

B.Sc. Engg. CSE 2nd Semester

01 April 2022

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4203: Discrete Mathematics

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **6 (six)** questions. Marks of each question and corresponding COs and POs are written in the right margin with brackets.

1. a) Based on the string "*FACE TO FACE EXAM IS GOOOOOOOD*", answer the following: 10 + 5
 - i. Use Huffman coding to generate the prefix codes of the letters in the string and represent the prefix codes using a binary tree (**do not ignore spaces**). (CO4) (PO2)
 - ii. What is the average number of bits required to represent a letter in this string using the prefix codes in question 1.a.(i). (CO3) (PO2)
- b) Consider two binary numbers, $(101100)_2$ and $(100100)_2$ and answer the following 5 + 5
 - i. Add the two numbers using the binary addition algorithm. Show step-by-step calculation. (CO3) (PO1)
 - ii. Multiply the two numbers using the binary multiplication algorithm. Show step-by-step calculation.
2. a) Use mathematical induction to prove that $2n < n!$ for every integer n with $n \geq 4$. 7

(CO3)
(PO2)
- b) Consider the expression $\left(\left((10 / 5) + 3\right) / 5\right) - \left(\left((2 \uparrow 3) - (2 * 5 - 6)\right) \uparrow .5\right)$, answer the following: 3 + 10

(CO4)
(PO2)

 - i. Generate the rooted tree for this expression.
 - ii. Evaluate the prefix and postfix notation for this expression.
- c) If $m \in \mathbf{Z}^+$, $a, b \in \mathbf{Z}$ and $a \equiv b \pmod{m}$ then prove that: 5
 - i. $(a + b) \pmod{m} \equiv ((a \pmod{m}) + (b \pmod{m})) \pmod{m}$ (CO1)
 - ii. $(ab) \pmod{m} \equiv ((a \pmod{m})(b \pmod{m})) \pmod{m}$ (PO1)

3. a) Determine whether the pair of graphs in Figure 1 are isomorphic.

15
(CO4)
(PO2)

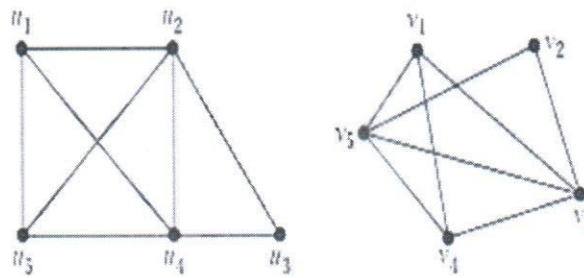


Figure 1: Graph for question 3(a)

- b) Consider that f and g are the functions from the set of integers to the set of integers defined by $f(x) = \frac{4x-3}{x-2}$ and $g(x) = \frac{2x+4}{x-4}$. Based on this information, answer the following:
- Find $f \circ g(x)$ and $g \circ f(x)$
 - Find the inverse of $f(x)$
4. a) i. Give a recursive algorithm for computing the **GCD** (*Greatest Common Divisor*) of two non-negative integers a and b with $a < b$.
 ii. Using that algorithm find the **GCD** of the numbers (37, 51). Show step by step execution of your algorithm.
- b) Consider the message "THIS TIME THERE IS NO BROWSING FOR SOLUTIONS". Encrypt the message with the following steps:
- Perform public key cryptography with a key value $k = 5$ (**ignore spaces**).
 - Using the encrypted message in (i), encrypt it further applying transposition cipher with $\sigma = \{1, 2, 3, 4\}$ and $\sigma(1) = 2$, $\sigma(2) = 4$, $\sigma(3) = 1$ and $\sigma(4) = 3$.
5. a) Consider the following adjacency matrix for a directed graph

	a	b	c	d	e
a	1	1	1	0	1
b	0	0	0	1	0
c	0	1	1	0	0
d	0	0	1	0	1
e	1	0	0	1	1

From the above information do the following:

- Draw the graph represented by the matrix.
 - Mathematically show that $\sum_{v \in V} \deg^-(v) = \sum_{v \in V} \deg^+(v) = |E|$.
- b) A father tells his two children, a boy and a girl, to play in their backyard without getting dirty. However, while playing, both children get mud on their foreheads. When the children stop playing, the father says "At least one of you has a muddy forehead," and then asks the children to answer "Yes" or "No" to the question: "Do you know whether you have a muddy forehead?" The father asks this question twice. What will the children answer each time this question is asked, assuming that a child can see whether his or her sibling has a muddy forehead, but cannot see his or her own forehead? Assume that both children are honest and that the children answer each question simultaneously.
- c) Describe the average-case performance of the linear search algorithms in terms of average number of comparisons used, assuming that the integer x is in the list and is equally likely to be in any position.

6. a) If x is a real number, then prove that $\lfloor 2x \rfloor = \lfloor x \rfloor + \left\lfloor x + \frac{1}{4} \right\rfloor$. 6
(CO1)
(PO1)
- b) Using rules of inference show that the premises:
7
"A student in this class has not read the book" and
(CO1)
"Everyone in this class passed the first exam",
(PO1)
imply the conclusion:
"Someone who passed the first exam has not read the book."
c) Solve the recurrence relation $a_n = a_{n-1} + 3$ with the initial condition $a_1 = 2$. 6
(CO1)
(PO1)
- d) Give a big-O estimate for $f(n) = 2n \log(n!) + (n^2 + 3) \log n$, where n is a positive integer. 6
(CO1)
(PO1)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 Hours

FULL MARKS: 150

CSE 4205: Digital Logic Design

Programmable calculators are not allowed. Do not write anything on the question paper.
 Answer all **6 (six)** questions. Marks of each question and corresponding COs and POs are written in the right margin with brackets.

1. a) *Subtractor* is a combinational circuit that subtracts two numbers and produces their differences. 7
 Design the circuits of half subtractor and full subtractor following the *design procedure*. (CO1)
(PO1)
 - b) If we increase the number of bits in binary numbers to be subtracted, binary ripple borrow subtractor will be required. Design a 4-bit binary ripple borrow subtractor. 5
(CO1)
(PO1)
 - c) Borrow propagation time is a critical attribute in computational time to generate correct output. To reduce the borrow propagation time, borrow look-ahead logic is a mostly used technique. Design a Borrow look ahead generator logic for 4-bit subtractor. 8
(CO3)
(PO2)
 - d) When we perform the subtraction with paper and pencil, an underflow is not a problem. Underflow is a problem for digital systems because of limited storage space. Now design an Underflow detection that will identify the occurrence of an underflow. 5
(CO2)
(PO2)
2. a) Explain the differences among a truth table, a state table, a characteristic table, and an excitation table. Also, explain the difference among a Boolean equation, a state equation, a characteristic equation, and a flip-flop input equation. 10
(CO1)
(PO1)
 - b) A sequential circuit with two *D* flip-flops *A* and *B*, two inputs, *x* and *y*; and one output *z* is specified by the following next-state and output equations. 15
(CO3)
(PO2)

$$A(t + 1) = xy' + xB$$

$$B(t + 1) = xA + xB'$$

$$z = A$$
 - i. Draw the logic diagram of the circuit.
 - ii. List the state table for the sequential circuit.
 - iii. Draw the corresponding state diagram.
 - iv. What type of sequential circuit is this circuit a representative of?
3. a) The counter circuit that follows irregular count sequences is called an irregular counter. It does not follow the natural binary sequence. The count sequences are prespecified, and the counter progresses according to that. 15
(CO3)
(PO2)
 - i. Consider an irregular sequence: 0010 → 0110 → 1000 → 1001 → 1100 → 1101 and design the circuit for such a counter using J-K flip-flops. The counter must always reset to 0010 on the next clock pulse when it is in an undesirable condition.
 - ii. Draw the waveform of such counter including regular clock pulses.

- iii. Is it a single mode counter, allowing for the implementation of its multimode counterpart? What modifications would you recommend in order to construct such a counter that counts in reverse order?
- b) Construct a binary counter that counts from 0 through binary 127. Additionally, examine the class of this counter.
4. a) Design the sequential circuit shown in Figure 1 by following the steps in the *design procedure*. To implement the circuit, T flip-flops are required.

10
(CO3)
(PO2)

15
(CO5)
(PO2)

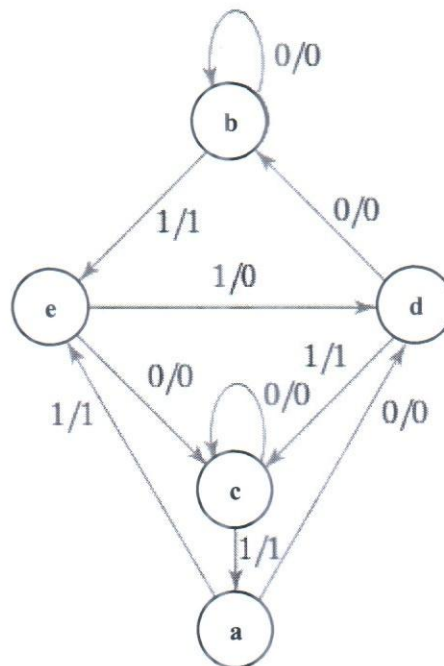


Figure 1: State diagram

- b) Draw the logic diagram of a four-bit register with four *D* flip-flops and four 4×1 multiplexers with mode selection inputs S_1 and S_0 . The register operates according to the following function table (Table 1).

10
(CO5)
(PO2)

Table 1: Selection modes

S_1	S_0	Register Operation
0	0	No change
1	0	Complement the four outputs
0	1	Clear register to 0 (synchronous with the clock)
1	1	Load parallel data

5. a) Assume that a digital system receives an analog input from the user, processes it using 1's complement, and then returns the processed signal to the user. Consider that the digital processor is capable of processing data in the 4-bit range. **15**
(CO2)
(PO2)
- Now, using ADC and DAC, create a basic block diagram of this signal processing system.
 - Identify the most important ways for implementing those ADC and DAC.
 - Design a DAC and an ADC using either of the ways indicated in question (ii), such that they could be used to develop the sequence shown in the block diagram in question (i).
 - What specifications will manufacturers of DACs and ADCs provide to ensure their products' stability and accuracy?
- b) Explain the workings of a serial adder with necessary logic diagram and waveforms. **10**
(CO1)
(PO1)
6. a) Why mobius counter is considered as a switch-tail ring counter? What is the disadvantage of the mobius counter? **5**
(CO3)
(PO2)
- b) Design a code converter that converts 2421 code to BCD using (a) PROM, (b) PLA, and (c) PAL. To design these devices, derive respective program table keeping the value of n , p and m minimum. **15**
(CO5)
(PO2)
- c) What are the *Direct inputs* in sequential circuit? Explain their necessities and limitations with truth table. **5**
(CO1)
(PO1)

Name of the Program: B. Sc. in CSE
Semester: Summer semester

Date: 28 March, 2022
Time: 10:00 am–01:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course Number: Phy 4241
Course Title: Physics II

Summer Semester : 2020 - 2021
Full Marks: 150
Time: 3.0 Hours

There are 06 (six) questions. Answer 06 (six) questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

1. a. Explain the retentivity property of a material.

5
(CO3)
(PO1)

- b. Find the value of current I required to establish a flux of $2 \times 10^{-4} \text{ Wb}$ in the air gap of the magnetic circuit in Fig. 1. Here, area of the section other than $bg = 5 \times 10^{-4} \text{ m}^2$.
 $l_{ab} = l_{bg} = l_{gh} = l_{ha} = 0.2 \text{ m}$, $l_{bc} = l_{fg} = 0.1 \text{ m}$, $l_{cd} = l_{ef} = 0.099 \text{ m}$

12
(CO3)
(PO2)

- c. Find the current I_0 in the network of Fig. 2. The supply current is $5 \angle 0^\circ \text{ A}$.

8
(CO2)
(PO2)

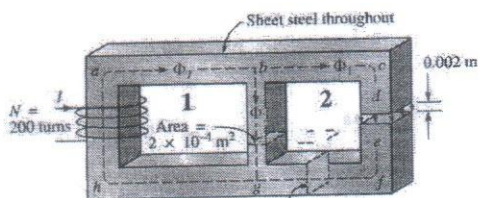


Fig. 1

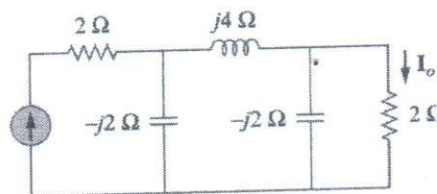


Fig. 2

2. a. Justify whether superposition theorem is applicable in magnetic circuit analysis.

5
(CO3)
(PO1)

- b. Determine the magnetic flux established in the circuit configuration of Fig. 3. Here, area = $2 \times 10^{-4} \text{ m}^2$, $l_{cd} = 8 \times 10^{-4} \text{ m}$, $l_{ab} = l_{be} = l_{ef} = l_{af} = 0.2 \text{ m}$, $l_{bc} = l_{de}$.

12
(CO3)
(PO2)

- c. Find the value of Z in the network of Fig. 4. $V_0 = 4 \angle 0^\circ \text{ V}$.

8
(CO2)
(PO2)

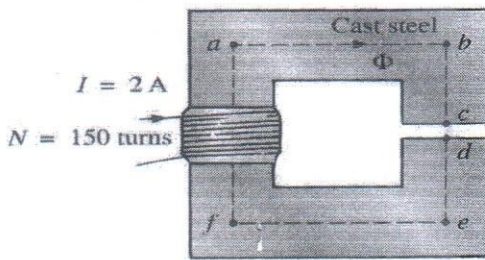


Fig. 3

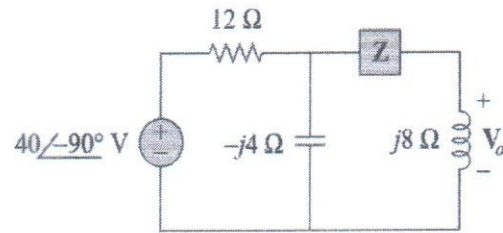


Fig. 4

3. a. Explain why ac is preferable over dc in most applications.
- b. Find V_o in the circuit of Fig. 5 using mesh analysis.
- c. Find i_o in the circuit of Fig. 6.

5

(CO1)

(PO1)

10

(CO2)

(PO2)

10

(CO2)

(PO2)

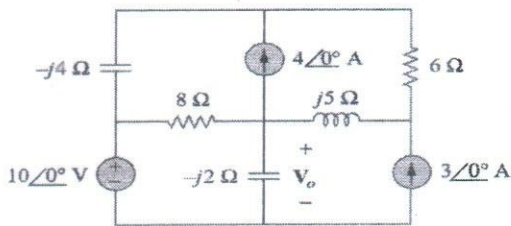


Fig. 5

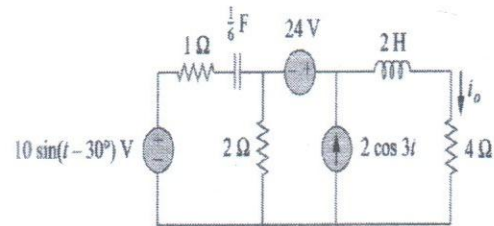


Fig. 6

4. a. Draw the phasor diagram representing voltage-current relationship for an inductor and a capacitor.

5

(CO1)

(PO1)

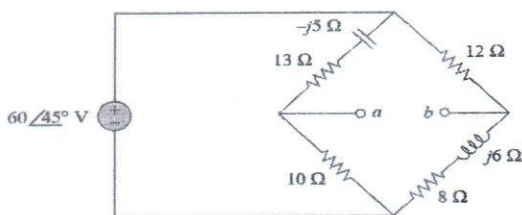


Fig. 7

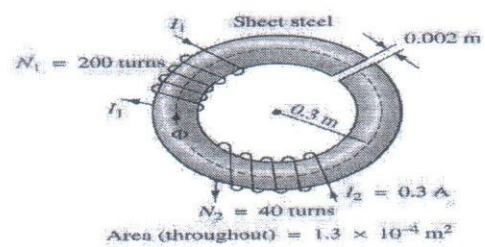


Fig. 8

- b. Find the Thevenin equivalent circuit at terminal a-b in the circuit of Fig. 7.

