

Sylhet Engineering College

Department of Computer Science and Engineering

3rd Year 2nd Semester Final Examination' 2023 (Session: 2020-21)

Course Code: CSE 605 Credit: 3

Course Title: Software Engineering and Design Pattern

Time: 3 Hours

Total Marks: 60

All parts of each question must be answered sequentially. Figures in the right margin indicate full marks.

Group A

[Answer any THREE sets of questions]

1. (a) Mention all the components of DFD with a proper diagram. 2
(b) Explain the terms: Estimation management and Scheduling management. 3
(c) Describe a real-world scenario where the Singleton design pattern is the best fit. Explain why this pattern is suitable in that context, and write the appropriate code to implement it. 5
2. (a) List the skills of a software project manager. 2
(b) Suppose the main class of a software got too large, because the developer assigned too many responsibilities to that class. Which of the SOLID principles does that class violate? How should it be refactored? 3
(c) Imagine you are the manager of a digital Biryani outlet, which allows customers to customize their own Biryani orders. Suppose your outlet offers two types of base Biryani – Chicken Biryani and Beef Biryani. Customers can choose any one base. You also allow your customers to enhance their Biryani with various add-ons such as Boiled Egg, Extra Meat, and Salad, where each add-on increases the total cost. At any time, a customer should be able to check what they are ordering (*description* of the order) and the current total *cost*.
Which design pattern would you follow to maintain the orders in your Biryani outlet? Write an appropriate code. 5
3. (a) What is the main difference between Software Testing and Quality Assurance? 2
(b) Briefly elaborate the building components of SCRUM and explain how they are interconnected. 3
(c) A library keeps records of current loans of books to borrowers. Each borrower is identified by borrower number and each copy of a book by an accession number. The information held about books is the title, author's name/s, publisher's name, publication date, international standard book number (ISBN - a unique book identifier), purchase price, classification (reference or fiction), and number of pages. A given book may be written by a number of different authors. A book may cover a number of different subjects. When a member of the library issues a borrowing request, s/he is granted it if the book is available and his/her personal borrowing restriction is not violated. Each member has a restriction on the maximum number of books to be allowed to borrow at a time depending on the type of membership, e.g., student/teacher. When a book is borrowed, the return date is automatically recorded based on the current date and the borrower's classification. Other borrowers, pending their return, may reserve books out on loan. Borrowers who hold overdue books or who have reached their loan limit, are flagged to prevent further borrowings 5
4. (a) From the perspective of software engineering, explain the principle "Be Open to the Future" by answering the following questions. 2
i. What measures should be taken to fulfill this principle?
ii. What are the potential consequences if an organization fails to follow this principle?
(b) Design a UML Class Diagram for an Online Banking System. Include classes such as Account, Customer, Transaction, and Loan with appropriate relationships (e.g., inheritance, association, aggregation). 4
(c) To determine your eligibility for a job application in a tech company, you need to meet four conditions: 4
Relevant work experience > 2 years, Proficient in at least one programming language, complete a technical assessment, and submit a professional portfolio.

Group B

[Answer any THREE sets of questions]

