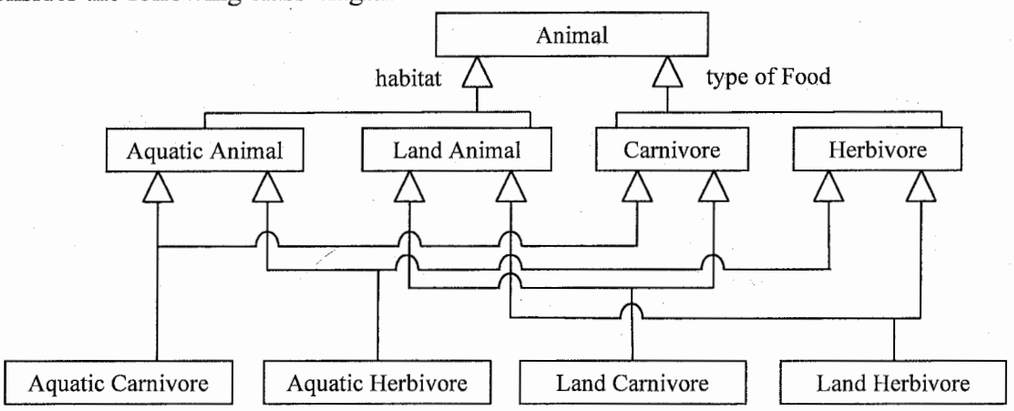
5. a) A healthcare provider is developing a new Healthcare Management System (HMS) to improve patient care and streamline administrative process. As a senior software engineer, develop a comprehensive quality assurance plan, identify the primary Stakeholders and propose a Stakeholder communication plan for the HMS. (10) [CO2]
   b) An e-commerce platform sells a wide range of products and manages user interactions. Design a class hierarchy for the e-commerce platform. Include a base class 'Product' and at least three derived classes ('Electronics', 'Clothing', 'Book'). Explain how inheritance is used in your design to promote code reuse and extensibility. (10) [CO1]
   c) Develop an Online Collaborative Learning Platform (OCLP) using the Object Client-Server Framework (OCSF). The platform should support multiple clients (students and instructors) to interact in real time, access course materials, and participate in discussions. (15) [CO3]

6. a) Consider the following simplified use case diagram for the online Movie Ticket Booking System which is also incomplete. (10) [CO1]



Draw the complete diagram including actions for: (i) Booking tickets, (ii) Sending notifications after booking tickets.
Also explain the relationships if you have used any.

b) Consider the following class diagram. (10) [CO



Explain the problem in the system. Draw the class diagram for solving the problem with an appropriate design pattern.

c) Suppose, you are creating a software project that provides a way to convert various file formats (e.g., text, pdf, image) into a common format (e.g., plain text) for further processing. Additionally, the system should support adding new file formats and converters without modifying existing code. Apply appropriate design pattern(s). Draw the class diagram. (15) [CO3]

7. a) Draw a sequence diagram for an Online Food Delivery System that handles customer orders, restaurant processing, delivery logistics, and payment transactions. (10) [CO1]

b) Consider the following pseudocode. (15) [CO2]

```
1.  Start
2.  Initialize user
    authentication process
3.  Input username
4.  Input password
5.  If username is empty, go
    to step 9
6.  If password is empty, go
    to step 9
7.  Validate username and
    password
8.  If credentials are
    valid, go to step 10
9.  Display error message
10. Display success message
11. End
```

i) Draw the flow graph representation for the above pseudocode.
ii) Design test cases for valid credentials, empty username, empty password and invalid credentials.
iii) Show execution path for these test cases on the flow graph.

c) Model a futuristic smart home automation system using the MVC (Model-View-Controller) architectural pattern. (10) [CO3]

8. a) Estimate the cost of a project for which you developed a system domain model composed of 24 classes. Assume from past experience that the system domain model classes represent half of the total number of classes in the final system. An average class has 6 attributes, and 14 methods, averaging 6 lines of code each. The weighted average salary is $11,000/month. The values of a, b, c are 0.0, 2.4, and 1.11 respectively. Counts of features and their corresponding weights for the project are shown below. (15) [CO1]

Name of the feature	Count	Weight
Number of user inputs	50	4
Number of user outputs	40	5
Number of user inquiries	20	4
Number of files	30	7
Number of external interfaces	10	6
Number of kilo lines of code (KLOC)	Determine	9

b) Consider a complex real-time embedded system for a medical device. The system handles multiple tasks such as monitoring vital signs, controlling infusion pumps, and communicating with external system concurrently. There is a shared memory buffer used for inter-process communication between the monitoring task and the data logging task. Identify a potential critical race scenario and solve it to make the system more reliable. (10) [CO3]

c) Differentiate between spiral model and agile model. State the appropriate usage of these models. (10) [CO2]