10

(CO2)

(PO2)

- c. Determine the value of I_1 required to establish a flux of $2 \times 10^{-4} \text{ Wb}$ in the magnetic circuit of Fig. 8. 10
(CO3)
(PO2)
5. a. Explain Quality factor of a resonant circuit. 5
(CO4)
(PO1)
- b. Find the equivalent capacitance between the terminals a-b in the circuit of Fig. 9. 10
(CO2)
(PO2)
- c. For a series RLC network with $R = 2\Omega$, $L = 1 \text{ mH}$ and $C = 0.4 \mu\text{F}$ - Find the resonant frequency and half-power frequencies; the quality factor and bandwidth; the amplitude of the current at ω_0 , ω_1 and ω_2 . The supply voltage is $20 \sin \omega t$. 10
(CO4)
(PO2)

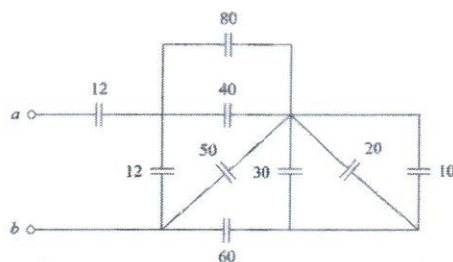


Fig. 9

6. a. Explain the concept of resonance in an RLC circuit. 5
(CO4)
(PO1)
- b. Determine the resonant frequency of the circuit in Fig. 10. 10
(CO4)
(PO2)
- c. Determine the type of filter shown in Fig. 11. Calculate the cut-off frequency. Here, $R = 2\text{K}\Omega$, $L = 2\text{H}$ and $C = 2\mu\text{F}$. 10
(CO4)
(PO2)

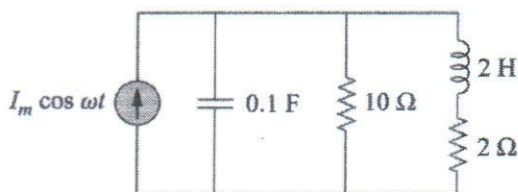


Fig. 10

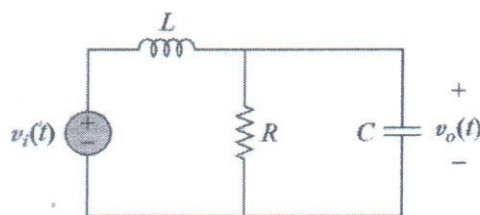


Fig. 11

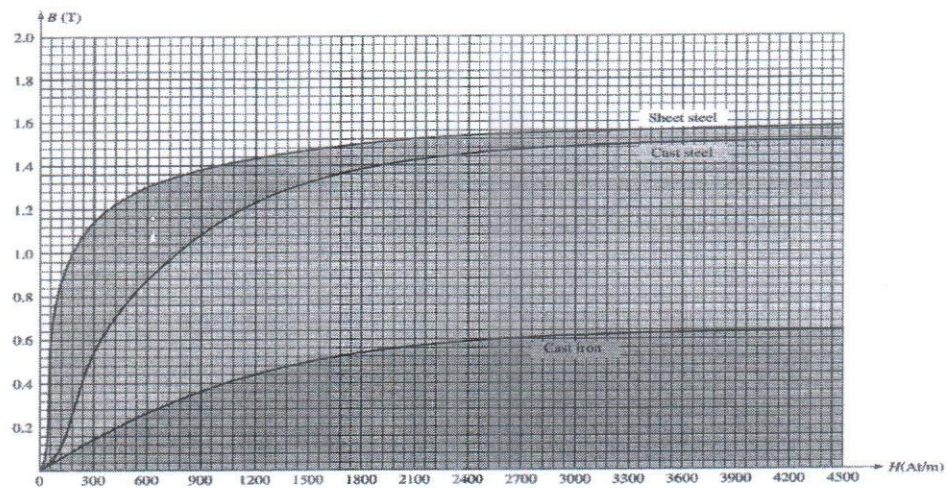


Fig. 12. Normal magnetization curve for 3 different ferromagnetic materials

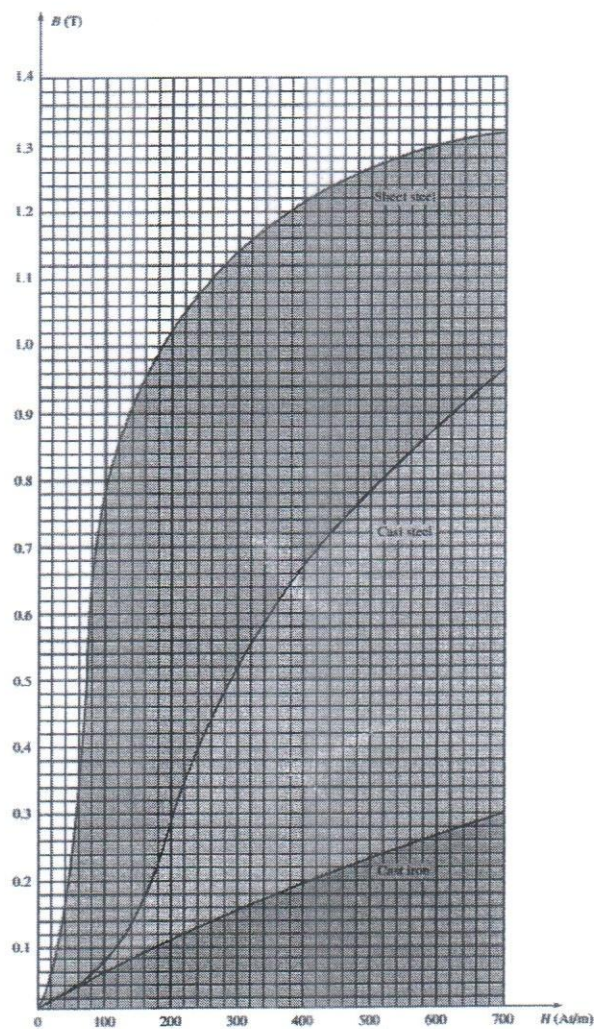


Fig. 13. Normal magnetization curve for 3 different ferromagnetic materials

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Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 200

Math 4241: Integral Calculus and Differential Equations**Programmable calculators are not allowed. There are 6(six) questions. Answer all of them.**

Figures in the right margin indicate marks.

1. a) Find the solution to the following IVP: 15

$$ty' = 2y + 4t^3 \cos(4t), y\left(\frac{\pi}{8}\right) = 0$$
(CO4)
(PO1)
- b) Find the area bounded by the region $f(x) = x^2$ by Riemann Sum. 18
(CO1)
(PO1)
2. a) Find the solution of the following IVP: 14

$$y' = -3y + 1, y(0) = 1$$
(CO4)
(PO1)
- b) **R** is the region in the first quadrant that lies below the curve $y = x^2 + 4$ and is bounded by this curve, the line $y = -x + 10$, and the coordinate axis. 10+10
(CO2)
(PO1)
 - i. Graph the mentioned curve and lines, and define the region **R**.
 - ii. Find the area of the region **R**.
3. A population of rabbits in a meadow observed to be 1500 in the beginning of a survey. After a month, the rabbit population is observed to be increased by 50. In ideal condition, only 5000 rabbits can survive in that meadow.
 - a) Write the logistic differential equation and initial condition for this model. 8
(CO4)
(PO1)
 - b) Determine the population of rabbits as a function of time t . 12
(CO4)
(PO1)
 - c) Use the solution to predict the population after 1 year. 7
(CO4)
(PO1)
 - d) After how much time, the rabbit population will be doubled? 6
(CO4)
(PO1)
4. a) Find all the solutions y of the following differential equation, 15

$$y't^2 - ty - t - 1 = y^2 + 2y$$
(CO4)
(PO1)

Hint: Check if the equation is Euler homogeneous after variable substitution.
- b) If a semi-circle is revolved around the y -axis about its diameter, what would be the volume of the structure? Draw and formulate. 12
(CO2)
(PO1)

- c) Show that, $y(t) = e^{2t} - \frac{3}{2}$ is a solution of the equation $y' = 2y + 3$.

6
(CO3)
(PO1)

5. a) Check if the following functions are scale invariant:

6
(CO3)
(PO1)

$$f_1(t, y) = \frac{ty^2}{t^2} \quad f_2(t, y) = \frac{t^3 + t^2y + ty^2 + y^3}{t^3 + ty^2}$$

- b) Find all solutions to the following differential equation:

20
(CO4)
(PO1)

$$5xy'e^{-y} + 2y' \cos(3x) + 5e^{-y} - 3 \sin(3x) = 0$$

- c) Consider the differential equation,

7
(CO4)
(PO1)

$$\frac{d^2y}{dx^2} - 4 \frac{dy}{dx} + 3y = 0$$

Show that e^x and e^{3x} are linearly independent solutions of this equation.

6. a) An archaeologist investigating the site of an ancient village finds a burial ground where the amount of carbon-14 present in individual remains is between 46 and 48% of the amount present in live individuals. Estimate the age of the village and the length of time for which it survived. [Use that the half-life of carbon-14 is 5730 years.]

14
(CO4)
(PO1)

- b) Given that $y = e^{2x}$ is a solution of the following equation;

18 + 2
(CO4)
(PO1)

$$(2x + 1) \frac{d^2y}{dx^2} - 4(x + 1) \frac{dy}{dx} + 4y = 0,$$

Find a linearly independent solution by reducing the order. Write the general solution.

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Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 Hours

FULL MARKS: 150

Chem 4241: Chemistry

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin.

- | | | |
|-------|--|----------------------|
| 1. a) | Define and classify conductance. What is an electrochemical cell? | 5
(CO1)
(PO1) |
| b) | Draw and explain Galvanic cell. What is salt bridge and its function? | 8
(CO1)
(PO1) |
| c) | Derive the thermodynamic relationship between Equilibrium Constant (K) and Gibb's free Energy. What is the significance of this relationship? | 12
(CO1)
(PO1) |
| 2. a) | Derive a relationship between elevation of boiling point of the solvent and the molecular mass of the dissolved non-volatile solute in the solvent. | 10
(CO1)
(PO1) |
| b) | Explain why the boiling point of a liquid rises when a nonvolatile solute is dissolved in it and the dissolution of gases in liquid is exothermic. | 6
(CO1)
(PO1) |
| c) | The vapor pressure of ether at 25°C is 445mm of Hg. When 6.5gm solute is dissolved in 50gm ether, the vapor pressure of the solution is 410mm of Hg. What is the MW of the solute when the MW of ether is 74gm/mol? | 9
(CO1)
(PO1) |
| 3. a) | What is Equilibrium Constant (K)? Show how the equilibrium constant (K) is related with temperature with the derivation of the mathematical equation. | 10
(CO1)
(PO1) |
| b) | What is Buffer solution? How can it be classified? Show how Buffer solution operates in different medium. | 9
(CO1)
(PO1) |
| c) | For the reaction $2\text{NH}_3(\text{g}) \leftrightarrow 3\text{H}_2(\text{g}) + \text{N}_2(\text{g})$ at equilibrium, the value of K_p is 1.22×10^{-3} atm at 25°C and 2.16 atm at 225°C. Calculate ΔH for the reaction. | 6
(CO1)
(PO1) |
| 4. a) | State and explain Henry's law. What is the effect of temperature on the solubility of gases in liquids? | 10
(CO1)
(PO1) |
| b) | What is critical solution temperature (CST)? Draw and explain the CST diagram for the water – triethyl amine system. | 10
(CO1)
(PO1) |
| c) | Give the salient features of Lowry-Bronsted concept related to acids and bases. | 5
(CO1)
(PO1) |

5. a) Define heat of solution and heat of combustion with examples. Describe a method for the determination of heat of combustion. 10
(CO1)
(PO1)
- b) State and explain Hess's law of constant heat summation with suitable examples. 8
Mention Some applications of the law. (CO1)
(PO1)
- c) The standard heat of formation of liquid water is $-68.3 \text{ kcal at } 25^{\circ}\text{C}$. calculate the value of standard heat of formation of liquid water at 100°C . The molar heat capacities at constant pressure in the given temperature range of $\text{H}_2(\text{g})$, $\text{O}_2(\text{g})$ and $\text{H}_2\text{O}(\text{l})$ are 6.89, 6.97 and $18.0 \text{ cal. deg}^{-1} \text{ Mole}^{-1}$ respectively. 7
(CO1)
(PO1)
6. a) State Le Chatelier principle and explain it with suitable examples. 6
(CO1)
(PO1)
- b) How is concentration of a solution defined? What are the units of expressing concentration? Describe what you understand by Molarity and Normality of a solution. 10
Are they temperature dependent? (CO1)
(PO1)
- c) What are boiling points and vapor pressure of liquids? What are osmosis and reverse osmosis? Explain them with suitable examples in industries and our and nature. 9
(CO1)
(PO1)

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Department of Computer Science and Engineering (CSE)

FINAL SEMESTER EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 Hours

FULL MARKS: 100

CSE 4271: Computer Programming

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

-
- | | | |
|----|--|--------------------------------|
| 1. | a) What is the difference between array and pointer? | 4
(CO1)
(PO1) |
| | b) Define ' <i>call by value</i> ' and ' <i>call by reference</i> '. | 4
(CO1)
(PO1) |
| | c) Write a C program to reverse the elements of a given array using pointers . | 8.66
(CO2,
CO3)
(PO3) |
| 2. | a) Explain the phases in the life cycle of a computer program. | 4
(CO1)
(PO1) |
| | b) Write a C program to find the sum of even numbers using the goto statement. | 6
(CO2)
(PO3) |
| | c) Given an integer n ($0 < n < 1000$), write a C program using function to check whether the given number is an Armstrong number or not. Armstrong number is a number that is equal to the sum of the cubes of its digits. | 6.67
(CO2,
CO3)
(PO3) |
| 3. | a) Define three different approaches that can be used to pass structures as function arguments. | 4
(CO1)
(PO1) |
| | b) Differentiate among array, structure and union. | 4
(CO1)
(PO1) |
| | c) Define a structure called ' cricket ' that will contain the player name, team name and batting average. Using ' cricket ', declare an array named player with 50 elements. Write a C program to read the information about all the 50 players and print a team-wise list containing names of players with their batting average. | 8.67
(CO2,
CO3)
(PO3) |
| 4. | a) How can you detect the end of a file? | 3
(CO1)
(PO1) |
| | b) Distinguish between the following: <div style="margin-left: 20px;"> i. Actual and Formal arguments
 ii. Global and Local variables
 iii. Automatic and Static variables </div> | 6
(CO1)
(PO1) |

- c) Suppose a company wants to keep the details of their employees in a file. So you are asked to create a text file named '**emp.txt**' containing the following information of an employee: Emp. ID, Emp. Name, Emp. Age, Emp. Dept (Admin/Sales/Production/IT), and Emp. contact number. Write a C program to read and write the employee details using the created file "**emp.txt**". 7.67 (CO2, CO3) (PO3)
5. a) What is the difference between *scanf()* and *gets()* function? 3 (CO1) (PO1)
- b) Explain the following string handling functions with example: 6 (CO1) (PO1)
- strcpy()*
 - strcmp()*
 - strcat()*
 - strlen()*
- c) Ace loves football very much. One day, as he was watching a football match between team A and B, he was writing the players' current positions on a piece of paper. To simplify the situation he depicted it as a number consisting of zeros and ones. A "0" corresponds to players of one team; a "1" corresponds to players of another team. If there are at least 7 players of some team standing in a certain situation, then the situation is considered dangerous for the other team. For example, the situation **1101111110** is dangerous and **01010101** is not. Write a C program to determine whether a situation is dangerous or not. (Assume that, 0=Players of team A, 1=Players of team B). 7.67 (CO2, CO3) (PO3)
6. a) Is it better to use a *macro* or a *function*? Explain different forms of macro substitutions with example. 5 (CO1) (PO1)
- b) Write a C program using *nested macro* to find the minimum of three values. 5 (CO2) (PO3)
- c) Convert the following functions in Figure (i), (ii), and (iii) into function-like-macros and use them in the main function: 6.66 (CO2) (PO3)

<pre>float form(int a, int b) { float c = a+b; float d = a-b; c = c*c; d = d*d; return sqrt(c+d); }</pre>	<pre>int mul(int a,int b) { int c; c = a*b; return c; }</pre>	<pre>float div(int a,int b) { float c, d; c = a; d = b; return c/d; }</pre>
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Figure (i)

Figure (ii)

Figure (iii)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4279: Data and Telecommunications

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) In IUT there are more than 2500 internet users. However, IUT has only 4 public IP addresses. Explain the procedure with necessary diagram by which IUT can provide services to 2500 user with only 4 registered public IP. 15
(CO3)
(PO3)
 What are the advantages an IUT internet user is facing for this?
- b) In internet, different network follows one of the two IP protocols - IPv4 or IPv6. Why different protocol is chosen and how can they prevail simultaneously. 10
(CO2)
(PO2)
2. a) An ISP is granted a block of addresses starting with 150.40.0.0/16. The ISP wants to distribute these blocks to 2600 customers as follows: 15
(CO3)
(PO3)
 - The first group has 200 medium-size businesses; each need 128 addresses.
 - The second group has 400 small businesses; each need 16 addresses.
 - The third group has 2000 households; each need 4 addresses.
 Design the sub-blocks and give the slash notation for each subblock. Find out how many addresses are still available after these allocations.
- b) In IPv4 there is an 8-bit field called service type. Write down the significance of each bit of the field. 10
(CO1)
(PO1)
3. a) Draw the flow diagram of CSMA/CD and CSMA/CA. Criticize the advantages and disadvantages of these two techniques for different transmission medium. 15
(CO3)
(PO3)
- b) Draw the TCP/IP protocol suite. 10
(CO1)
(PO1)
 Hint: In your answer you need to mention different protocols in each layer of TCP/IP protocol suite.
4. a) TCP protocol is a connection-oriented protocol which undergoes several steps in connection establishment. Show the steps of connection establishment with necessary diagram. 15
(CO3)
(PO3)
 Analyze the disadvantages of this process and how these disadvantages can be overcome.
- b) UDP is connectionless transport layer service. Though this service is unreliable, justify its application in different services including Routing Information Protocol (RIP) 10
(CO2)
(PO2)
5. a) In network layer intermediary router may fragment a received IP datagram. 15
 - i. When did a router fragment a datagram? Is it possible to avoid fragmentation? (CO3)
 - ii. What are the changes applied on a received datagram before sending out? (PO3)
 - Case 1: A non-fragmented datagram needs to be fragmented.
 - Case 2: A fragmented datagram (not the last datagram) needs to be fragmented.
 - Case 3: A fragmented datagram (last fragment) needs to be fragmented.

b) Write down the unabbreviated form of following IPv6 address

- i. 0::0
- ii. 0::FFFF:0:0
- iii. 582F:1234::2222
- iv. 4821::14:22
- v. 54EF::A234:2

10
(CO1)
(PO1)

6. a) Which data link control protocol is represented by the flow diagram in figure 1. Explain the advantages and disadvantages of this protocol from the given scenario.

