

①

Group A

[Answer all the questions]

1. Answer any FIVE

5x2=10

- What is load factor(α) in hashing?
- Why is MCM used?
- Describe the role of Residual Graphs in finding the max flow through a network.
- In which case Recurrence Tree method is used?
- Write the memory complexity of a trie.
- Describe Overlapping Sub problem property.

2. Answer any FOUR

4x5=20

- What do you understand by Perfect Hashing?
- Write the recurrence complexity of finding the n th Fibonacci number. Can you optimize so that there are less calls to the $Fib()$ function? Share your idea.
- Find the LCS of the strings, $s_1 = \text{"shakespeare"}$, $s_2 = \text{"jacksparrow"}$
- What is graph colouring problem? How many colours do we need to assign to each node of a graph such that no two adjacent nodes share the same colour?
- How can you optimize the required number of operations for multiplication method of hashing? Give proper examples. Also properly describe the constraints that needs to be set.

Ans part

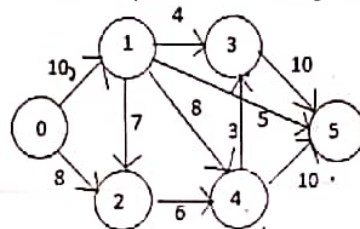
$$4+1+3+1$$

$$4+1$$

3. Answer any TWO

2x10=20

- Find the max possible flow through the following network (0-5): (Show each step)



$$6+2+12$$

$$20$$

- i. Suppose you are using uniform hashing scheme. Now you have a table of 100000 elements. 90019 elements are already filled. Can you tell the worst case number of operations to insert and search an element?

7+3

- ii. Describe Double Hashing.

Consider inserting the keys 10, 22, 31, 4, 15, 28, 17, 88, 59 into a hash table of length $m = 11$ using open addressing with the auxiliary hash function $h'(k) = k \bmod m$, quadratic probing.

$$6+3+2+1$$

$$3$$

Also use quadratic probing to insert using $c_1 = 1$ and $c_2 = 3$.

For your convenience:

Linear probing: $h(k, i) = (h'(k) + i) \bmod m$

Quadratic probing: $h(k, i) = (h'(k) + c_1 \cdot i + c_2 \cdot i^2) \bmod m$

Where i represents number of times collision occurred and k means key. Consider array index start from 0. Also consider initially $i = 0$.

$$0+1+3$$

$$0+2+12$$

$$0+3+27$$

$$0+4+3 \times 16$$

$$62$$

Group B

[Answer all the questions]

4. Answer any FIVE

5x2=10

- Write the complexity of the solution of a max flow problem.
- Find the proper suffixes of the string "Institute"
- Write the complexity of Matrix Chain Multiplication.
- If there are n keys to insert in a hash table what should be the table size to ensure that the probability of collision will be 0.5? Consider using Perfect Hashing Scheme.
- Write the complexity of the following code snippet:

```
while(i > 1) {
    i = i / 2;
}
```
- In uniform hashing what is the probability of a collision given a table size of m elements?

$$0+5+3 \times 25$$

$$0+6+3 \times 66$$

5. Answer any FOUR

4x5=20

- a) What is Linear Probing? What are its drawbacks?
b) Suppose you have the following items:

Item	Weight (kg)	Total Value
Item1	30	60
Item2	40	120
Item3	30	120

Now suppose you have a backpack to fill which has a capacity of 85 kg. Find the maximum value that you can achieve within this limit.

- c) Generate a suffix tree for the string "Assurance"
d) Find the LIS of the Given array: (Show each step)
10, 22, 1, 2, 33, 4, 21, 11
e) Suppose you are given coins = {1, 2, 4}. Find the total number of possible ways to make value 6. You may suppose there are infinite supply of each coins.