5. (a) Your course teacher has assigned your group to prepare an SRS document for your SE project. Explain in detail what information should be included in the SRS to ensure it is complete and well-structured and identify any irrelevant information that should be excluded from the document. 3
- (b) Differentiate between Top down and bottom-up integration. 3
- (c) Write a note on 'Agile methodology' using a diagram. Mention the main advantage of the Agile model? 4
6. (a) Differentiate between White box testing and Black box testing. 2
- (b) Identify the type of risks indicated by the following examples: 3
- i. A software feature stops working properly when tested with real-world data.
- ii. The software cannot be sold in some countries due to new government rules.
- iii. A key project sponsor pulls out during development, affecting funding.
- (c) Draw a Use Case Diagram for an Online E-Learning Platform. Identify actors such as Student, Instructor, Administrator, and their corresponding use cases like Enroll in Course, Submit Assignment, Grade Assignment, and Manage Courses. 5
7. (a) Define Efficiency and Interoperability in terms of requirement engineering. 2
- (b) You are testing a university management system you developed, which includes features like student registration, grading, and fee payment. What key testing activities would you perform throughout the testing process to ensure the system works correctly, performs well, and is secure? Explain. 4
- (c) Your team is developing safety-critical software for a medical device. The development process strictly follows a structured approach where each design phase is paired with a corresponding testing phase. Draw this development process, clearly showing the connection between design and testing stages. Highlight its key advantages and disadvantages in the context of such a project. 4
8. (a) Briefly explain the three key activities under risk assessment: risk identification, risk analysis, and risk prioritization. 4
- (b) Write appropriate code for the following scenario: 6
- You have to design a navigation system for a ride-hailing application that supports multiple travel modes: **Driving** and **Walking**, each with unique methods for calculating the **travel time**, and **cost**. Create a **NavigationContext** class that allows the user to set or change the travel mode dynamically during runtime, using a **TravelMode** interface with methods like **calculateTravelTime()**, and **estimateCost()**. Implement at least two concrete travel modes: **Driving** (consider fuel cost), **Walking** (assume zero cost). In the main class, show how the user can choose a travel mode and see the corresponding travel time and cost.

Sylhet Engineering College, Sylhet

(Shahjalal University of Science & Technology)

Department of Computer Science and Engineering

3rd Year 2nd Semester Final Examination, 2023

Session: 2020-21

Course Code: CSE 607

Course Title: Numerical Methods

Credits: 2.0

Time: 2 hours Total Marks: 40

Part A

[Answer any two questions]

1. a) Write down the algorithm for the false position iteration method. 2
- b) When does the Newton-Raphson method fail? 3
- c) Apply the Newton-Raphson method to find the double root of the equation 5
 $f(x) = x^3 + x^2 - x - 10$
Up to three iterations where the root is near (0.7).
2. a) What do you mean by order of convergence? What is iteration in the Numerical method? 2
- b) Use the Runge-Kutta method of order four with $h = 0.2$ to obtain an approximation to 8
estimate $y(0.4)$ for the solution of $\frac{dy}{dx} = x^2 + y^2$ and $y(0) = 0$.
3. a) Find the first approximate root of the equation $x^3 - 2x^2 - 4 = 0$ by using bisection method. 3
- b) Use the LU decomposition method to solve the system of equations 7
 $x + 4y + 9z = 16$
 $2x + y + z = 10$
 $3x + 2y + 3z = 18$

Part B

[Answer any two questions]

4. a) Use Euler's method to compute $y(0.9)$ from the following differential equation: 4
 $\frac{dy}{dx} = x^2$, $y(0) = 1$ and $h = 0.3$
- b) Suppose you have a function of $Y = e^x$. Now, using the Gauss interpolation formula, find the value 6
of $e^{1.13}x$, where the value of X is given as.

X	1	1.05	1.10	1.15	1.20
Y	2.718	2.857	3.004	3.158	3.320

5. a) Write the equation of the Stirling Formula up to $\Delta^7 y$. 3
- b) Using Milne's predictor & correction method finds y when $x = 0.8$ given $\frac{dy}{dx} = x - y^2$, 7
 $y(0) = 0$, $y(0.2) = 0.02$, $y(0.4) = 0.795$, $y(0.6) = 0.1762$, $y(0.8) = ?$

Sylhet Engineering College, Sylhet
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Department of Computer Science & Engineering

Final Examination, 2023
Course No: CSE 603
Time: 02 (Two) hours

3rd Year 2nd Semester
Course Title: Introduction to Data Science
Full Marks: 40

N.B. : (i) Answer any three questions from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART-A

(Answer any two questions)

1. (a) Define data science. 2
 (b) The following table contains training examples. Use the ID3 algorithm to construct a decision tree that predicts whether a student will pass an exam based on study habits. Also computing entropy and information gain. 8

No	Study Hours	Group Study	Pass
1	High	Yes	Yes
2	Medium	No	No
3	High	No	Yes
4	Low	Yes	No
5	Medium	Yes	Yes
6	Low	No	No
7	High	Yes	Yes