12
(CO3)
(PO3)

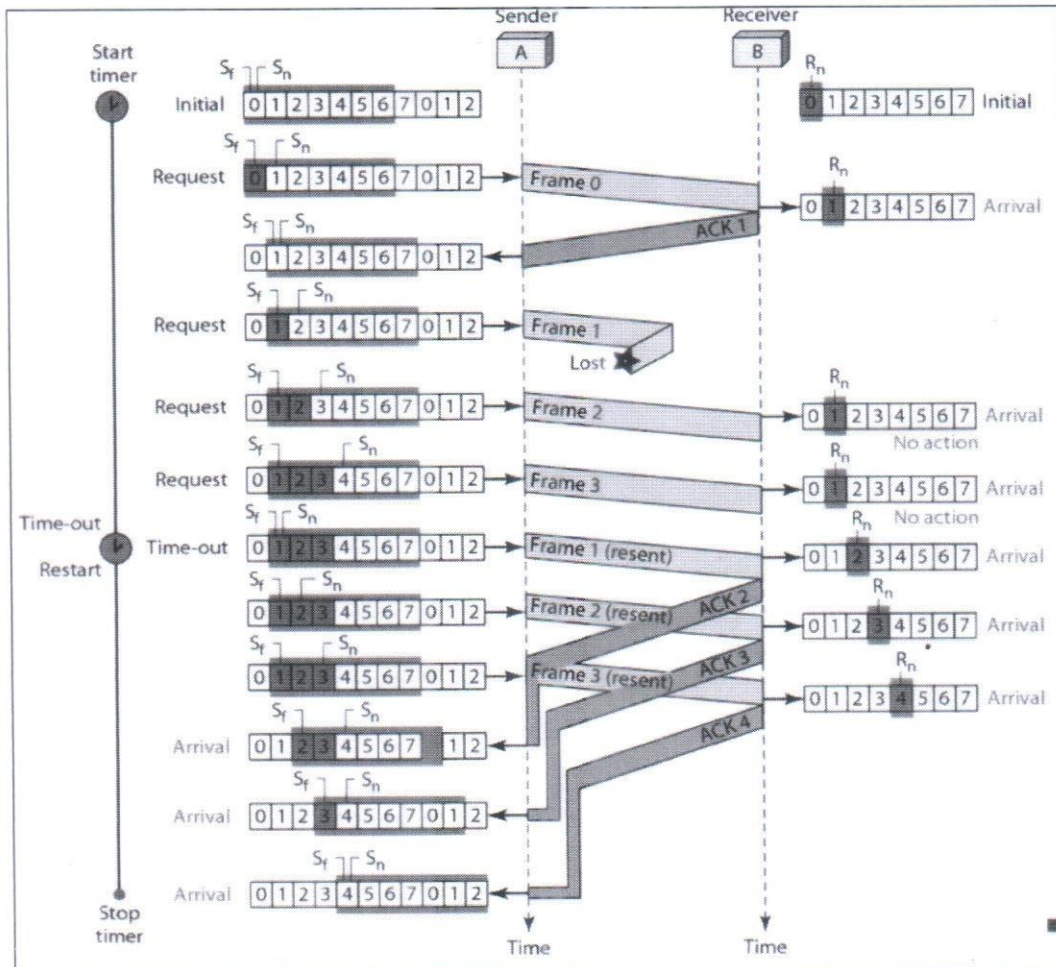


Figure 1: Flow diagram of a data link control technique

- b) Explain with necessary diagram how a burst error can be handled with single-bit error correction method. Justify the handling procedure of the burst error with single-bit error correction instead of a unique burst error solution.
- c) Write down the differences between circuit switched network and packet switched network.

8
(CO2)
(PO2)

5
(CO1)
(PO1)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4403: Algorithms

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Answer the following questions: 3+5+5
 - i. Find the worst-case complexity of counting sort by explaining its working principle. (CO1)
(PO1)
 - ii. Calculate the memory requirement of counting sort when sorting 32 bits and 64 bits numbers.
 - iii. Explain how radix sort with counters overcomes the memory requirement issues of counting sort by using the idea of prefix sum.
- b) Show the steps of sorting the following list of numbers using radix sort with counters: 12

12 23 25 14 36

(CO2)
(PO1)
2. a) Analyse the configuration of each of the following graphs and choose the most suitable algorithm among Dijkstra, Bellman-Ford and Floyd-Warshall to find the shortest path. 5x3
 - i. You are provided with an undirected graph with negative weights. Your goal is to find the shortest path between a pair of vertices. (CO1)
(PO2)
 - ii. A directed weighted graph with negative weights, but with no cycle is provided as input and your goal is to find the shortest path for all possible pairs of vertices.
 - iii. A directed disconnected graph with negative cycles is provided as input. Your goal is to detect whether there exists a negative cycle or not.

Justify the reason for your selection. Also, provide the worst-case complexity for your selected algorithm.
- b) Consider the graph presented in Figure 1 and answer the following questions:

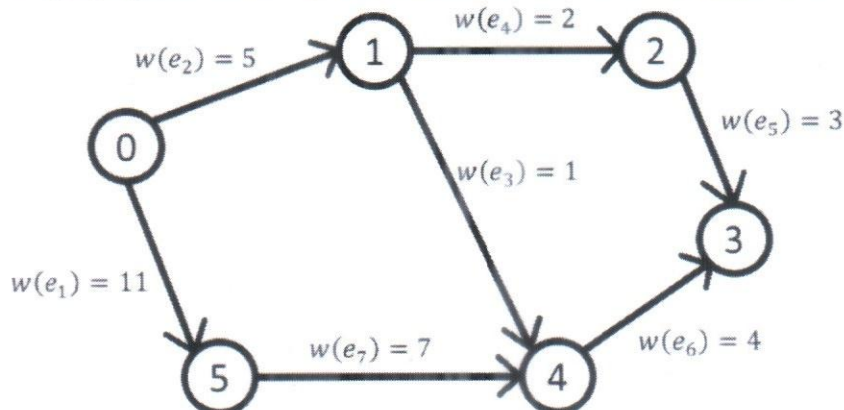


Figure 1: An undirected weighted graph

- i. Find the order of the vertices to be deleted from the priority queue if you apply Dijkstra's algorithm with vertex 0 as the source. 4
(CO1)
(PO1)
- ii. Apply the Bellman-Ford algorithm to find the shortest path from vertex 0 to vertex 4. 6
(CO2)
(PO1)

3. a) Assume you have obtained a Minimum Spanning Tree (MST) T from graph G . Determine whether the tree T will remain MST if you decrease the weight of one of the edges $e \notin T$. Justify if your answer is yes. If your answer is no, then provide an efficient algorithm to find the updated MST. 10 (CO2) (PO1)
- b) Consider the graph presented in Figure 1 as an undirected graph and apply Prim's algorithm starting from vertex 1 on the graph to find the minimum spanning tree. 10 (CO2) (PO1)
- c) An MST edge whose deletion from the graph would cause the MST weight to increase is called a critical edge. Find all critical edges of the undirected version of the graph presented in Figure 1. 5 (CO1) (PO1)
4. a) Write down an algorithm to approximate the value π (π) using Monte Carlo simulation. 6 (CO1) (PO1)
- b) Assume a box contains an infinite supply of red and green balls. You are playing a game, where you randomly pick a ball from the box and if two consecutive red balls are picked, then the game is over. The score of the game is determined by the number of balls picked before the game is over. The probability of picking the green ball is p .
- i. Derive a mathematical formula to calculate the expected score of the game. 5 (CO2) (PO1)
- ii. Propose an algorithm to find the expected score of the game using the Monte Carlo simulation. 7 (CO2) (PO3)
- c) Explain by providing a Las Vegas algorithm for the solution of the 8-Queen problem. How does the Las Vegas algorithm finds the exact result unlike approximating the result as Monte Carlo simulation? 7 (CO1) (PO2)
5. a) The following is a general recurrence relation for a divide and conquer algorithm:

$$T(n) = a T(n/b) + f(n)$$
3+3+6 (CO1) (PO1)
- i. Explain whether is it necessary to have the value of b and a greater than 1 or not.
- ii. Determine the value of a , b and $f(n)$ for the merge sort
- iii. Using the recurrence tree, determine the runtime for the following recurrence relation:

$$T(n) = T(n/3) + T(2n/3) + cn$$
- b) Given a set of points in the plane, the **convex hull** of the set is the smallest convex polygon that contains all the points of it.
- i. Propose a divide and conquer algorithm to find the convex hull from a given set of points. 10 (CO2) (PO2)
- ii. Determine the runtime of your proposed algorithm. 3 (CO3) (PO3)
6. a) To manage the booking of the IUT auditorium, a Google Form is circulated among the staff. The staff choose an opening and closing time based on their need. Given all the booking requests for a particular day, your job is to create a schedule so that the maximum number of staff can be served.
- i. Propose a greedy algorithm to solve this problem. 10 (CO1) (PO1)
- ii. Find the sorting criteria of the request while processing, to obtain the global optimal result. Justify your answer. 8 (CO2) (PO3)

- b) Consider the flow network graph provided in Figure-2:

7
(CO1)
(PO1)

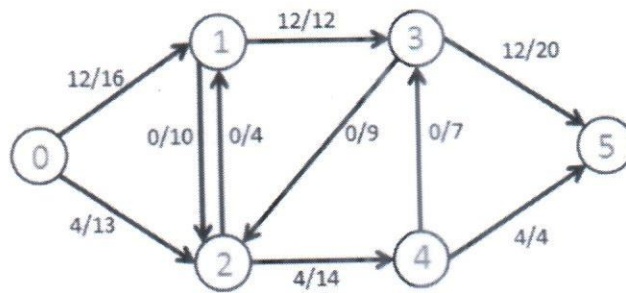


Figure 2: A flow network graph

Find the maximum flow over the network by applying the Ford-Fulkerson algorithm, considering vertex 0 as the source and vertex 5 as the sink.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS:200

CSE 4405: Data and Telecommunications

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all of the 6 (six) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) How are OSI and ISO related to each other? Distinguish between communication at the transport layer, at the network layer, and at the data-link layer. 2+7.33
(CO1)
(PO1)
- b) Briefly explain the concept of *Baseline Wandering* and *DC Component* in digital transmission. Find out the bit sequence for the given digital signals from the following figures. For the Figure 1, consider NRZ and NRZ-I coding. And for the Figure 2, consider Manchester and Differential Manchester coding schemes. 6+6
(CO2)
(PO1,PO2)



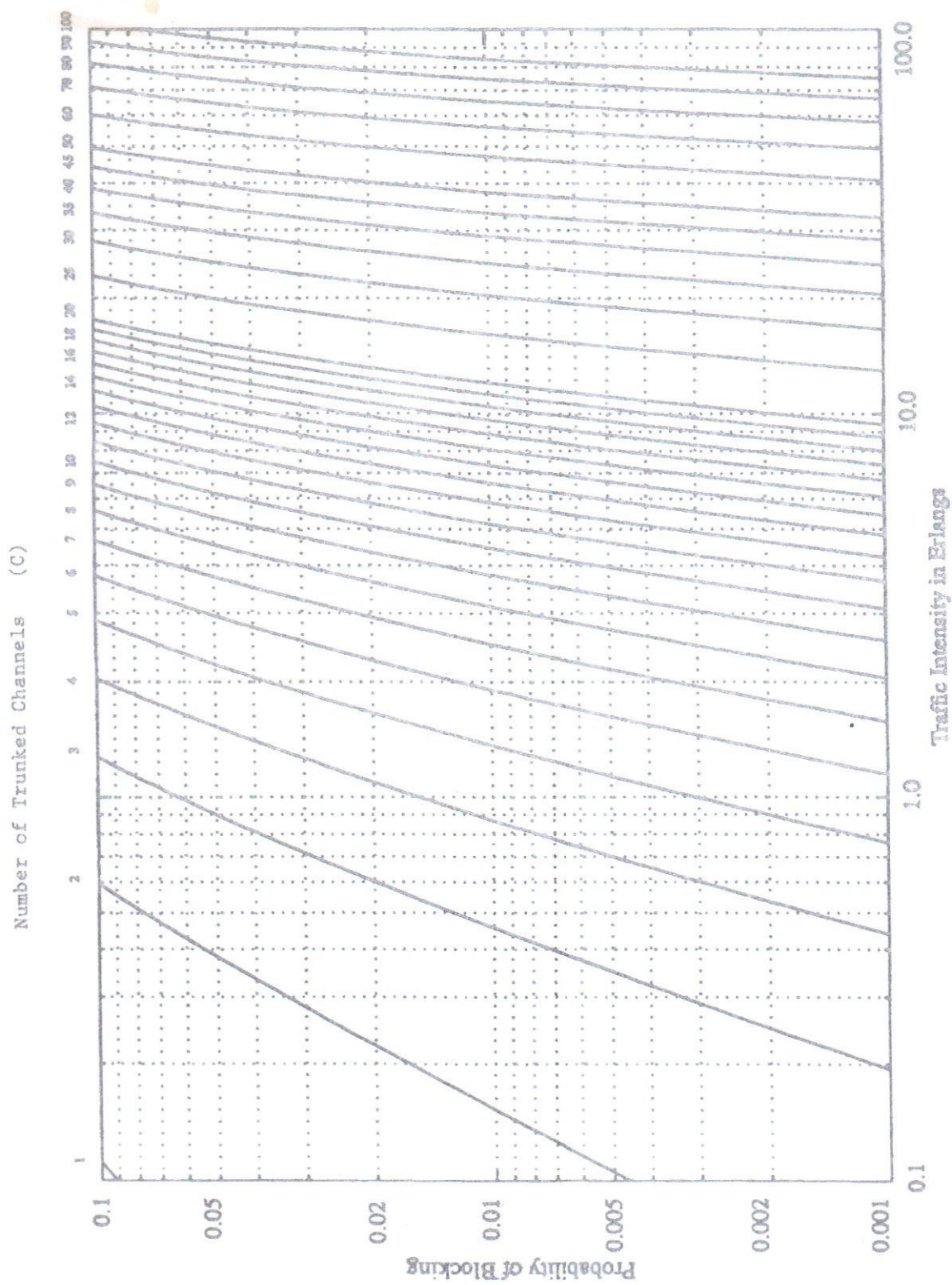
Figure 1



Figure 2

- c) What do you mean by multiplexing? In a synchronous TDM multiplexing technique, different input data rates need to be multiplexed where the output line has a capacity of 200 kbps. Input data rates are 15, 20, 30, 40, 40 kbps. 2+4+6
(CO2)
(PO3,PO1)
- i. Draw the block diagram to show how disparity of data rates will be handled.
 - ii. Briefly explain each of the techniques.
2. a) Define a switch and describe the need for switching. Compare and contrast a circuit-switched network and a packet-switched network in terms of delay and efficiency. 10.33
(CO3)
(PO1,PO2)
- b) What is the role of the address field in a packet traveling through a datagram network? How does the role change in a packet travelling through a virtual-circuit network? 7
(CO3)
(PO1,PO2)
- c) Design a three-stage space-division switch with $N = 100$. Use 10 crossbars at the first and third stages and 4 crossbars at the middle stage. (CO3)
(PO1,PO3)
- i. Draw the configuration diagram. 4
 - ii. Calculate the total number of crosspoints. 2
 - iii. Comment on the blocking factor of this system. 2
 - iv. State the *Clos* criteria and redesign the above configuration using it. 8
3. a) Write short notes on the followings: 3x3
(CO3)
(PO1,PO2)
- i. Checksum
 - ii. Two-dimensional parity
 - iii. Burst error
- b) What do you mean by minimum Hamming distance? Find the minimum Hamming distance for detection of 6 errors and correction of 2 errors. Illustrate the structure of the encoder and decoder for a Hamming code $C(7, 4)$. 3+3+6
(CO3)
(PO1,PO2)