6. Answer any TWO

2x10=20

- a) Draw the recursion tree of the following code snippet: (Show output where necessary)

```
int main() {
    #include <bits/stdc++.h>
    using namespace std;
    void printCombinations(int startIndex, int totalAmount);
    int coins[] = {2, 3, 4};
    int counts[3];
    int n;
    int value;
    int main() {
        n = sizeof(coins)/sizeof(coins[0]);
        value = 5;
        printCombinations(0, value);
    }
    void printCombinations(int startIndex, int totalAmount) {
        if (startIndex >= n) {
            int i = 0;
            printf("%d = ", value);
            for (i = 0; i < n; ++i) {
                if (i == n-1) {
                    printf("%d * %d", counts[i], coins[i]);
                }
                else {
                    printf("%d * %d, ", counts[i], coins[i]);
                }
            }
            printf("\n");
            return;
        }
        if (startIndex == n-1) {
            if (totalAmount % coins[startIndex] == 0) {
                counts[startIndex] = totalAmount / coins[startIndex];
                printCombinations(startIndex + 1, 0);
            }
        }
        else {
            int i = 0;
            for (i = 0; i <= totalAmount/coins[startIndex]; ++i) {
                counts[startIndex] = i;
                printCombinations(startIndex + 1, totalAmount - coins[startIndex] * i);
            }
        }
    }
}
```

(2-1)
101

Handwritten notes and calculations:

- 5/2 3/3 (1/3)
- 1 = 2 - 1, 2
- 2 = 2, 4
- 4 = 2, 2
- 5/3 5/4
- 2 10 94
- 0, 1 (5/4)
- 5 (0,1) 37.
- 5-3 1
- 3-3 1
- 5-1 2 3
- 5-1 3 0

- b) Consider the following instance of the Knapsack Problem:
Number of given Object, n = 5 and Maximum Weight, m = 8. Here, P_i and W_i denotes the price and weight of the i-th product respectively.

P _i	10	5	15	7	8
W _i	3	4	3	5	2

Now calculate the Solution using Dynamic algorithm.

- c) Find the minimum number of operations required to convert s1 into s2 and the alignment of the strings s1 = "hereweareon" and s2 = "weonindhere". Consider insert and delete costs as 1 and if same character replace occurs then it is 0 and if different character replace occurs then it is 2. Show proper backtracking arrows.

10

10

Note: Answer all the questions. Figures at right margin show marks.

Group - A

1. Answer in one line or less. Which of the followings are ethical issues? Why or why not? [5x1] 5
 - a) Non Judicial killing
 - b) Evolution
 - c) Genetically modified Food
 - d) Honor killing
 - e) Quota system in government job
2. Classify the following statements in various categories of Ethics. [5 x 1] 5
 - a) My father is very strict and do not let me do anything fun, on the other hand my mother overlooks a lot of my childish behavior.
 - b) I will go for the relief work for flood victims, just make sure the news is shown in TV.
 - c) I am always nice to you, I expect you to be nice to me.
 - d) I borrowed some money from my friend, but never returned.
3. Give counter example of the following theories: [2 x 2.5] 5
 - a) Consequentialist Theory: "An action is right, if the consequence of the event is favorable."
 - b) Psychological egoism: "All of our actions are selfishly motivated."
4. Answer any one of the following questions: [10 x 1] 10
 - a) There are organizations which help individuals with terminal illness to commit suicide. (i) Give arguments showing it justifiable. (ii) Give counter arguments showing it is not justifiable.
 - b) Explain with proper examples: "Ethics doesn't always show the right answer to moral problems."

Group - B

5. Answer any FIVE. [5 x 1] 5
 - a) What is Trojan horse?
 - b) How can you identify phishing emails?
 - c) What is software piracy?
 - d) Who are gray hat hackers?
 - e) What is cyber security?
 - f) What is identity theft?
 - g) What is stalking?
6. Write short notes on any four of the followings. [2.5 x 4] 10
 - a) Law
 - b) Cyber law
 - c) Cyber space
 - d) Rule of Law
 - e) Contract
 - f) Trade mark
7. Answer any TWO. [5 x 2] 10
 - a) Summarize the copyright law of Bangladesh.
 - b) What do you understand by the concept of cybercrimes? Explain with examples.
 - c) Provide an extensive list of offenses under the ICT Act 2006.
 - d) What is E-Contract? Elaborate.

[Answer every question]

Group A

Q.1 Answer any 2 questions. [2 x 2.5]

- Do you understand the concepts of significant figures, accuracy and precision?
- Do you recognize the difference between analytical and numerical solutions?
- Explain how the root finding can be made faster using false-position method.