2. (a) Briefly discuss about the foremost Goals of EDA. 4
 (b) A company wants to classify a new mobile phone based on its **Battery Life** and **Camera Quality** using the **K-Nearest Neighbors (KNN)** classifier. The dataset below is provided with existing mobile phones categorized as "**High-End**" or "**Budget**". You are asked to determine the class of a new phone with **Battery Life = 8 hrs** and **Camera Quality = 7 MP**, using **K = 3** and **Euclidean Distance**. 6

No	Battery Life (hrs)	Camera Quality (MP)	Class
1	6	5	Budget
2	9	7	High-End
3	8	6	Budget
4	7	8	High-End
5	10	9	High-End
6	5	6	Budget

3. (a) Suppose we have a dataset of six weeks of ice cream sales data (in thousands of dollars). Apply a linear regression technique to build the prediction model and then predict the sales for the 8th and 12th week. 4

Week (xi)	Sales (yi)
1	2.1
2	2.4
3	2.0
4	3.1
5	3.6
6	4.2

- (b) Given a one-dimensional dataset:
X={4,9,13,1,16,7}
 Use **Agglomerative Hierarchical Clustering with Single Linkage** to form the hierarchy. 6

- Start with each point as a separate cluster

PART-B

(Answer any two questions)

4. (a) Briefly discuss about Q-Learning algorithm of Reinforcement Learning. 4
(b) For the following dataset, apply **K-Means Clustering** using the **Euclidean distance metric**, with **K = 2** and initialize the centroids with **C1 = P1** and **C2 = P5** 6

Answer the questions as follows:

- i) Perform **K-means clustering** step by step until **convergence**
ii) Show **cluster memberships** after convergence
iii) Report the **final centroids** of both clusters

Sample No	X	Y
P1	0.10	0.30
P2	0.20	0.25
P3	0.12	0.45
P4	0.50	0.40
P5	0.60	0.25
P6	0.55	0.15

5. (a) For the given dataset, apply Apriori algorithm to discover strong association rules and assume that minimum support of 40% and minimum confidence 70%. Generate association rules from the frequent item sets and calculate the confidence of each rule and identify all the strong association rules. 6

TID	Items
T1	Burger, Fries, Coke
T2	Fries, Coke
T3	Burger, Nuggets
T4	Burger, Fries
T5	Fries, Nuggets
T6	Burger, Coke, Fries

- (b) Explain the steps to build an NLP pipeline. 4
6. (a) What are the key challenges in Natural Language Processing? 3
(b) Explain how collaborative filtering works. Illustrate with a sample user-item matrix. 7

Sylhet Engineering College, Sylhet
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Final Examination, 2023
Course No: CSE 601
Time: 03 (Three) hours

3rd year 2nd semester
Course Title: Compiler Design
Full Marks: 60

- N.B.: (i) Answer any three questions from each PART (ii) Use separate answer scripts for each PART
 (iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any) -----N/A----

PART-A

(Answer any three questions)

1. (a) Draw the block diagram of the phase of a compiler. 2
 (b) How the phases of a compiler can be grouped? How does the Lexical Analyzer increase the efficiency of the compiler? 2+2
 (c) Show output of different phases to translate the C statement $c = a+b*60$ where a, b and c are variables. 4

2. (a) What is the purpose of assembler, linker and loader in compiler? 3
 (b) What language is generated by the following grammars? In each case justify your answer. 2.5
 - i. $S \rightarrow 0S1 \mid 01$
 - ii. $S \rightarrow +SS \mid -SS \mid a$
 - iii. $S \rightarrow S(S)S \mid \epsilon$
 - iv. $S \rightarrow aSbS \mid bSaS \mid \epsilon$
 - v. $S \rightarrow a \mid S+S \mid SS \mid S^* \mid (S)$
- (c) Which of the grammars in Question 2(a) are ambiguous? 2.5
- (d) Consider the set with strings on $\{0,1\}$. Now construct a DFA and NFA that accepts. 2
 - i) All strings contain 00 but not 01.
 - ii) All strings containing no occurrence of 01.