- c) Define a cyclic code. How does a cyclic code differ from a linear block code? Given the dataword 101001111 and the divisor 10111, show the generation of the CRC codeword at the sender site (using both binary division and polynomials). 2+3+7.33
(CO3)
(PO1,PO3)
4. a) What is CDMA? How does CDMA differ from other channelization protocols? Generate the chip sequences for a CDMA network with 14 stations? 2+3+5
(CO3)
(PO1,PO3)
- b) What is the use of persistence methods in CSMA? Draw the flow diagram of the p-Persistent method. 3+4.33
(CO3)
(PO1,PO3)
- c) Demonstrate a comparative analysis of the random access MAC protocols. (Hints: Your answer must include vulnerable time and throughput along with other parameters as a basis for comparison) 16
(CO3)
(PO1,PO2)
- OR
- With necessary examples and figures demonstrate the evolution process of different link control protocols. (Hints: Your answer should include the window size, acknowledge type along with other parameters) 16
(CO3)
(PO1,PO2)
5. a) Define cluster and footprint in cellular communication. With necessary diagrams and equations, explain the frequency reuse concept of cellular communication. 16.33
(CO3)
(PO1,PO3)
- OR
- With necessary diagrams and equations, explain the co-channel interference and system capacity of cellular communication. 16.33
(CO4)
(PO1,PO3)
- b) A 30 MHz spectrum is allocated to a wireless system that uses two 25 kHz simplex channels to provide full-duplex voice and control channels. Compute the number of channels available per cell if that system uses a 12-cell reuse pattern. If 1 MHz of the allocated spectrum is dedicated to control channels, determine an equitable distribution of control channels and voice channels in each cell of that system. 6
(CO4)
(PO1,PO2)
- c) A system has 800 cells with 25 traffic channels available where a minimum SIR of 15dB must be maintained. Consider that there are 6 channels in the first tier. Find the minimum cluster size with path loss exponent 3. If each user averages two calls per hour at an average call duration of 2 min, how many subscribers can this system support for a 2% GOS? 5+6
(CO4)
(PO1,PO2)
6. a) Neatly sketch the GSM system architecture. Name all the logical channels available in GSM and present the tasks of each control channel involved in connectivity maintenance. 4+7
(CO4)
(PO1,PO3)
- b) With the aid of necessary diagrams, explain how a call to a mobile user initiated by a PSTN subscriber is established. Mention different logical channels involved in different stages of call establishment. 10.33
(CO4)
(PO1,PO3)
- OR
- With necessary diagrams explain the handoff scenario between two cells under different MSCs of a GSM network. Mention different logical channels involved in different stages of hand-off process. 10.33
(CO4)
(PO1,PO3)
- c) Explain the following GSM terms with appropriate examples: 3×4
i. Interleaving ii. Normal burst iii. Duplex distance iv. Channel coding (CO4)
(PO1,PO3)



The Erlang B chart showing the probability of blocking as functions of the number of channels and traffic intensity in Erlangs.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 Hours

FULL MARKS: 100

CSE 4407: System Analysis and Design

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (Six)** questions. Marks of each question and corresponding CO and PO are written in the right margin.

1. a) What does “**exploding**” mean in a data flow diagram? 2
(CO1)
(PO1)

- b) What is a **context-level** data flow diagram? Discuss the differences between a **context-level** diagram and **level 0 DFD** (data flow diagram). 4
(CO2)
(PO2)

- c) McDonuts, a famous donut place, wants to **install** a system to **record orders** for donuts and boba tea. When regular customers call McDonuts on the phone, they are asked for their phone number. When the number is typed into a computer, the name, address, and last order date is automatically brought up on the screen. Once the order is taken, the total, including tax and delivery, is calculated. Then the order is given to the cook. A receipt is printed. Occasionally, **special offers (coupons)** are printed so the customers can get a discount. Drivers who make deliveries give customers a copy of the receipt and a coupon (if any). Weekly totals are kept for comparison with last year’s performance. 4 + 6
(CO4)
(PO3)
 - i. Design a context-level data flow diagram for McDonuts.
 - ii. Design another diagram showing all the major processes that should be present in the system.

2. a) Explain the concept of **UML**. What is the significance of **UML** in designing the structure of an object oriented system? 4
(CO2)
(PO1)

- b) What are the three major elements of **UML**? List the diagrams included in structural and behavioral diagrams. 6
(CO1)
(PO1)

- c) Woody’s Supermarket, a small chain of grocery stores, is building a website to allow customers to place orders for groceries and other items they sell. When the customer places an order, the customer database is updated, and an order record is created. The order prints at a local store, and the goods are picked from the shelves by the store employees. Customers are sent an email notification that their order is ready. When they pick up the order, one of the employees hands them a receipt of the order received. Mr. Fuzz Lightyear, a friend of Mr. Woody, wants to learn more about the activities that a customer has to perform to buy any product from that website. Design an **activity diagram** for Mr. Fuzz Lightyear showing the customer using the website to place an order, verification of the order, order confirmation, order details sent to the local store, and a customer email sent to the customer. 7
(CO4)
(PO3)

3. a) Define the role of an actor in a Use Case diagram. 3
(CO1)
(PO1)
- b) Briefly explain the purpose of swimlanes in an activity diagram. 3
(CO1)
(PO1)
- c) Create a **use case diagram** that would illustrate the use cases for the following dentist office system: 11
(CO4)
(PO3)
Whenever new patients are seen for the first time, they complete a patient information form that asks their name, address, phone number, and brief medical history, which is stored in the patient information file. When a patient calls to schedule a new appointment or change an existing appointment, the receptionist checks the appointment file for an available time. Once a good time is found for the patient, the appointment is scheduled. If the patient is a new patient, an incomplete entry is made in the patient file; the full information will be collected when the patient arrives for the appointment. Because appointments are often made far in advance, the receptionist usually mails a reminder postcard to each patient two weeks before his or her appointment.
4. a) Explain how *fit* among the three HCI elements (human, computer, and tasks to be performed) leads to *performance* and *well-being*? 3
(CO2)
(PO2)
- b) List three ways an analyst can improve a website interface design to help three types of person with disabilities, i.e., **visually impaired**, **hearing impaired**, or **mobility impaired**. 6
(CO1)
(PO1)
- c) An IT executive, Lian Yang, from Pied Piper Innovators, Inc., has asked you to design a graphical user interface for an executive desktop to help him in his work. Use icons for file cabinets, a wastebasket, a telephone, and so on. Show how they would appear on the computer display. 8
(CO4)
(PO3)
5. a) Explain the concept of Six Sigma. Describe the steps of the Six Sigma methodology. 6
(CO2)
(PO1)
- b) Describe the structured walkthrough method to ensure the quality of a system. 4
(CO2)
(PO1)
- c) Briefly explain the different conversion strategies for converting an old system to a new one. 7
(CO4)
(PO1)
6. a) List and discuss the seven phases of the system development life cycle (SDLC). 7
(CO2)
(PO1)
- b) Briefly explain the agile development methodology. 5
(CO1)
(PO1)
- c) When is break-even analysis useful? 4
(CO2)
(PO2)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 Hours

FULL MARKS: 150

HUM 4441: Engineering Ethics

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. Answer any 4 (four) questions, where 1.(e) is mandatory.

- | | | |
|---|---|-------|
| a) Discuss the major components of Professional Codes of Conduct. | 6 | |
| | | (CO1) |
| | | (PO8) |
| b) Assume that you are a researcher in your field of expertise. You write scholarly articles and publish them in journals. How could the term 'Conflict of Interest' become relevant under this scenario? | 6 | |
| | | (CO1) |
| | | (PO8) |
| c) Identify the models proposed to resolve the conflicts between engineers and managers. | 6 | |
| | | (CO1) |
| | | (PO8) |
| d) List the conditions to be fulfilled for 'Blameworthiness.' | 6 | |
| | | (CO1) |
| | | (PO8) |
| e) Explain the differences between 'Critical Loyalty' and 'Uncritical Loyalty' using a suitable scenario. | 7 | |
| | | (CO1) |
| | | (PO8) |

2. Answer any 4 (four) questions, where 2.(e) is mandatory.

- | | | |
|---|---|-------|
| a) Define the term 'Personal Data.' | 6 | |
| Suppose you went to a coffee shop and paid the bill through your credit card. Do you consider your credit card transaction's printed receipt as personal data? Please note that some of the digits of your credit card number are masked. Show proper reasonings in favor of your answer. | | (CO3) |
| | | (PO6) |
| b) List the major requirements of EU GDPR. | 6 | |
| | | (CO3) |
| | | (PO6) |
| c) Explain the key concepts of PDPA. | 6 | |
| | | (CO3) |
| | | (PO6) |
| d) Identify the significant differences between EU GDPR and PDPA. | 6 | |
| | | (CO3) |
| | | (PO6) |
| e) Describe two recent international incidents of breaching Personal Data. | 7 | |
| | | (CO3) |
| | | (PO6) |

3. a) Explain the necessity of 'Data Anonymization'.

5
(CO3)
(PO6)

b) Compare and contrast the terms 'Anonymization' and 'Pseudonymization'.

5
(CO3)
(PO6)

c) Consider the following dataset presented in Table 1.

3+12
(CO3)
(PO6)

Table 1: Student Information

Student ID	Zip	Age	Gender	Monthly Income of Family	Avg. GPA in Core Courses	Overall CGPA
2018-1-60-001	1215	19	M	75000	3.05	2.95
2017-2-60-101	1816	21	F	70000	3.85	3.90
2018-2-60-002	1500	22	F	40000	2.56	2.43
2017-3-60-130	1313	20	M	100000	3.75	3.65
2018-1-60-002	1805	24	M	90000	2.98	3.13
2016-2-60-096	1310	22	F	55000	3.35	3.50
2017-3-60-002	1312	19	F	120000	3.97	3.99
2017-1-60-007	1315	20	M	110000	3.65	3.67
2018-1-60-054	1216	20	M	85000	3.24	3.40
2017-2-60-012	1805	21	M	45000	2.75	2.85
2016-2-60-081	1380	21	F	30000	3.49	3.45
2018-2-60-062	1505	23	F	75000	2.99	3.01

The university wants to build a correlation between *Avg. GPA in Core Courses* and *Overall CGPA*. Answer the following questions.

- Identify the quasi-identifiers in the dataset mentioned above.
- Apply different data anonymization techniques to create an anonymized dataset. Please remember that you cannot apply the same technique over multiple columns. The answer to this question would be used in Question 4. (b).

4. a) Explain the 'k-anonymity' data privacy model using a suitable example.

5
(CO3)
(PO6)

b) Does your anonymized dataset for the Question 3. (c).ii satisfy the k-anonymity model? If yes, what is the value of k? If not, what changes need to be made in your anonymized dataset? Justify your answer in detail.

10
(CO3)
(PO6)

c) Consider the following release tables presented in Table 2 and Table 3.

6 + 4
(CO3)
(PO6)

Table 2: Release Table 1

Zip	Gender	Test Result
12**	Male	-ve
12**	Male	-ve
13**	Female	+ve
13**	Female	+ve
15**	Human	+ve
15**	Human	+ve

Table 3: Release Table 2

Zip	Gender	Test Result
1215	Human	-ve
1217	Human	-ve
1303	Human	+ve
1307	Human	+ve
1515	Human	+ve
1550	Human	+ve

Discuss an attack model the intruder can use to deanonymize the data. How can you ensure data anonymization against such type of attack?

5. a) Substitution cipher is one of the ancient methods of transforming plain text into ciphertext. Consider the following ciphertext and find the corresponding plain text. Do not consider the punctuations while decoding. Justify your answer. 7
(CO4)
(PO2)

“Xkrgzoboze gvvroky zu vneyoiy, tuz kznoi.” - Grhkxz Kotyzkot.

- b) Suppose Alice wants her friends to encrypt E-mail messages using a public-key encryption system before sending the E-mails to her. Assume that computers represent text as long numbers (01 for ‘A,’ 02 for ‘B’ and so on), so an E-mail message is just a very big number. Alice chooses $p = 17$ and $q = 11$. 3 + 7
(CO4)
(PO1)

Answer the following questions.

- i. Find the public key of Alice. The value of public exponent or e must be between 10 and 15.
 - ii. Compute the private key of Alice based on the chosen public key. Show the detailed computation.
- c) Explain the process of the PGP cryptosystem with appropriate figures. Comment on the significant advantage and disadvantages of PGP Encryption. 4 + 4
(CO4)
(PO2)
6. a) Explain the different types of threats to Information Systems. Comment briefly on the remedies to these threats. 5 + 4
(CO4)
(PO2)
- b) Mention different kinds of Intellectual Property Rights. Suppose someone reveals your trade secret by reverse engineering and market analysis and uses that knowledge for their goods. Can you take appropriate legal measures against that person or organization? Justify your answer and mention any assumptions if necessary. 4 + 4
(CO4)
(PO2)
- c) Creative Commons (CC) License is one of the most popular public licenses. There are four “baseline rights” in CC licenses. What are those rights? 4 + 4
(CO4)
(PO2)
Suppose you have built an application and want to manage its copyright so that the other users can use the system, even they can modify it but cannot use it for any commercial purpose. Which type of CC license would you use?

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

Math 4441: Probability and Statistics

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Figures in the right margin indicate full marks of the question whereas the contents within brackets in the right margin represent COs and POs.

If you think required data are not available for any questions, then assume relevant values.

1. a) An urn contains 3 red balls, 2 green balls and 5 black balls. Suppose 5 balls are picked from the urn without replacement. Find the probability that exactly 1 red ball, 1 green ball and 3 black balls are picked. 6
(CO2)
(PO2)
- b) Dr. Shams has 23 hypertensive patients, of whom five do not use any medicine but try to lower their blood pressures by self-help: dieting, exercise, not smoking, relaxation, and so on. Of the remaining 18 patients, 10 use beta blockers and 8 use diuretics. A random sample of seven of all these patients is selected. Let X , Y , and Z be the number of the patients in the sample trying to lower their blood pressures by self-help, beta blockers, and diuretics, respectively. 6
(CO2)
(PO2)
- Find the joint probability mass function of X , Y , and Z .
- c) The three-dimensional random vector $\mathbf{X} = [X_1 \ X_2 \ X_3]^T$ has the following PDF 8 + 5
(CO1)
(PO1)

$$f_{\mathbf{X}}(\mathbf{x}) = \begin{cases} 6, & 0 \leq x_1 \leq x_2 \leq x_3 \leq 1, \\ 0, & \text{otherwise} \end{cases}$$
 - i. Find the expected value vector $E[\mathbf{X}]$
 - ii. Find the correlation matrix $\mathbf{R}_{\mathbf{X}}$.
2. a) Suppose you randomly pick an integer from 1 to 3, with the three possibilities being equally likely. Call this integer N . You then randomly pick an integer from N to 3, with the $(4 - N)$ possibilities being equally likely. Call this second integer M . Find the PMF of M . Also, find $P[M = 3]$. 8
(CO1)
(PO1)
- b) A coin that comes up heads with probability p is continuously flipped until the pattern T, T, H appears. That is you stop flipping when the most recent flip lands head, and the two immediately preceding it lands tails. Let X denote the number of flips made, find $E[X]$. 10
(CO2)
(PO2)
- c) The random variable X has a range of $\{0, 1, 2\}$ and the random variable Y has a range of $\{1, 2\}$. The joint PMF of X and Y are given by 7
(CO1)
(PO1)

x	y	$P[X = x, Y = y]$
0	1	0.2
0	2	0.1
1	1	0.0
1	2	0.2
2	1	0.3
2	2	0.2

Find whether X and Y are independent or not.