Q.2 Answer any 2 questions. [2 x 10]

a) Answer the following. [4+6]

- Discuss the method of Bisection to find an approximate root of an equation $f(x) = 0$.
- Find the real root of the equation $x^3 + x^2 - 1 = 0$ by using False Position method (use $a = 0$ and $b = 1$).

b) Answer the following. [4+6]

- Derive Lagrange's interpolation formula for unequal intervals.
- Using Lagrange's interpolation formula, find the form of the function $f(x)$ from the following table.

x	0	1	3	4
$f(x)$	-12	0	12	24

c) Answer the following. [5+5]

- Using Euler's method find, $y(0.1)$, $y(0.2)$ and, $y(0.3)$ from $\frac{dy}{dx} = 1 + xy$ with $y(0) = 2$, taking $h = 0.1$.
- Solve by using Runge-Kutta method, for $x = 1.4$ from $\frac{dy}{dx} = xy$, $y(0) = 2$, $x(0) = 1$ taking $h = 0.2$.

Group B

Q.3 Answer any 2 questions. [2 x 2.5]

- Compare the performance of Gauss-Jacobi and Gauss-Seidel iterative method for solution of system of linear equation.
- How does the Simpson rule differ from Trapezoidal rule.
- What do you understand by diagonally dominant matrix. Explain with an example.

Q.4 Answer any 2 questions. [2 x 10]

a) Answer the following. [4+6]

- Using Newton's formula for interpolation, estimate the population for the year 1905.

Year	1891	1901	1911	1921	1931
Population	98752	132285	168076	195690	246050

- Evaluate $\int_0^6 \frac{1}{1+x^2} dx$ by using the A) Trapezoidal rule, B) Simpson's 1/3 rule and C) Simpson's 3/8 rule.

b) Answer the following. [5+5]

- Solve the following system of linear equation by the Gauss-Jacobi iterative method.

$$\begin{aligned} 10x - 2y + z &= 2 \\ -3x + 11y + 2z &= 5 \\ x - y + 5z &= 1 \end{aligned}$$

- Solve the following system of linear equation by the Gaussian Elimination method.

$$\begin{aligned} 2x_1 + x_2 - x_3 &= 1 \\ 5x_1 + 2x_2 + 2x_3 &= -4 \\ 3x_1 + x_2 + x_3 &= 5 \end{aligned}$$

c) Answer the following. [4+6]

- Using Newton's forward difference formula derive expressions for the first and second derivatives of a function.

- Find the first, second and third derivatives at the point $x = 1.5$ of the function $y = \sqrt{x}$ tabulated below.

x	1.00	1.05	1.10	1.15	1.20	1.25	1.30
$y = \sqrt{x}$	1.00000	1.02470	1.04881	1.07238	1.09544	1.11803	1.14017

(5)

Shahjalal University of Science and Technology

Institute of Information and Communication Technology

Software Engineering

Final Examination, 2nd Year 2nd Semester, 2019

Course No.- ECO-205w Course Title: Principles of Economics

Credits: 3 Full Marks: 100 Time: 3 Hours

Part A

Answer Any 2 Questions from Part-A

1.	d. Explain why a demand curve is downward sloping. Distinguish change in demand and change in quantity demanded.	2+4
	b. Discuss market equilibrium.	8
	c. Explain using necessary graphs the impacts on equilibrium prices and quantity when-	4+7
	i. It is winter and we are concerned about the market for Coca Cola.	
	ii. The government announces a new improved pay scale but the fee for electricity increases; (consider any good)	

2.	a. Define price elasticity of demand, point elasticity and arc elasticity.	3
	b. What are the main determinants of price elasticity of demand?	5
	c. Explain the relationship between price elasticity and total revenue.	8
	d. Show elasticity is different at different points on a linear demand curve.	7
	e. Define cross-price elasticity and income elasticity.	2

3.	a. Define an indifference curve and show why it has negative slope.	2+2
	b. Define the budget constraint and derive its slope.	2+2
	c. Explain consumers optimum	10
	d. Distinguish-	3+4
	i. Goods and Bads	
	ii. Normal and inferior goods	