3. (a) What is a regular expression? In which part is it necessary in Compiler design? 1+1
 (b) Consider the following CFG. 4
 Productions:
 $E \rightarrow E+T \mid T$
 $T \rightarrow T^*F \mid F$
 $F \rightarrow (E) \mid id$
 What will be the output of FIRST () and FOLLOW () functions for the above CFG?
 (c) Construct the LL (1) parsing table for the following grammar. 4
 Productions:
 $E \rightarrow E+T \mid T$
 $T \rightarrow T^*F \mid F$
 $F \rightarrow (E) \mid id$

4. (a) Show that all binary strings generated by the following grammar have values divisible by 3. 2
 Hint. Use induction on the number of nodes in a parse tree.
 $num \rightarrow 11 \mid 1001 \mid num \ 0 \mid num \ num$
- (b) Does the grammar in question 4(a) generate all binary strings with values divisible by 3? 2
- (c) Construct a syntax-directed translation scheme that translates arithmetic expressions from postfix notation into infix notation. Give annotated parse trees for the inputs $95-2^*$ and 952^* . 4
- (d) Construct CFG for the language having any number of a's over the set $\Sigma = \{a\}$. 2

PART-B

(Answer any three questions)

5. (a) We can prove that two regular expressions are equivalent by showing that their minimum-state DFA's are the same, except for state names. Using this technique, show that the following regular expressions are all equivalent. 3
- i. $(a | b)^*$
 - ii. $(a^* | b^*)^*$
 - iii. $((\epsilon | a)b^*)^*$
- (b) Consider the following FA and construct a minimum state FA for given finite automata. 7

	0	1
→q1	q2	q6
q2	q7	q3
q3	q1	q3
q4	q3	q7
q5	q8	q6
q6	q3	q7
q7	q7	q5
q8	q7	q3

6. (a) Consider the grammar 1X3
- $$S \rightarrow aSbS | bSaS | \epsilon$$
- i. Show that this grammar is ambiguous by constructing two different leftmost derivations for the sentence abab.
 - ii. Construct the corresponding rightmost derivations for abab.
 - iii. Construct the corresponding parse tree for abab.
- (b) Try to design grammar for each of the following languages. Which languages are regular? 2
- i. Strings of 0's and 1's with an equal number of 0's and 1's.
 - ii. Strings of 0's and 1's with an unequal number of 0's and 1's.
 - iii. Strings of 0's and 1's of the form xy where $x \neq y$.
 - iv. Strings of 0's and 1's of the form xx.
- (c) Construct the SLR parsing table for this grammar. 5
- $$E \rightarrow E+T | T$$
- $$T \rightarrow T * F | F$$
- $$F \rightarrow F^* | a | b$$
- Construct the SLR parsing table for this grammar.
7. a) What is Three Address Code? Explain the concepts to build Three Address Code. 2
- b) Define Quadruples, Triples and Indirect Triples 3
- c) Construct the DAG for the expression $(x+y) - ((x+y) * (x-y)) + ((x+y) * (x-y))$ and convert the corresponding Three Address Code. 5
8. (a) Generate optimal code for the following assignment statements: 2
- i. $x := a + b + c$
 - ii. $x := (a * - b) + (c - (d + e))$
 - iii. $x := (a / b - c) / d$
 - iv. $x := a + (b + c / d * e) / (f * g - h * i)$
 - v. $a[i, j] := b[i, j] - c[a[k, l]] * d[i + j]$

(b) Consider the following three-address instructions:

1. $i=1$
2. $j=1$
3. $t1=5*i$
4. $t2=t1+j$
5. $t3=4*t2$
6. $t4=t3$
7. $a[t4]=-1$
8. $j=j+1$
9. if $j \leq 5$ goto (3)
10. $i=i+1$
11. if $i < 5$ goto (2)

- i. Partition the following three-address instructions into basic blocks 2
- ii. Construct a flow graph from the three-address statements. 2
- iii. What is the depth of the flow graph? 1