3. a) A type of golf ball is tested, by dropping it onto a hard surface from a height of 1 metre. The height it bounces is known to be normally distributed with a standard deviation of 3.6 cm. If a sample of 9
(CO3)
(PO4)

100 balls are tested and the mean height of the bounces is 82 cm, find a 90% confidence interval for the mean of the bounce of the golf ball.

- b) A major department store chain is interested in estimating the average amount, its credit card users spent on their first visit to the chain's new store. Fifteen credit cards were randomly sampled and analyzed to show a mean of \$50.50 and variance of 400. Construct a 95% confidence interval for the average amount its credit card users spent on their first visit to the chain's new store assuming that the amount spent follows a normal distribution. (CO3) (PO4) 9
- c) An unfair coin with an unknown probability θ of coming up heads is flipped 10 times, and the results are *TTTTT THTTH*. Find the maximum likelihood estimate for θ . (CO1) (PO1) 7
4. a) Suppose the firm, "Web Associates," builds advertising websites for client companies. The firm claims that the average number of hits or visits per day that their website gets by potential customers is around 550. Suspecting the company is exaggerating, you test this claim by compiling data on the number of hits in a day for a sample of 36 websites developed by Web Associates. You calculate a sample mean of 500 hits and a sample standard deviation of 120.5. Consider the following null and alternative hypotheses:
 $H_0: \mu = 550$
 $H_1: \mu \neq 550$
 i. Find the value of the test statistic and conclude the result of the hypothesis testing at a 5% significance level.
 ii. Find the p-value of the test and interpret the result based on the p-value. (CO3) (PO4) 8 + 7
- b) The value received at a certain message receiving station is equal to the value sent plus a random error that is normal, with mean 0 and standard deviation 2. Two messages, each consisting of a single value, are to be sent. Because of the random error, each message will be sent 9 times. Suppose we are interested in testing the hypothesis that there is no appreciable difference in the mean values of the first and the second messages.
 Should the hypothesis be rejected if the average of the values relating to the first message is 5.6 whereas the average of those relating to the second message is 4.1 at a 1% significance level? What is the p-value? (CO3) (PO4) 10
5. a) Three players *A*, *B*, and *C* play a series of games; none of which can be drawn and the probabilities of winning any game by the players are equal. The winner of each game scores 1 point and the series is won by the player who first scores 4 points. Out of the first three games, *A* won 2 games and *B* won 1 game. Find the probability that *C* will win the series. (CO2) (PO2) 10
- b) The coefficients of the equation $ax^2 + bx + c = 0$ are determined by throwing a four-sided fair die. Find the probability that the equation will have real roots. (CO2) (PO2) 8
 Note: a quadratic equation has real roots if the discriminant is greater than or equal to zero.
- c) A professor pays 25 cents for each blackboard error made in the lecture to the student who points out the error. In a career of n years filled with blackboard errors, the total amount in dollars paid by the professor can be approximated by a Gaussian random variable Y_n with expected value $40n$ and variance $100n$. Find the probability that Y_{20} is greater than 1000. (CO1) (PO1) 7
6. a) A child is lost at Fantasy Kingdom in Dhaka. The father of the child believes that the probability of his being lost in the east side of the Fantasy Kingdom is 0.75 and in the west side is 0.25. The security department sends three officers to the east side and two to the west to look for the child. Suppose that an officer who is looking in the correct side (east or west) finds the child, independently of the others, with probability 0.4.
 i. Find the probability that the child is found.
 ii. If the child is found, find the probability that he is found in the east side. (CO2) (PO2) 7 + 8
- b) Given that X has the following moment-generating function

$$M_X(t) = \frac{1}{6}e^{-2t} + \frac{1}{3}e^{-t} + \frac{1}{4}e^t + \frac{1}{4}e^{2t}.$$
 Find $P[X \leq 1]$ from the PMF of X . (CO1) (PO1) 10

Appendix A: PMF/PDF and the expected values of some Random Variables

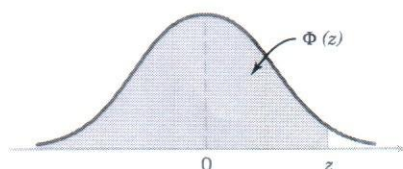
Distribution	PMF/PDF	Expected value	Variance
Bernoulli	$P_X(x) = \begin{cases} 1-p & x=0 \\ p & x=1 \\ 0 & \text{otherwise} \end{cases}$	$E[X] = p$	$Var[X] = p(1-p)$
Geometric	$P_X(x) = \begin{cases} p(1-p)^{x-1} & x \geq 1 \\ 0 & \text{otherwise} \end{cases}$	$E[X] = 1/p$	$Var[X] = (1-p)/p^2$
Binomial	$P_X(x) = \begin{cases} \binom{n}{x} p^x (1-p)^{n-x} & x = 1, \dots, n \\ 0 & \text{otherwise} \end{cases}$	$E[X] = np$	$Var[X] = np(1-p)$
Pascal	$P_X(x) = \begin{cases} \binom{x-1}{k-1} p^k (1-p)^{x-k} & x = k, k+1, \dots \\ 0 & \text{otherwise} \end{cases}$	$E[X] = k/p$	$Var[X] = k(1-p)/p^2$
Poisson	$P_X(x) = \begin{cases} \frac{(\lambda T)^x e^{-(\lambda T)}}{x!} & x \geq 0 \\ 0 & \text{otherwise} \end{cases}$	$E[X] = \alpha$ $\alpha = \lambda T$	$Var[X] = \alpha$
Uniform (discrete)	$P_X(x) = \begin{cases} \frac{1}{b-a+1}, & x = a, a+1, a+2, \dots, b \\ 0, & \text{otherwise} \end{cases}$	$E[X] = \frac{a+b}{2}$	$Var[X] = \frac{(b-a)(b-a+2)}{12}$
Exponential	$f_X(x) = \begin{cases} ae^{-ax} & x \geq 0 \\ 0 & \text{otherwise} \end{cases}$	$E[X] = 1/a$	$Var[X] = 1/a^2$
Gaussian	$f_X(x) = \begin{cases} \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}} & \sigma > 0 \\ 0 & \text{otherwise} \end{cases}$	$E[X] = \mu$	$Var[X] = \sigma^2$
Uniform (Continuous)	$f_X(x) = \begin{cases} \frac{1}{b-a}, & a \leq x < b \\ 0, & \text{otherwise} \end{cases}$	$E[X] = \frac{a+b}{2}$	$Var[X] = \frac{(b-a)^2}{12}$

Appendix B: Necessary formulas

Sample variance	$s^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}$
Sample mean	$\bar{x} = \frac{\sum_{i=1}^n X_i}{n}$
Variance	$Var[X] = E[(X - \mu)^2] = E[X^2] - (E[X])^2$
Standardization of Normal Random Variable	$Z = \frac{X - \mu}{\sigma}$
Joint distribution of \bar{X} and S^2	$(n-1) \frac{S^2}{\sigma^2} \sim \chi^2_{n-1}$
Distribution of \bar{X} with unknown σ^2	$\sqrt{n} \frac{(\bar{X} - \mu)}{S} \sim t_{n-1}$
Joint PDF of X and Y	$f_{XY}(x, y) = f_{X|Y}(x|y) f_Y(y)$
Joint PMF of X and Y	$P_{XY}(x, y) = P_{X|Y}(x|y) P_Y(y)$

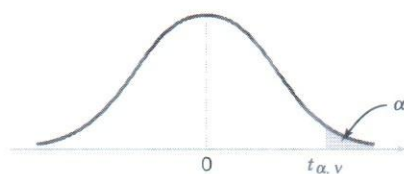
100(1 - α)% confidence intervals	$X_1, \dots, X_n \sim \mathcal{N}(\mu, \sigma^2) \quad \bar{X} = \sum_{i=1}^n X_i/n, \quad S = \sqrt{\sum_{i=1}^n (X_i - \bar{X})^2/(n-1)}$				
	Assumption	Parameter	Confidence Interval	Lower Interval	Upper Interval
	σ^2 known	μ	$\bar{X} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$	$(-\infty, \bar{X} + z_{\alpha} \frac{\sigma}{\sqrt{n}})$	$(\bar{X} + z_{\alpha} \frac{\sigma}{\sqrt{n}}, \infty)$
	σ^2 unknown	μ	$\bar{X} \pm t_{\alpha/2, n-1} \frac{S}{\sqrt{n}}$	$(-\infty, \bar{X} + t_{\alpha, n-1} \frac{S}{\sqrt{n}})$	$(\bar{X} + t_{\alpha, n-1} \frac{S}{\sqrt{n}}, \infty)$
	μ unknown	σ^2	$(\frac{(n-1)S^2}{\chi^2_{\alpha/2, n-1}}, \frac{(n-1)S^2}{\chi^2_{1-\alpha/2, n-1}})$	$(0, \frac{(n-1)S^2}{\chi^2_{1-\alpha, n-1}})$	$(\frac{(n-1)S^2}{\chi^2_{\alpha, n-1}}, \infty)$
100(1 - α)% confidence intervals for $\mu_1 - \mu_2$	$X_1, \dots, X_n \sim \mathcal{N}(\mu_1, \sigma_1^2)$ $Y_1, \dots, Y_m \sim \mathcal{N}(\mu_2, \sigma_2^2)$ $\bar{X} = \sum_{i=1}^n X_i/n, \quad S_1^2 = \sum_{i=1}^n (X_i - \bar{X})^2/(n-1)$ $\bar{Y} = \sum_{i=1}^m Y_i/n, \quad S_2^2 = \sum_{i=1}^m (Y_i - \bar{Y})^2/(m-1).$				
	Assumption		Confidence Interval		
	σ_1, σ_2 known		$\bar{X} - \bar{Y} \pm z_{\alpha/2} \sqrt{\sigma_1^2/n + \sigma_2^2/m}$		
	σ_1, σ_2 unknown but equal		$\bar{X} - \bar{Y} \pm t_{\alpha/2, n+m-2} \sqrt{(\frac{1}{n} + \frac{1}{m}) \frac{(n-1)S_1^2 + (m-1)S_2^2}{n+m-2}}$		
	Assumption		Lower Confidence Interval		
	σ_1, σ_2 known		$(-\infty, \bar{X} - \bar{Y} + z_{\alpha} \sqrt{\sigma_1^2/n + \sigma_2^2/m})$		
	σ_1, σ_2 unknown but equal		$(-\infty, \bar{X} - \bar{Y} + t_{\alpha, n+m-2} \sqrt{(\frac{1}{n} + \frac{1}{m}) \frac{(n-1)S_1^2 + (m-1)S_2^2}{n+m-2}})$		
Test statistics	H_0	H_1	Test Statistic TS	Significance Level α Test	p-Value if TS = t
	$\mu = \mu_0$	$\mu \neq \mu_0$	$\sqrt{n}(\bar{X} - \mu_0)/\sigma$	Reject if |TS| > $z_{\alpha/2}$	$2P\{Z \geq |t|\}$
	$\mu \leq \mu_0$	$\mu > \mu_0$	$\sqrt{n}(\bar{X} - \mu_0)/\sigma$	Reject if TS > z_{α}	$P\{Z \geq t\}$
	$\mu \geq \mu_0$	$\mu < \mu_0$	$\sqrt{n}(\bar{X} - \mu_0)/\sigma$	Reject if TS < $-z_{\alpha}$	$P\{Z \leq t\}$
	Z is a standard normal random variable.				
	H_0	H_1	Test Statistic TS	Significance Level α Test	p-Value if TS = t
	$\mu = \mu_0$	$\mu \neq \mu_0$	$\sqrt{n}(\bar{X} - \mu_0)/S$	Reject if |TS| > $t_{\alpha/2, n-1}$	$2P\{T_{n-1} \geq |t|\}$
	$\mu \leq \mu_0$	$\mu > \mu_0$	$\sqrt{n}(\bar{X} - \mu_0)/S$	Reject if TS > $t_{\alpha, n-1}$	$P\{T_{n-1} \geq t\}$
	$\mu \geq \mu_0$	$\mu < \mu_0$	$\sqrt{n}(\bar{X} - \mu_0)/S$	Reject if TS < $-t_{\alpha, n-1}$	$P\{T_{n-1} \leq t\}$
	T_{n-1} is a t-random variable with n - 1 degrees of freedom: $P\{T_{n-1} > t_{\alpha, n-1}\} = \alpha$.				
$H_0: \mu_1 = \mu_2$ versus $H_0: \mu_1 \neq \mu_2$.					
Assumption	Test Statistic TS		Significance Level α Test	p-Value if TS = t	
σ_1, σ_2 known	$\frac{\bar{X} - \bar{Y}}{\sqrt{\sigma_1^2/n + \sigma_2^2/m}}$		Reject if |TS| > $z_{\alpha/2}$	$2P\{Z \geq |t|\}$	
$\sigma_1 = \sigma_2$	$\frac{\bar{X} - \bar{Y}}{\sqrt{\frac{(n-1)S_1^2 + (m-1)S_2^2}{n+m-2} \cdot \frac{1}{n} + \frac{1}{m}}}$		Reject if |TS| > $t_{\alpha/2, n+m-2}$	$2P\{T_{n+m-2} \geq |t|\}$	
n, m large	$\frac{\bar{X} - \bar{Y}}{\sqrt{S_1^2/n + S_2^2/m}}$		Reject if |TS| > $z_{\alpha/2}$	$2P\{Z \geq |t|\}$	

$$\Phi(z) = P(Z \leq z) = \int_{-\infty}^z \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}u^2} du$$



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.500000	0.503989	0.507978	0.511967	0.515953	0.519939	0.523922	0.527903	0.531881	0.535856
0.1	0.539828	0.543795	0.547758	0.551717	0.555760	0.559618	0.563559	0.567495	0.571424	0.575345
0.2	0.579260	0.583166	0.587064	0.590954	0.594835	0.598706	0.602568	0.606420	0.610261	0.614092
0.3	0.617911	0.621719	0.625516	0.629300	0.633072	0.636831	0.640576	0.644309	0.648027	0.651732
0.4	0.655422	0.659097	0.662757	0.666402	0.670031	0.673645	0.677242	0.680822	0.684386	0.687933
0.5	0.691462	0.694974	0.698468	0.701944	0.705401	0.708840	0.712260	0.715661	0.719043	0.722405
0.6	0.725747	0.729069	0.732371	0.735653	0.738914	0.742154	0.745373	0.748571	0.751748	0.754903
0.7	0.758036	0.761148	0.764238	0.767305	0.770350	0.773373	0.776373	0.779350	0.782305	0.785236
0.8	0.788145	0.791030	0.793892	0.796731	0.799546	0.802338	0.805106	0.807850	0.810570	0.813267
0.9	0.815940	0.818589	0.821214	0.823815	0.826391	0.828944	0.831472	0.833977	0.836457	0.838913
1.0	0.841345	0.843752	0.846136	0.848495	0.850830	0.853141	0.855428	0.857690	0.859929	0.862143
1.1	0.864334	0.866500	0.868643	0.870762	0.872857	0.874928	0.876976	0.878999	0.881000	0.882977
1.2	0.884930	0.886860	0.888767	0.890651	0.892512	0.894350	0.896165	0.897958	0.899727	0.901475
1.3	0.903199	0.904902	0.906582	0.908241	0.909877	0.911492	0.913085	0.914657	0.916207	0.917736
1.4	0.919243	0.920730	0.922196	0.923641	0.925066	0.926471	0.927855	0.929219	0.930563	0.931888
1.5	0.933193	0.934478	0.935744	0.936992	0.938220	0.939429	0.940620	0.941792	0.942947	0.944083
1.6	0.945201	0.946301	0.947384	0.948449	0.949497	0.950529	0.951543	0.952540	0.953521	0.954486
1.7	0.955435	0.956367	0.957284	0.958185	0.959071	0.959941	0.960796	0.961636	0.962462	0.963273
1.8	0.964070	0.964852	0.965621	0.966375	0.967116	0.967843	0.968557	0.969258	0.969946	0.970621
1.9	0.971283	0.971933	0.972571	0.973197	0.973810	0.974412	0.975002	0.975581	0.976148	0.976705
2.0	0.977250	0.977784	0.978308	0.978822	0.979325	0.979818	0.980301	0.980774	0.981237	0.981691
2.1	0.982136	0.982571	0.982997	0.983414	0.983823	0.984222	0.984614	0.984997	0.985371	0.985738
2.2	0.986097	0.986447	0.986791	0.987126	0.987455	0.987776	0.988089	0.988396	0.988696	0.988989
2.3	0.989276	0.989556	0.989830	0.990097	0.990358	0.990613	0.990863	0.991106	0.991344	0.991576
2.4	0.991802	0.992024	0.992240	0.992451	0.992656	0.992857	0.993053	0.993244	0.993431	0.993613
2.5	0.993790	0.993963	0.994132	0.994297	0.994457	0.994614	0.994766	0.994915	0.995060	0.995201
2.6	0.995339	0.995473	0.995604	0.995731	0.995855	0.995975	0.996093	0.996207	0.996319	0.996427
2.7	0.996533	0.996636	0.996736	0.996833	0.996928	0.997020	0.997110	0.997197	0.997282	0.997365
2.8	0.997445	0.997523	0.997599	0.997673	0.997744	0.997814	0.997882	0.997948	0.998012	0.998074
2.9	0.998134	0.998193	0.998250	0.998305	0.998359	0.998411	0.998462	0.998511	0.998559	0.998605
3.0	0.998650	0.998694	0.998736	0.998777	0.998817	0.998856	0.998893	0.998930	0.998965	0.998999
3.1	0.999032	0.999065	0.999096	0.999126	0.999155	0.999184	0.999211	0.999238	0.999264	0.999289
3.2	0.999313	0.999336	0.999359	0.999381	0.999402	0.999423	0.999443	0.999462	0.999481	0.999499
3.3	0.999517	0.999533	0.999550	0.999566	0.999581	0.999596	0.999610	0.999624	0.999638	0.999650
3.4	0.999663	0.999675	0.999687	0.999698	0.999709	0.999720	0.999730	0.999740	0.999749	0.999758
3.5	0.999767	0.999776	0.999784	0.999792	0.999800	0.999807	0.999815	0.999821	0.999828	0.999835
3.6	0.999841	0.999847	0.999853	0.999858	0.999864	0.999869	0.999874	0.999879	0.999883	0.999888
3.7	0.999892	0.999896	0.999900	0.999904	0.999908	0.999912	0.999915	0.999918	0.999922	0.999925
3.8	0.999928	0.999931	0.999933	0.999936	0.999938	0.999941	0.999943	0.999946	0.999948	0.999950
3.9	0.999952	0.999954	0.999956	0.999958	0.999959	0.999961	0.999963	0.999964	0.999966	0.999967