Page 1 of 2

6

Part B

Answer Any 2 Questions from Part-B

4.

a. Explain a production function. Distinguish long-run and short-run.	2+4
b. Compare: i. AP_L and MP_L ii. production and cost	2+2
c. Explain how firms take decision about employment in the short-run.	10
d. Explain a long-run production curve.	5

5.

a. Distinguish – i. GDP & GNP ii. Nominal GDP and real GDP	2.5*2
b. Show the circular flow for a macro economy and prove that "Income=Expenditure"	10
c. Explain the expenditure approach to measure GDP. What are the common errors and omissions in the measurement of GDP	5+5

6.

a. Explain the function of 'Money'. Explain also the precautionary demand motive for money.	4+2
b. Explain how commercial banks create money.	10
c. Discuss how the commercial Banks credit creation process is controlled by the Central Bank.	9

Group A

[Answer all the questions]

1. Answer any FIVE

5x2=10

- a) A batch system executes, whereas a time-shared system has user program, or
- b) Differentiate job and task.
- c) Differentiate between protection and security.
- d) What are thread pools? Why are the uses of thread pools?
- e) Differentiate between protection and security.
- f) True or False-
 - i. Preemptive scheduling can result in race conditions.
 - ii. If several instances per resource type, deadlock for sure.
- g) Differentiate a process and a thread.

2. Answer any FOUR

4x5=20

- a) Explain different types of system calls.
- b) What is process? What are the states of a process?
- c) Graphically explain single threaded vs multi-threaded process.
- d) Explain performance gain using Amdahl's law with example.
- e) What are the categories of security violations.
- f) Discuss ways to establish relationship between user threads and kernel threads.

3. Answer any TWO

2x10=20

- a)
 - i. What are the services of operating systems?
 - ii. What are the benefits of multi-threading?

b) Consider the following snapshot of a system:

	Allocation	Max	Available
	A B C D	A B C D	A B C D
P0	2 0 0 1	4 2 1 2	3 3 2 1
P1	3 1 2 1	5 2 5 2	
P2	2 1 0 3	2 3 1 6	
P3	1 3 1 2	1 4 2 4	
P4	1 4 3 2	3 6 6 5	

Answer the following questions using the banker's algorithm:

- a. Illustrate that the system is in a safe state by demonstrating an order in which the processes may complete.
- b. If a request from process P1 arrives for (1, 1, 0, 0), can the request be granted immediately?
- c. If a request from process P4 arrives for (0, 0, 2, 0), can the request be granted immediately?

g) Explain race condition and the ways to solve the problem.

Group B

[Answer all the questions]

(2)

4. Answer any FIVE

5x2=10

- Consider the following variable for processes A, B, C, D. Allocation=0 0 1 2, Max=0 0 1 2, Available=1 5 2 0. Now, calculate Need.
- Briefly explain stack overflow.
- What is the relation between time quantum and context switch time? How trade-offs between these two are handled?
- Processes alternate between bursts and bursts.
- What is "principle of least privilege"? Explain.
- Define context switching.
- What is a safe state?

5. Answer any FOUR

4x5=20

- Write short notes on virus, worm and logic bomb.
- Consider 5 processes arriving at time 0. For 3 different scheduling algorithm, calculate minimum average waiting time.

Process	Burst Time	Priority
P1	10	3
P2	1	1
P3	2	4
P4	1	5
P5	5	2

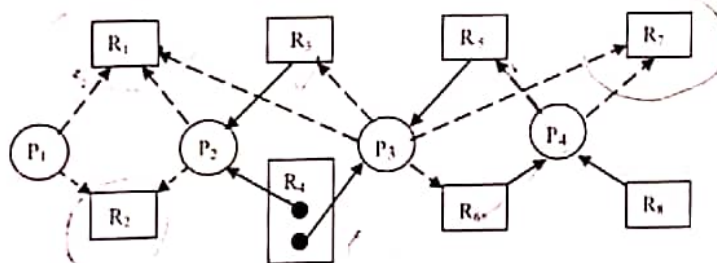
- Exemplify a deadlock prevention algorithm with single instance of a resource type.
- How does communication take place in client server system? Explain.
- What do you understand by process control block (PCB)? What kind of information PCB provide?
- What is Inter Process Communication (IPC)? Why do we need IPC.