(c) Generate code for the following C statements: 3

- i. $x = f(a) + f(a) + f(a)$
- ii. $x = f(a)/g(b,c)$
- iii. $x = f(f(a))$
- iv. $x = ++f(a)$

Sylhet Engineering College, Sylhet
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Department of Computer Science & Engineering

Final Examination, 2023

Course No: CSE 609

Time: 03(Three) hours

3rd Year 2nd Semester

Course Title: Cryptography and Network Security

Full Marks: 60

N.B.: (i) Answer any two questions from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any) -----N/A-----

PART-A

(Answer any three questions)

1. (a) What is cryptography? Describe three network security goals? 3
- (b) RSA system uses $P = 7$, $Q = 13$, if Alice decided to send a message $M = 9$ to the Bob what should be the public and private key and show that Bob is able to decrypt the message. 3
- (c) Describe the step-by-step encryption process of AES including the initialization, rounds, and final transformation. 4

2. (a) Why prime number is important in cryptography? 1
- (b) From the given values answer the following questions: 2+3
Prime Modulus $p = 23$, Primitive Root $g = 5$, Private Key $X_a = 6$, Private key $X_b = 15$
 - i. Explain the philosophy behind Diffie-Hellman key exchange protocol.
 - ii. Generate public keys (Y_a , Y_b) and shared secret key using Diffie-Hellman
- (c) $P = 23$, $g = 5$, $e = 8$, $d = 6$, choose a Message M , random number K and perform the ELGamal encryption and decryption. 4

3. (a) Why it is important to use padding in block ciphers? How does the size of the key affect the security of a symmetric cipher? 2
- (b) What is the transposition technique? Apply the Rail Fence technique for the plaintext "**Computer Science and Engineering**" using depth 3. 3
- (c) Draw the Diagram of S-DES key generation. 2
- (d) Given an 8-bit plaintext 10110101 and a 10-bit key 1010100010, perform the key generation step of the S-DES algorithm and calculate the subkeys K_1 and K_2 . Using
Permutation for p_{10} : 3,5,7,2,10,1,6,8,9
Permutation for p_8 : 7,3,6,5,9,4,10,1 3

4. (a) Describe advantages and limitations of different AES operation modes. 3
- (b) Given two numbers 360 and 600, answer the following questions, 3+2
 - i) Show the Prime Factorization of two numbers
 - ii) Discuss mathematically why in cryptographic systems (like RSA), it is important that two numbers used for key generation do not share the same prime factors
- (c) Explain how the distributive property works in GF (5) Field. 2

PART-B

(Answer any three questions)

5. (a) Describe how RSA digital signatures provide non-repudiation. Show the mathematical operations with example. 3
- (b) Differentiate between Authentication Header (AH) and Encapsulating Security Payload (ESP). 2
- (c) How does RBAC enhance security in an organization? 5
6. (a) What are the primary goals of IPsec in network communication? 3
- (b) Draw the working Diagram of HMAC and describe each step of generating HMAC 4
- (c) Discuss the vulnerability of Diffie-Hellman to man-in-the-middle attacks and how modern network protocols mitigate it. 3
7. (a) How does Hash function provide Integrity? Draw the diagram of a message sending process when hash function ensures both confidentiality and authentication? 3
- (b) For given information answer the following question. 4
- block size $m = 4$ bits
 $h(0) = 1010$
padding = 110
Message $M = 1101110010011$
Compress the Message M using Merkle Damgard Construction Algorithm.
- (c) Describe 3 Common TCP attacks, their attack techniques and the defense mechanism against the attacks. 3
8. (a) What are the key differences between CA-signed and self-signed certificates? 2
- (b) Explain the base-rate fallacy in IDS 2
- (c) From given values answer the following question. 3
- True Positive Rate (TPR) = 95%
False Positive Rate (FPR) = 2%
Total events = 20,000
Actual attacks = 50 (base rate = 0.25%)
what is the probability of real attack?
- (d) What is Honeypot? Describe it types. 3