Appendix D: Percentage Points of the t-distribution

Percentage Points $t_{\alpha, \nu}$ of the t-Distribution

$\nu \backslash \alpha$	.40	.25	.10	.05	.025	.01	.005	.0025	.001	.0005
1	.325	1.000	3.078	6.314	12.706	31.821	63.657	127.32	318.31	636.62
2	.289	.816	1.886	2.920	4.303	6.965	9.925	14.089	23.326	31.598
3	.277	.765	1.638	2.353	3.182	4.541	5.841	7.453	10.213	12.924
4	.271	.741	1.533	2.132	2.776	3.747	4.604	5.598	7.173	8.610
5	.267	.727	1.476	2.015	2.571	3.365	4.032	4.773	5.893	6.869
6	.265	.718	1.440	1.943	2.447	3.143	3.707	4.317	5.208	5.959
7	.263	.711	1.415	1.895	2.365	2.998	3.499	4.029	4.785	5.408
8	.262	.706	1.397	1.860	2.306	2.896	3.355	3.833	4.501	5.041
9	.261	.703	1.383	1.833	2.262	2.821	3.250	3.690	4.297	4.781
10	.260	.700	1.372	1.812	2.228	2.764	3.169	3.581	4.144	4.587
11	.260	.697	1.363	1.796	2.201	2.718	3.106	3.497	4.025	4.437
12	.259	.695	1.356	1.782	2.179	2.681	3.055	3.428	3.930	4.318
13	.259	.694	1.350	1.771	2.160	2.650	3.012	3.372	3.852	4.221
14	.258	.692	1.345	1.761	2.145	2.624	2.977	3.326	3.787	4.140
15	.258	.691	1.341	1.753	2.131	2.602	2.947	3.286	3.733	4.073
16	.258	.690	1.337	1.746	2.120	2.583	2.921	3.252	3.686	4.015
17	.257	.689	1.333	1.740	2.110	2.567	2.898	3.222	3.646	3.965
18	.257	.688	1.330	1.734	2.101	2.552	2.878	3.197	3.610	3.922
19	.257	.688	1.328	1.729	2.093	2.539	2.861	3.174	3.579	3.883
20	.257	.687	1.325	1.725	2.086	2.528	2.845	3.153	3.552	3.850
21	.257	.686	1.323	1.721	2.080	2.518	2.831	3.135	3.527	3.819
22	.256	.686	1.321	1.717	2.074	2.508	2.819	3.119	3.505	3.792
23	.256	.685	1.319	1.714	2.069	2.500	2.807	3.104	3.485	3.767
24	.256	.685	1.318	1.711	2.064	2.492	2.797	3.091	3.467	3.745
25	.256	.684	1.316	1.708	2.060	2.485	2.787	3.078	3.450	3.725
26	.256	.684	1.315	1.706	2.056	2.479	2.779	3.067	3.435	3.707
27	.256	.684	1.314	1.703	2.052	2.473	2.771	3.057	3.421	3.690
28	.256	.683	1.313	1.701	2.048	2.467	2.763	3.047	3.408	3.674
29	.256	.683	1.311	1.699	2.045	2.462	2.756	3.038	3.396	3.659
30	.256	.683	1.310	1.697	2.042	2.457	2.750	3.030	3.385	3.646
40	.255	.681	1.303	1.684	2.021	2.423	2.704	2.971	3.307	3.551
60	.254	.679	1.296	1.671	2.000	2.390	2.660	2.915	3.232	3.460
120	.254	.677	1.289	1.658	1.980	2.358	2.617	2.860	3.160	3.373
∞	.253	.674	1.282	1.645	1.960	2.326	2.576	2.807	3.090	3.291

 ν = degrees of freedom.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION
DURATION: 3 HOURS

SUMMER SEMESTER, 2020-2021
FULL MARKS: 150

CSE 4461: Computer Science and Technology II

Programmable calculators are not allowed. Do not write anything on the question paper.
 Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. Consider the following schema for a relational database, where the primary keys are underlined:

person (driver_id, name, address)

car (license_plate, model, year)

accident (report_number, year, location)

owns (driver_id, license_plate)

participated (report_number, license_plate, driver_id, damage_amount)

- | | |
|--|--|
| <p>a) Write DDL statements to create <i>person</i> and <i>accident</i> tables. While writing the DDL statements, include the integrity constraints and references.</p> | <p>4
(CO2)
(PO1)
3 x 7</p> |
| <p>b) Suppose, all the tables have already been created with proper constraints and references. Now, write SQL statements to perform the following operations:</p> <ol style="list-style-type: none"> i. Find the total number of accidents that happened in "Dhaka" in 2020. ii. Find the total number of people who owned cars that were involved in accidents in 2021. iii. Delete all year-2018 cars belonging to the person whose ID is '12345'. iv. Find the number of accidents involving a car belonging to a person named "MH Hasan". v. Find the model of the car that belongs to a person named "MH Hasan". vi. Update the damage amount for the car with license plate "AABB2000" in the accident with report number "AR2197" to 3000 BDT. vii. Find the name and address of the person who is involved in an accident with highest damage. | <p>(CO2)
(PO1)</p> |
| <p>2. a) Draw an E-R diagram of a database for an airline. The database must keep track of customers and their reservations, flights and their status, seat assignments on individual flights, and the schedule and routing of future flights. You can include all the necessary attributes that you think are relevant.</p> | <p>15
(CO3)
(PO1)</p> |
| <p>b) Convert the E-R diagram that you have designed in 2(a) into a set of relations with proper justifications. Identify the appropriate primary key for each relation.</p> | <p>10
(CO4)
(PO1)</p> |
| <p>3. a) Explain the distinctions among the terms primary key, candidate key, and superkey.</p> | <p>5
(CO1)
(PO1)
5 x 3</p> |
| <p>b) With examples, explain the differences between the following:</p> <ol style="list-style-type: none"> i. Weak and Strong entity. ii. Disjoint constraints and Overlapping constraints. iii. Total constraints and Partial constraints. | <p>(CO2)
(PO1)</p> |

- c) Explain the mapping cardinality constraints with examples.

5
(CO2)
(PO1)

4. Consider the following set F of functional dependencies on the relation schema R (A, B, C, D, E, G):

$A \rightarrow BCD$
 $BC \rightarrow DE$
 $B \rightarrow D$
 $D \rightarrow A$

- a) Identify all candidate keys for R.

6
(CO5)
(PO1)

- b) Write down the Armstrong's axioms and the additional rules that can be inferred from the Armstrong's rule for functional dependency.

6
(CO5)
(PO1)

- c) Compute a canonical cover for this set of functional dependencies F; give each step of your derivation with an explanation.

6
(CO5)
(PO1)

- d) Is the relation R in BCNF? Justify your answer explaining the rules of being in BCNF. If your answer is no, decompose the relation in BCNF, showing your decomposition steps.

7
(CO5)
(PO1)

5. a) Let T_1 transfer 10% of the balance from A to B and T_2 transfer \$75 from A to B. Now write a serial schedule for these two transactions.

4
(CO6)
(PO1)

- b) Explain the transaction states with a diagram.

4
(CO6)
(PO2)

- c) Compare the conflict serializability and view serializability with proper explanation.

7
(CO6)
(PO2)

- d) Is the schedule S shown in Table 1 conflict serializable and view serializable? Explain your answer with the rules of serializability.

10
(CO6)
(PO1)

Table 1: Schedule S for Question 5 (d)

T_1	T_2	T_3
read(A)	write(A)	
write(A)		
		write(A)

6. a) Consider constructing a B+ tree with order 4 (i.e., $n = 4$, each index node can have n keys and $n+1$ pointers). Show the resulting tree step by step after inserting keys in this order: 1, 4, 7, 10, 17, 21, 31, 25, 19, 20, 28, 42.

15
(CO6)
(PO1)

- b) From the tree constructed in 6(a), show the resulting tree step-by-step after deleting keys in this order: 10, 31, 21, 4, 20.

10
(CO6)
(PO1)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 100

CSE 4615: Wireless Networks

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) How are the *Mobile Ad Hoc Networks (MANET)* different from *Cellular Networks*? 3.5
(CO1)
(PO2)
- b) Consider an *Independent Basic Service Set (IBSS)* of **IEEE 802.11e** wireless LAN (WLAN) consists of three stations (*A, B, and C*). Assume that all the stations operate in same frequency band and they can all hear each other transmissions. Consider the *RTS/CTS* transmission is enabled in this scenario. 14.5
(CO3)
(PO1)

Each of the stations of this WLAN maintains two *Access Categories (AC)* labeled as *AC_HP* and *AC_LP* and thus two backoff entities exist in every IEEE 802.11e compliant stations. Note here that, the *AC_HP* and *AC_LP* serve the high priority traffic and low priority traffic of the network.

Draw a *Timeline Diagram* representing the sequence of actions for a successful retransmission from *AC_HP* of the Station A to Station B after one data packet collision. Note that the x-axis of the diagram shows time and y-axis shows the contending stations in *IBSS*. An action (i.e., transmission of a frame) is represented by a horizontal line where the line is placed in the same horizontal line of the station with line length representing period.

The diagram should depict the detailed backoff procedure performed by all the stations in the *IBSS*. Minimum *Contention Window (CW)* values for two *Access Categories* are listed in Table 1. *Arbitration Interframe Space AIFS[AC]* for two *AC* are listed in Table 2.

The size of the *CW* in backoff stage *i*, after *i-1* times unsuccessful transmission is determined by the following formula.

$$CW_i[AC] = \min[2^i(CW_{\min}[AC] + 1) - 1, CW_{\max}[AC]]$$

Table 1: Minimum Contention Window Values

Item	Value
$CW_{\min}[AC_HP]$	3
$CW_{\min}[AC_LP]$	5

Table 2: Arbitration Interframe Space values

Item	Value
$AIFS[AC_HP]$	$SIFS + 2 * a \text{ Slot Time}$
$AIFS[AC_LP]$	$SIFS + 3 * a \text{ Slot Time}$

2. a) What is meant by *Routing Metric*? 2 (CO3)
(PO1)
- b) Consider an application that transmits data at a steady rate (for example, the sender generates an N -bit unit of data every k time units, where k is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. 4.5
(CO1)
(PO2)
- c) Find the path that minimizes the *Expected Transmission Time* from **node A** to **node F** in the given network topology depicted in Figure 1. Assume the default packet size in the given network is 2 MB. Table 3 contains the values of different link parameters. 10
(CO3)
(PO1)

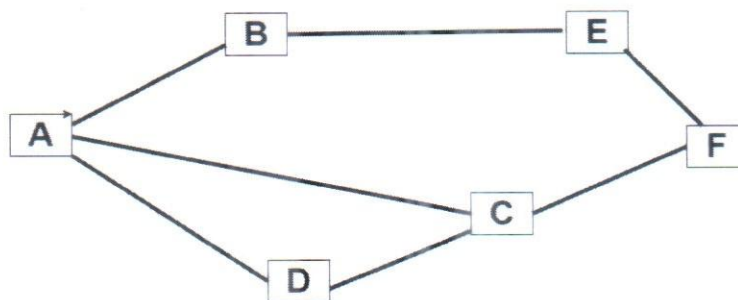


Figure 1: Network topology for question

Table 3: Network parameters for question 2.c

Link	Forward Delivery Ratio, R_{fwd}	Reverse Delivery Ratio, R_{rev}	Link Bandwidth, B MB/S
A—B	0.85	0.92	40
A—C	0.70	0.93	42
A—D	0.92	0.87	38
B—E	0.76	0.73	30
C—F	0.88	0.90	34
D—C	0.77	0.87	36
E—F	0.88	0.66	44

3. a) Why is the *post backoff* used in *Distributed Coordination Function (DCF)* of the IEEE 802.11 standard? 2.5
(CO3)
(PO1)
- b) Clarify the fundamental concept of wastage aware routing in *Energy Harvesting Wireless Sensor Networks (EH-WSNs)*. 3.5
(CO2)
(PO1)
- c) Consider the sample topology for an *EH-WSN* shown in Fig. 1. Find the path that **maximizes** the **total residual network energy** for traffic generated from *node A* and destined for *node F*. Table 4 and Table 5 contain the values of different network parameters. Assume, B is the maximum battery capacity of any node and ΔT is the future period to predict the harvest and consumption. 11
(CO3)
(PO1)

Table 4: Nodal energy parameters for question 3. c

<i>Node</i>	<i>Current Battery Level, E_p</i>	<i>Estimated Energy Harvest after ΔT, E_h</i>
A	0.90 <i>B</i>	0.15 <i>B</i>
B	0.93 <i>B</i>	0.17 <i>B</i>
C	0.77 <i>B</i>	0.21 <i>B</i>
D	0.92 <i>B</i>	0.12 <i>B</i>
E	0.89 <i>B</i>	0.20 <i>B</i>
F	0.77 <i>B</i>	0.18 <i>B</i>

Table 5: Link parameters for question 3.c

<i>Link</i>	<i>Predicted Consumption over ΔT, E_c</i>
A—B	0.06 <i>B</i>
A—C	0.11 <i>B</i>
A—D	0.14 <i>B</i>
B—E	0.15 <i>B</i>
C—F	0.11 <i>B</i>
D—C	0.08 <i>B</i>
E—F	0.09 <i>B</i>

4. a) Explain the necessity of Internet Standards. 2 (CO3)
(PO1)
- b) *Wi-Fi MultiMedia (WMM) ad hoc network* needs to maintain the priority of audio, video, and voice over other applications which are less time critical. Hence, for QoS support mechanisms in such networks, random access based *Distributed Coordination Function at Medium Access Control (MAC)* sublayer requires modifications. 3
(CO2)
(PO2)
- Mention the appropriate IEEE MAC standard as a supplement to the IEEE 802.11 standard which will support quality-of-service (QoS) in the given scenario. Justify your answer with proper arguments.
- c) With the aid of a single diagram clarify the following terminologies in wireless medium. 5
(CO3)
(PO1)
- Transmission Range
 - Detection Range
 - Interference Range
 - Signal to Noise Ratio (SNR)
- d) Consider a packet of length L which begins at end system A and travels over three links to a destination end system. These three links are connected by two packet switches. Let d_i , s_i , and R_i denote the length, propagation speed, and the transmission rate of link i , for $i = 1, 2, 3$. The packet switch delays each packet by d proc. Assuming no queuing delays, in terms of d_i , s_i , R_i , ($i = 1, 2, 3$), and L , formulate the necessary equations to calculate the total **end-to-end delay** for the packet? 7
(CO3)
(PO1)
- Suppose, the packet is 1,500 bytes, the propagation speed on all three links is 2.5×10^8 m/s, the transmission rates of all three links are 2 Mbps, the packet switch processing delay is 3 msec, the length of the first link is 5,000 km, the length of the second link is 4,000 km, and the length of the last link is 1,000 km. For these values, calculate the **end-to-end delay**.