6. Answer any TWO

2x10=20

- Discuss different types of CPU scheduling algorithms and their advantages and disadvantages concisely.
 - Explain the classical problem of Bounded Buffer with solution.
- Find average rotational latency from given rpm-
5400, 7200, 10000
 - Consider the following graph-

2+8



Determine the deadlocked process, if any.

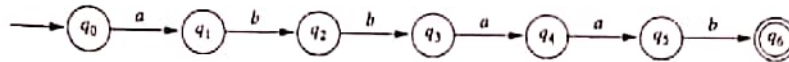
Group A

[Answer all the questions]

1. Answer any FIVE

- a) Write down the logical connectives.
- b) How language is annotated? Give examples.
- c) Draw a FA for The language of all strings that begin or end with aa or bb .
- d) What is Regular expression?
- e) Show the Concatenation and Union of Regular expression to ϵ -NFA
- f) Define right-most derivation.
- g) Write down the purpose of Turing Machine.
- h) Explain this Finite Automata.

5x1=5



2. Answer any FOUR

- a) In each case below, construct a truth table for the statement and find another statement with at most one operator (\vee , \wedge , \neg , or \rightarrow) that is logically equivalent. $(p \rightarrow q) \wedge (\neg p \rightarrow q)$
- b) Write down the theorem of pumping lemma for regular language.
- c) Describe a PDA that accepts even palindromes.
- d) Let M_1 and M_2 be the FAs pictured in Figure below accepting languages L_1 and L_2 , respectively.

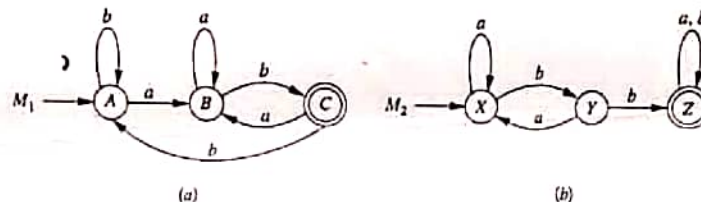
4x2.5=10

2.5

2.5

2.5

2.5



Draw FAs accepting the languages $L_1 \cup L_2$.

- f) Give English descriptions of the languages of the following regular expressions
- $(1 + \epsilon)(00^*1)^*0^*$

2.5

- g) Suppose the PDA $P = (\{q_0, q_1, q_2, q_3, f\}, \{a, b\}, \{Z_0, A, B\}, \delta, q_0, Z_0, \{f\})$ has the following transition function:

2.5

$$\begin{array}{lll}
 \delta(q_0, a, Z_0) = (q_1, AAZ_0) & \delta(q_0, b, Z_0) = (q_2, BZ_0) & \delta(q_0, \epsilon, Z_0) = (f, \epsilon) \\
 \delta(q_1, a, A) = (q_1, AAA) & \delta(q_1, b, A) = (q_1, \epsilon) & \delta(q_1, \epsilon, Z_0) = (q_0, Z_0) \\
 \delta(q_2, a, B) = (q_3, \epsilon) & \delta(q_2, b, B) = (q_2, BB) & \delta(q_2, \epsilon, Z_0) = (q_0, Z_0) \\
 \delta(q_3, \epsilon, B) = (q_2, \epsilon) & \delta(q_3, \epsilon, Z_0) = (q_1, AZ_0) &
 \end{array}$$

Give an execution trace (sequence of ID's) showing that string bab is in $L(P)$.

3. Answer any One

10x1=10

- a) Design a PDA to accept $\{0^n 1^n \mid n \geq 1\}$. Show the Instantaneous Descriptions of the PDA using input 000111.

10

- b) i) Let $L = \{0^i 1^j \mid i \leq j\}$. Use the pumping lemma for regular languages to prove L is not regular. Suppose n is the pumping lemma constant. Demonstrate that xy^iz is not in L for some i . Below, tell your choice of i and explain why the resulting string is not in L .