5. a) With the aid of an appropriate diagram clarify the fundamental idea of Sensor MAC (S-MAC) protocol in extending the node life time in battery powered Wireless Sensor Networks (WSNs). 4 (CO3)
(PO1)
- b) Consider a wireless local area network (WLAN) consists of a large number of mobile nodes with fixed infrastructure. Nodes are free to move randomly as the network topology changes frequently.
The MAC sublayer does not exhibit good channel utilization and collision avoidance in such networks while Random Channel-Access Scheme is being used without any modification.
- i. Now propose few modifications in Random Channel-Access Scheme to ensure better channel utilization and collision avoidance mechanism in such scenarios. 3 (CO4)
(PO3)
- ii. Why does the proposed solution perform better in such scenarios? Justify the claim with proper arguments. 3 (CO1)
(PO2)
- iii. Draw a *Timeline Diagram* representing the sequence of actions for two successful transmission and two unsuccessful transmissions. 7
(CO3)
(PO1)

The diagram should depict the detailed backoff procedure performed by all the contending nodes. Note that, the x-axis of the diagram shows time and y-axis shows the contending stations in *WLAN*. An action (i.e., transmission of a frame) is represented by a horizontal line where the line is placed in the same horizontal line of the station with line length representing period.

6. a) A *Vehicular Ad-hoc Network (VANET)* consists of groups of moving or stationary vehicles connected by a wireless network. VANET allows vehicles to communicate with the roadside equipment. Propose two promising VANET applications for developing countries. 4.5
(CO1)
(PO2)
- b) Consider a High data Rate Wireless Personal Area Networks (HR-WPANs) consists of fixed number of static nodes, which is used for short-range indoor and outdoor multimedia and data centric applications.
All the nodes in this network maintain synchronized clock through some synchronization function.
- i. Propose one *distributed TDMA scheduling based medium access control protocol* from the state-of-the-art protocols which will be well-suited for the given network. Justify your answer with proper arguments. 2
(CO2)
(PO2)
- ii. With the aid of a *Timeline Diagram*, clarify the schedule preparation phase of the proposed protocol. 6
(CO3)
(PO1)
- iii. Draw a *Timeline Diagram* to demonstrate the data transmission phase of the proposed protocol. 2
(CO3)
(PO1)

Note that the x-axis of each Timeline Diagram shows time and y-axis shows the contending stations in HR-WPANs. An action (i.e., transmission of a frame) is represented by a horizontal line where the line is placed in the same horizontal line of the station with line length representing period.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4619: Peripherals and Interfacing

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

-
- | | | |
|-------|--|----------------------|
| 1. a) | What is an Embedded System? How does it differ from typical Computer Systems? | 10
(CO1)
(PO1) |
| b) | What is Daisy-Chain Arbitration? Write its pros and cons. | 8
(CO1)
(PO1) |
| c) | In order to connect a Dot-Matrix Display with an 8086 Microprocessor system, how can you interface using a single 8255 PPI? Draw the interfacing diagram. | 7
(CO4)
(PO2) |
| 2. a) | What is meant by priority resolving for handling multiple interrupts? Which PIC is best suited with 8086 microprocessor? And why? | 10
(CO2)
(PO2) |
| b) | How can 8259 PIC handle 64 Interrupt levels? Explain with necessary diagram. | 8
(CO2)
(PO1) |
| c) | Draw the control word format for the 8255A PPI when Port-A is connected with a 7-Segment display and other ports are also in output mode. | 7
(CO4)
(PO1) |
| 3. a) | Describe DMA and its signals. Draw the diagram for logical pins and internal registers of the 8237 DMA controller. | 10
(CO2)
(PO2) |
| b) | “Memory-Read & I/O Write and I/O Read & Memory-Write signals are used simultaneously for DMA operation” – Explain. | 8
(CO2)
(PO2) |
| c) | Explain the use of Q1 and Q2 pins of 74HC373 latch while connecting it with an 8255 PPI. | 7
(CO4)
(PO2) |
| 4. a) | What is CAN bus and why is it called a broadcast type bus? “CAN bus protocol remove $\frac{n(n-1)}{2}$ connections complexity for an embedded system” – explain how? | 10
(CO3)
(PO1) |
| b) | How does CAN bus protocol encode the transmitted data? Write a short note on CAN bus characteristics and its logic states. | 8
(CO3)
(PO1) |

- c) Suppose, your student ID is 180041X₁X₂X₃. Now, for CAN Bus Protocol consider two component nodes N₁ having 11-bit Identifier X₁X₂X₃ and N₂ having 11-bit Identifier X₃X₂X₁. Using the identifier values draw the timing diagram for CSMA/CD Non-Destructive Arbitration (NDA) concept of CAN. Your answer should clearly state the *bit-by-bit* scenario to show which node becomes the dominant to access the CAN Bus and transmit data first. 7 (CO3) (PO3)
5. a) What is I²C Bus? Draw the data formats of I²C protocol when the Master IC reads and writes to/from Slave IC. 10 (CO3) (PO1)
- b) Draw the frame format of I²C bus and briefly explain it. 8 (CO3) (PO2)
- c) Why does in I²C bus the Start-End condition and Data-Transition signaling are opposite to each other? Explain. 7 (CO3) (PO3)
6. a) Write the pros and cons of the *Serial* and *Parallel* interface transmissions. How does the I²C bus handle multi-master scenario? 10 (CO1) (PO1)
- b) How the use of Bluetooth, WiFi and 3G/4G do differs from each other in terms of designing wireless interfaces using IR and RF? 8 (CO3) (PO1)
- c) “LoRaWAN devices send small amount of data for a longer distance” – Justify the statement with example. 7 (CO3) (PO1)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4621: Machine Learning

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets. Symbols have their usual meaning.

1. a) Suppose the following 2D data is given.

Table 1

x_1	x_2
3	3
4	4
5	5

Show all numeric calculations required to perform Principal Component Analysis (PCA) to transform the original data into 1D data with maximum variance.

Note: One of the Eigen values of the covariance matrix is 0, and corresponding Eigen vector is $[-0.7071 \ 0.7071]^T$.

20
[CO1,
PO1]

- b) Is there any difference if we choose the number of principal components using either 'the maximum projection error allowed' or 'minimum variance retained'? Justify your answer.

5
[CO2,
PO2]

2. a) Identify the strengths and weakness of elbow method in determining the number of clusters in a dataset?

5
[CO2,
PO2]

- b) Does k -medoids clustering technique produce convex-shaped clusters? Explain your answer.

7
[CO1,
PO1]

- c) Compare between k -means and k -medoids clustering techniques.

8
[CO2,
PO2]

- d) Design a criterion function J for partitioning, where for each class a distance measure can be used between samples p , instead of using cluster center c_i .

5
[CO3,
PO3]

3. a) Consider a Support Vector Machine and the following training data for a two-class problem given in Table 2:

Table 2

class	x_1	x_2
+	1	1
+	2	2
+	2	0
-	0	0
-	1	0
-	0	1

- i. After plotting these six training points (use graph paper), construct the weight vector for the optimal hyperplane, and the optimal margin width.

10+5
[CO1,
PO1]

- ii. If you remove one of the support vectors does the size of the optimal margin decrease, stay the same, or increase?

[Note: You do not need to calculate the solutions by solving, rather find the answers from inspecting the graph.]

- b) Suppose the test data in a two-class problem is not linearly separable and noisy with outliers. Which concepts can you employ to make the SVM classifier work with better generalization? Explain in brief with changes in the objective function.

10
[CO3,
PO3]

4. a) Compare between Generative and Discriminative models.

5
[CO2,
PO2]

- b) Suppose you are training a robot in a lumber yard, and the robot must learn to discriminate Oak wood from Pine wood. You choose to learn a Naïve Bayes classifier with the following data in Table 3:

4+1
[CO1,
PO1]

Table 3

Density	Grain	Hardness	Class
Heavy	Small	Hard	Oak
Heavy	Large	Hard	Oak
Heavy	Small	Hard	Oak
Light	Large	Soft	Oak
Light	Large	Hard	Pine
Heavy	Small	Soft	Pine
Heavy	Large	Soft	Pine
Heavy	Small	Soft	Pine

Consider a new sample (Density=**Light**, Grain=**Small**, Hardness=**Soft**)^T. Calculate the posterior probability for each class and classify the sample

- c) For the Naïve Bayes classifier, the decision rule $f(x)$ can be written as follow, where the sample will be classified to the positive class (i.e., $y=1$) if $f(x) > 0$:

5
[CO3,
PO3]

$$f(x) = \log \frac{P(y=1|x)}{P(y=0|x)}$$

Can the decision rule be formulated similarly for multiclass Naive Bayes? Explain why.

- d) During decision tree generation for classification, instead of taking a binary split for the numeric attribute, can we use ternary split using two thresholds w_{ma} and w_{mb} ? In other words, three potential branches where samples can take j -th branch according to the following conditions:

7+3
[CO3,
PO3]

$$x_j < w_{ma}; w_{ma} \leq x_j \leq w_{mb}; x_j > w_{mb}$$

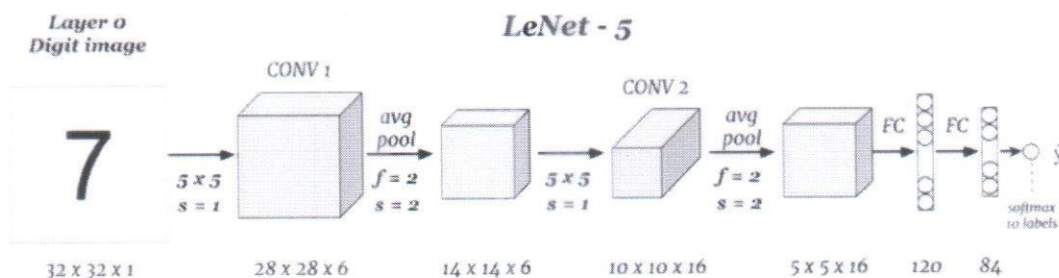
Propose a modification of the tree induction method along with impurity measure to learn those two thresholds. What are the advantages of performing ternary split over binary?

5. a) What is the motivation behind 1×1 convolution? How can it help in reducing the computation cost? Give an example scenario

5
[CO1,
PO1]

- b) Consider the following LeNet-5 model in Figure 1. If we replace the average-pool with max-pool layers, determine the changes you might see?

7
[CO2,
PO2]



- c) Examine the benefits of using skip connections in Convolution Neural Network (CNN). How do we incorporate such skip connections and in which cases? [CO2, PO2] 6
- d) You come up with a CNN classifier as shown in Figure 2. For each layer, measure the number of weights, number of biases and the size of the associated feature maps. [CO1, PO1] 7

The notation follows the convention:

- CONV-K-N denotes a convolutional layer with N filters, each them of size $K \times K$, Padding and stride parameters are always 0 and 1 respectively.
- POOL-K indicates a $K \times K$ pooling layer with stride K and padding 0.
- FC-N stands for a fully-connected layer with N neurons.

Layer	Activation map dimensions	Number of weights	Number of biases
INPUT	$128 \times 128 \times 3$	0	0
CONV-9-32			
POOL-2			
CONV-5-64			
POOL-2			
CONV-5-64			
POOL-2			
FC-3			

Figure 2.

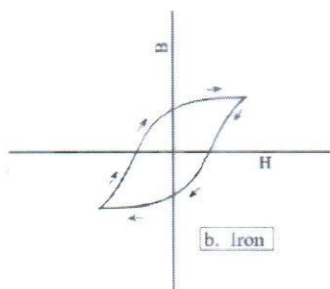
6. a) For large batch sizes, the number of iterations does not change much as the batch size is increased. Explain this statement. [CO1, PO1] 5
- b) Why do we need a Regularization term in the cost function? Compare between L1 and L2 Regularization. 2+5 [CO2, PO2]
- c) The standard form of L2-regularized loss function for linear regression is:

$$J(\theta) = \frac{1}{2m} \sum_{i=1}^m (h_{\theta}(x^i) - y^i)^2 + \frac{\lambda}{2m} \theta^T \theta$$

- i. Suppose you have accidentally defined: $J(\theta) = \frac{1}{2m} \sum_{i=1}^m (h_{\theta}(x^i) - y^i)^2 + \frac{\lambda}{m} Y^T Y$. What kind of regularization effect will you have? 4+4 [CO2, PO2]
- ii. Suppose we use the correct expression but accidentally choose $\lambda < 0$. Will you either have overfitting or underfitting? Justify your answer.
- d) If the following first-order condition is true:
 $\forall x, y \in \text{dom } f, f(y) \geq f(x) + [\nabla f(x)]^T \cdot (y - x)$, then determine that the function f is convex. 5 [CO3, PO3]

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**ORGANISATION OF ISLAMIC COOPERATION (OIC)****Department of Computer Science and Engineering (CSE)****SEMESTER FINAL EXAMINATION****SUMMER SEMESTER, 2020-2021****DURATION: 3 HOURS****FULL MARKS: 150****CSE 4631: Digital Signal Processing****Programmable calculators are not allowed. Do not write anything on the question paper.**Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets. Any Other Statements if necessary.

1. a) Describe in brief how digital signal processing has had a revolutionary impact on the following areas of science and engineering: 5
(CO1)
(PO1)
 - i. Telecommunication,
 - ii. Audio Processing,
 - iii. Image Processing.
- b) Suppose a discrete-time signal $x(n) = 10 \times ID \times \cos\left(\frac{\pi}{10} n\right)$ is quantized with a resolution of $\Delta = 0.1$. Here, ID is the value obtained by taking the last two digits of your student ID. For example, if your ID is 170041001, then you should consider $x(n) = 10 \times 1 \times \cos\left(\frac{\pi}{10} n\right)$. What is the minimum number of bits required for the ADC if you are performing analog to digital conversion? 5
(CO2)
(PO1)
- c)
 - i. What are characteristics that make a digital system linear? 5+5+5
(CO1)
 - ii. What are the common strategies for analyzing non-linear systems? (PO1)
 - iii. A graph depicting the relationship between magnetic intensity H and flux density B is given in Figure 1. Why is this relationship non-linear?

**Figure 1: Relationship between magnetic intensity H and flux density B**

2. a)
 - i. "Convolution can be viewed as a collection of sums of weighted inputs" – explain this statement. 3+3
(CO1)
 - ii. Why and when does the problem of circular convolution occur when we perform convolution in the frequency domain? (PO1)
- b)
 - i. Given the signal, $x[n] = \{4, 3, 1, 7, -1, 2, P, Q\}$, where P and Q are the first and last digit of your student ID, respectively. 5
(CO1)
Now, resolve $x[n]$ as a sum of shifted and weighted/scaled impulse responses. (PO1)

- ii. Suppose, the signal from 2.b)(i), $x[n]$, passes through the linear systems **S1** and **S2** placed in parallel as shown in Figure 2. Here, **Add** is an elementwise addition operation.

6
(CO1)
(PO1)

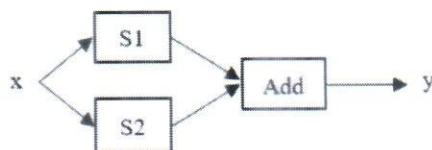


Figure 2: System for question 2.b)(ii).

The impulse response of S1 is $h_{s1}[n] = \{1, \hat{2}, -1\}$ and, the impulse response of S2 is $h_{s2}[n] = \{-2, \hat{3}, 2\}$. Find $y[n]$.