5 x 2= 10

ii) Give DFA's accepting the following languages over the alphabet $\{0, 1\}$ which is the set of all strings ending in 00.

4. Answer any FIVE
a) What is ϵ -NFA?
b) Find the equivalent DFA for the NFA given by $M = \{A, B, C\}, (a, b), \emptyset, A, \{C\}$ where \emptyset is given by

	a	b
$\rightarrow A$	A, B	C
B	A	B
(C)	-	A, B

- c) What is context free grammar?
d) Write down the PDA Formalism.
e) Draw a Finite Automata that accept the all strings that contains at least two a's.
f) Suppose you have this $S \rightarrow SS \mid (S) \mid ()$ grammar. Show the left most derivation.
g) What is language? Give an example.
h) Consider the language L of all strings of a's and b's that do not end with b and do not contain the substring bb. Find a finite language S such that $L = S^*$.

5. Answer any FOUR

4x2.5=10

- a) Write the meaning of the following RE:

2.5

- i) $/[A|a|/$ ii) $/[a?b|/$ iii) $/[^a-z|/$ iv) $/[tT]he|/$ v) \backslash^*
vi) $/[e^|/$ vii) $/[1234567890|/$ viii) $/[beg.n|/$ ix) $/\$[0-9]+|/$ x) $/[wW]oodchucks|/$

- b) Using the minimization algorithm, Find a minimum-state FA recognizes the same language for the figure (a).

2.5

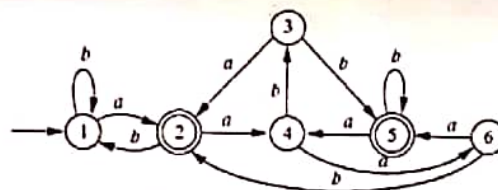


Figure: (a)

- c) Draw a FA using the figure of 2(d) which accepts $L_1 \cap L_2$.
d) The following grammar generates the language of regular expression $0^*1(0+1)^*$

2.5

2.5

$$\begin{aligned} S &\rightarrow A1B \\ A &\rightarrow 0A \mid \epsilon \\ B &\rightarrow 0B \mid 1B \mid \epsilon \end{aligned}$$

$0^*10^*10^*$

Give leftmost and rightmost derivations of the following strings: 00101

- e) Suppose the PDA $P = (\{q, p\}, \{0, 1\}, \{Z_0, X\}, \delta, q, Z_0, \{p\})$ has the following transition function:

2.5

$$1. \delta(q, 0, XZ_0) = \{(q, XZ_0)\}.$$

$$2. \delta(q, 0, X) = \{(q, XX)\}.$$

$$3. \delta(q, 1, X) = \{(q, X)\}.$$

$$4. \delta(q, \epsilon, X) = \{(p, \epsilon)\}.$$

$$5. \delta(p, \epsilon, X) = \{(p, \epsilon)\}.$$

$$6. \delta(p, 1, X) = \{(p, XX)\}.$$

$$7. \delta(p, 1, Z_0) = \{(p, \epsilon)\}.$$

Starting from the initial ID (q, w, Z_0) , show all the reachable ID's when the input w is: 01

Draw a TM that computes the function: $f(x, y) = x + y$

2.5

6. Answer any ONE

10x1=10

Convert the following NFA to a DFA and informally describe the language it accepts.

10

	0	1
$\rightarrow p$	$\{p, q\}$	$\{p\}$
q	$\{r, s\}$	$\{t\}$
r	$\{p, r\}$	$\{t\}$
$*s$	\emptyset	\emptyset
$*t$	\emptyset	\emptyset

b) Suppose you have a language. Where every identifier must begin with a or b, which may be followed by any string in $\{a, b, 0, 1\}$ and two variables E for expressions and I for identifier.

10

$(a + b)(a + b + 0 + 1)^*$

i) Show the context free grammar for this simple expression

ii) Derive the grammar for the following strings.

	String
(i)	a
(ii)	b
(iii)	$b0$
(iv)	$b00$
(v)	a
(vi)	$b00$
(vii)	$a + b00$
(viii)	$(a + b00)$
(ix)	$a * (a + b00)$

01, 101, 00, 001