- c) i. Why the first and last $M-1$ points in the output signal of a convolution operation may not be usable? Here, M is the kernel length. 4
(CO3)
(PO2)
- ii. How does correlation help with the implementation of Radar systems? Explain with proper figures and diagrams. 4
(CO1)
(PO1)
3. a) i. Why is the duality between the time domain and the frequency domain stronger when complex DFT is used instead of real DFT? 3
(CO2)
(PO1)
- ii. Analyze and compare the time complexity of DFT and FFT. 3
(CO3)
(PO2)
- iii. Mention some steps you can take to make FFT even faster. 3
(CO1)
(PO1)
- b) i. What is the basic calculation element of FFT? Explain the mathematical operations that takes place in it. 3
(CO1)
(PO1)
- ii. In FFT, why is the odd point frequency spectrum multiplied with a sinusoid? 3
(CO3)
(PO2)
- c) i. Draw and explain FFT synthesis flow diagram that combines two 4-point frequency spectra into a single 8-point frequency spectrum. 5+5
(CO2)
- ii. Figure 3 shows the frequency response of a digital filter for the frequency range of 0 to 0.5 times of the sampling rate. Draw a figure that shows the frequency response of the same filter from -1 to 1 times of sampling rate. (PO1)

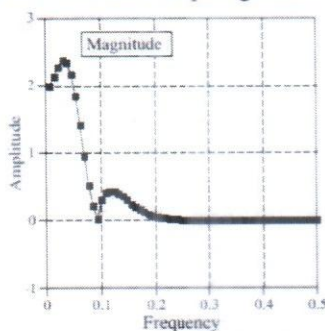


Figure 3: Frequency response of a digital filter for question 3.c)(ii)

4. a) i. Why digital filters are preferred over analog ones in most applications? 3
(CO3)
(PO2)
- ii. Why is the step response of such great concern in analyzing and evaluating time domain filters? 3
(CO1)
(PO1)
- b) i. What are the three major characteristics of a good time domain filter? 4+4
ii. How does the windowed sinc filter perform in the time domain? Justify your answer. (CO1)
(PO1)
- c) i. Suppose you have a high-pass digital filter and a low-pass digital filter. The cut-off frequency of the low-pass filter is higher than the high-pass one. How can you make a band-reject filter that rejects any frequency that both the high-pass and the low-pass filters accept? 5+6
(CO4)
(PO3)
- ii. Transform the given impulse response in such a way so that its corresponding frequency response gets flipped left for right. P and Q are the last two digits of your student ID.

$$x[n] = \{1, 3, -4, 7, P, -1, 5, Q\}$$

5. a) i. Why is a windowed sinc filter an excellent low-pass filter? 4
(CO2)
(PO1)
- ii. How does a blackmann window improve the performance of windowed sinc filter? 4
(CO3)
(PO2)
- b) i. Why is the recursive implementation of a moving average filter faster than its convolution-based implementation? 4
(CO1)
(PO1)
- ii. How can you increase the stopband attenuation and the roll-off of a windowed-sinc filter? 4
(CO4)
(PO3)
- c) The final design of a windowed sinc filter is given as: 9
(CO2)
(PO1)

$$h[i] = K \frac{\sin\left(2\pi f_c \left(i - \frac{M}{2}\right)\right)}{\pi\left(i - \frac{M}{2}\right)} \left[0.42 - 0.5 \cos \frac{2\pi i}{M} + 0.08 \cos \frac{4\pi i}{M}\right]$$

Explain the different parts of this equation.

6. a) i. If two sinusoids having different frequencies are added in the time domain, how will the corresponding frequency domain signal of the resultant signal look like? 5
(CO1)
(PO1)
- ii. When a time domain signal shifted, why the change in phase for the higher frequency component signals larger than that of the lower frequency component signals? 5
(CO3)
(PO2)
- b) i. What happens to the frequency domain when a signal is down sampled in the time domain? 4+4
(CO1)
- ii. How would you interpolate a time domain signal with 50 samples into a signal with 400 samples? (PO1)
- c) i. What is the effect of hamming window in spectral analysis? 3+4
(CO1)

- ii. What happens to the corresponding frequency response when you pad zeros to the impulse response of a system? (PO1)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION**SUMMER SEMESTER, 2020-2021****DURATION: 3 HOURS****FULL MARKS: 150**

CSE 4635: Web Architecture

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **6 (six) questions**. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

The following scenarios will be used across multiple questions in this paper:

Scenario 1: XYZ is a new bank in Bangladesh and its target customers are villagers in rural areas of the country. It now wants to develop a web application to handle its operations and functions. To make things easier for the rural people, they decided to allow opening of bank accounts if a customer has a phone number. XYZ has decided that it will allow multiple customers to share the same account, and at the same time it will allow a customer to open multiple accounts. XYZ also wants to introduce a feature through which customers will be able to access different information regarding their accounts (i.e., balance, transaction history, and fund transfer) from their phones. Aside from these features, the bank wants the application to be developed quickly and without too much monetary investment. They want to ensure that there is minimum latency during transactions, and they want fast development and deployment based on the requirements they gather after proper consultation. For now, XYZ wants to focus on building the application for handling their business needs in a homogenous environment.

Scenario 2: An e-commerce company has laid out the following features for their web application:

- 1) There will be separate modules for users, vendors, admin, and products.
- 2) User module will consist of the following sub-modules: user account management, items wish list, past purchases, address book, payment method, products/category browsing, and shopping cart management.
- 3) Vendor module will consist of the following sub-modules: Product and inventory management, customer queries, customer notification management etc.
- 4) Admin module will consist of several sub-modules, one of which is a "Visitor Count" sub-module that keeps track of the number of visitors visiting the website.
- 5) The homepage of the web application will display a list of products. The list of products can be filtered based on different item categories.
- 6) Whenever a user clicks on a product link, details about the product like name, price, color, vendor etc. will be shown to the users. In addition, users will also be shown a list of other items similar to the item currently being displayed.
- 7) If the same product is offered by multiple vendors, users will get the option to see which vendor offers the best pricing options.
- 8) If an item is out of stock, users will be able to place requests for that item and get notifications whenever the item is back in stock. The vendor module will handle this feature.
- 9) The application should be able to serve a growing number of customers and vendors.
- 10) Multiple data sources may be used to design the database of the application.
- 11) The company plans to release an application for android devices in the future.

1. a) Explain with suitable examples the role of Model, View, and Controller in an MVC pattern. 6
(CO1)
(PO1)
 - b) Given the applications mentioned in **Scenario 1** and **Scenario 2**, explain with proper justification which application architecture should be used to design each of these two applications. 6
(CO2)
(PO2)
 - c) "HTTP is a stateless protocol, but it allows stateful sessions" – Evaluate this statement. 7
(CO1)
(PO1)
 - d) Create a diagram to show the several stages of the lifecycle of JSP. In this diagram, show in which steps the three lifecycle methods of JSP are invoked. 6
(CO3)
(PO3)
2. a) What are the major differences between `<%@include%>` and `<jsp:include>`? 3
(CO1)
(PO1)
 - b) Consider the following figure and answer the subsequent question: 15
(CO3)
(PO3)

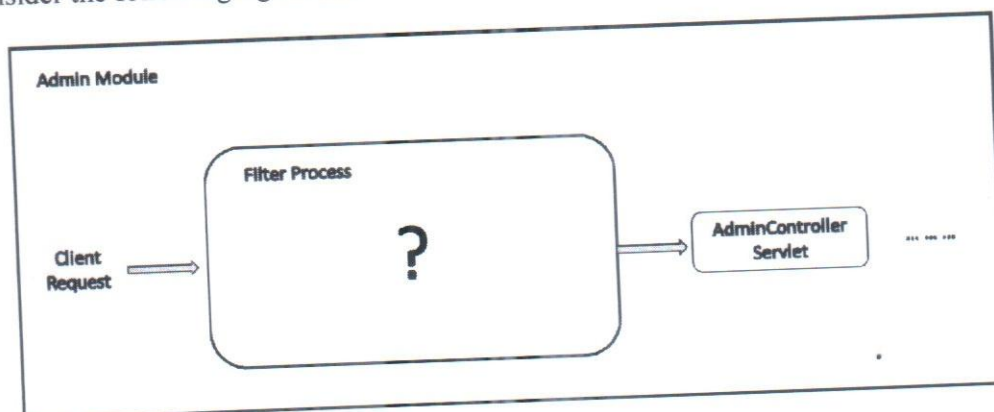


Figure 1: Figure for Question 2 (b)

Figure 1 shows part of the admin module mentioned in **Scenario 2**.

Create the necessary classes, pages etc. (all with code) required to complete the "Filter Process" shown in the figure. If the client is authenticated with the username and password values as "admin" and "adminpw" respectively, the client request should be forwarded to a servlet called **AdminControllerServlet**. Otherwise, the client request will be forwarded to a page called **AdminLogin.jsp**.

- c) For the application mentioned in **Scenario 1**, assume you have a **JavaBean** called **TransactionBean**, and it has the following variables: *transId*, *transDate*, *customerId*, *transAmount*, all with necessary setter and getter methods. Also assume that you have obtained a list of 15 such transactions from your database, with *transId* values ranging from 2101 to 2115. Now, create a **CustomerTransactions.jsp** page (with code) to dynamically load the information (*transId*, *transDate*, *customerId*, *transAmount*) about the first 10 transactions. 7
(CO3)
(PO3)
- Note that You cannot hard-code the information about the transactions. Avoid using scriptlets inside the **CustomerTransactions.jsp** page.

3. a) Explain the dynamic typing nature of JavaScript with example. 4+3
(CO1)
(PO1)
- What will be the boolean values of the following conditional expressions in JavaScript?
 - i. `(10=="10")`
 - ii. `(20!="20")`
 - iii. `(100!="100")`

- b) Assume you are using “Front Controller” design pattern to handle client requests for the user module (feature number 2) mentioned in **Scenario 2**. Using the Servlet Front strategy, create a class (with code) that implements this pattern. 8
(CO3)
(PO3)

For each of the sub-modules, you can assume that there are separate JSP pages to which you can dispatch the client requests. You do not have to create the JSP pages.

- c) Consider the following code snippet for an HTML form and answer the subsequent question: 10
(CO3)
(PO3)

```
<form id="form1" onsubmit="getFormValue()">
  First Name: <input type="text" id="fname-input" placeholder="First Name">
  <br>
  Last Name: <input type="text" id="lname-input" placeholder="Last Name">
  <br>
  <input type="submit" class="submit-btn" value="Submit">
</form>
```

Create a JavaScript function **getFormValue()** that will be invoked whenever a user clicks on the “Submit” button of the aforementioned HTML form. The function will use a *prompt* to take the year of birth as an additional input from the user. It will then calculate the age of the user based on the entered year of birth and print the following message in an *alert box*:

“Welcome, {First Name} {Last Name}! Your age is {Age}.”

The values of {First Name} and {Last Name} should be obtained from the HTML form, and the value of {Age} should be calculated using the year of birth of the user.

4. a) Define marshaling and unmarshaling; Which classes are responsible for performing the marshaling and unmarshaling processes in RMI? 5
(CO1)
(PO1)
- b) “The concept of RMI focuses on the fact that local processes can operate on objects stored in remote nodes as if they were operating on objects stored in local nodes.” – Evaluate this statement. 5
(CO1)
(PO1)
- c) Read the following information about the application mentioned in **Scenario 1**: 3
“XYZ also wants to introduce a feature through which customers will be able to access different information regarding their accounts (i.e., balance, transaction history, and fund transfer) from their phones.”
(CO2)
(PO2)
What technology should be used to fulfil this requirement? Justify your answer.
- d) For the application mentioned in **Scenario 2**, suppose there are currently three registered vendors. Assume that there is a **static list** of three **ArrayList** objects that store the information about the products in their inventory for each corresponding vendor. The name of the **static list** is **VendorProductList**. Information related to each individual product are as follows: prodId, prodName, quantity, price, manufacturerName. 12
(CO3)
(PO3)
Now, create a RESTful endpoint (with code) that takes a vendor ID as input and returns the list of products for that vendor as an array list of JSON objects. For simplicity, you can assume that the vendor IDs are 0, 1 and 2 and correspond to the first three indices of the **static list**.
You only need to create the RESTful endpoint. You can assume that any other required class is already created.
5. a) For the features marked 2-11 for the application mentioned in **Scenario 2**, identify with proper reasoning what kind of session beans should be used to implement each feature. 15
(CO3)
(PO3)
Note that one feature may require multiple session beans depending on the requirements.
- b) Create a session bean (with code) that will handle the “Visitor Count” sub-module mentioned in feature number 4 of the application mentioned in **Scenario 2**. Your session bean should contain two methods: One for updating the visitor count, and the other for showing the current visitor count. 10
(CO3)
(PO3)

6. a) Assume you are currently working with the following two entities for the database of the application mentioned in **Scenario 1**:

10
(CO3)
(PO3)

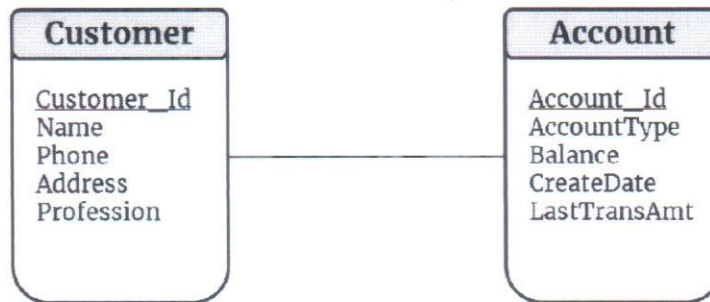


Figure 2: Entities mentioned in Question 6 (a)

Here, *Customer_ID* and *Account_ID* are primary keys that need to be generated using the "Identity" generation scheme.

Assuming bidirectional association, create entity classes (with code) for these two tables, maintaining the proper relationship between them.

- b) Consider the content of the **persistence.xml** file shown below and answer the subsequent question:

5
(CO3)
(PO3)

```

<persistence xmlns="http://xmlns.jcp.org/xml/ns/persistence"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://xmlns.jcp.org/xml/ns/persistence
    http://xmlns.jcp.org/xml/ns/persistence/persistence_2_2.xsd"
  version="2.2">
  <persistence-unit name="my_pu" transaction-type="JTA">
    <provider>org.hibernate.jpa.HibernatePersistenceProvider</provider>
    <properties>
      <property name="javax.persistence.jdbc.url"
        value="jdbc:h2:tcp://localhost/~test"/>
      <property name="javax.persistence.jdbc.driver" value="org.h2.Driver"/>
      <property name="javax.persistence.jdbc.user" value="sa"/>
      <property name="javax.persistence.jdbc.password" value=""/>
    </properties>
  </persistence-unit>
</persistence>
  
```

Create an **EntityManager** using the persistence unit defined in the aforementioned **persistence.xml** file.

- c) Assume that the database module of the application mentioned in **Scenario 1** has three entities: *Customers*, *Accounts*, *Transactions*. Now, create this module using the Data Access Object (DAO) design pattern.

10
(CO3)
(PO3)

You do not have to write the code for the classes. However, you must briefly describe the purpose of each class that you use to develop this module using Data Access Object design pattern.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**ORGANISATION OF ISLAMIC COOPERATION (OIC)****Department of Computer Science and Engineering (CSE)****SEMESTER FINAL EXAMINATION****SUMMER SEMESTER, 2020-2021****DURATION: 3 HOURS****FULL MARKS: 150****Math 4641: Numerical Methods****Programmable calculators are not allowed. Do not write anything on the question paper.**Answer all 6 (six) questions. Marks of each question and corresponding CO and PO are written in the right margin.

1. a) Use Taylor's polynomial to derive the orders of error for the Forward Difference rule, Backward Difference rule, and Central Difference rule of Numerical Differentiation. Show mathematical reasoning for choosing one of these three. 9+5
(CO1, CO3)
(PO1)
- b) A tissue paper company advertises that every roll of their toilet paper has at least 250 sheets. The probability that there are 250 or more sheets in the toilet paper roll is given by the following equation: 11
(CO2)
(PO2)

$$P(y \geq 250) = \int_{250}^{\infty} 0.3515e^{-0.3881(y-252.2)^2} dy$$

By theoretical reasoning, the above integral calculates the probability up to infinite sheets. But practically, it has been seen that the number of sheets rarely exceed 270. So, considering 270 as the maximum possible number of sheets, the above integral can be approximated as follows:

$$P(y \geq 250) = \int_{250}^{270} 0.3515e^{-0.3881(y-252.2)^2} dy$$

Use the 2-segment Trapezoidal rule to find the probability that there are 250 or more sheets in a random toilet paper roll.
2. a) Without using linearization transform, describe the individual solution approaches for the following nonlinear regression models: 4+5+4
(CO1)
(PO1)
 - i. Exponential model
 - ii. Growth model
 - iii. Polynomial model
- b) What is the drawback in directly using the first 3 terms of the Taylor series for deriving y_{i+1} in Runge-Kutta 2nd order method? What is the alternative way of approximating the first 3 terms of the series? 3+3
(CO3)
(PO2)
- c) What are the different forms of the approximation of Runge-Kutta 2nd order method based on Heun's method, Midpoint method and Ralston's method? 6
(CO1)
(PO1)
3. a) Find the Eigenvalues and Eigenvectors of the following matrix A: 12
(CO2)
(PO1)

$$A = \begin{bmatrix} 2 & 27 & 0 \\ 0 & 4 & 40 \\ 0 & 3 & 30 \end{bmatrix}$$
- b) Describe how linearization transform is applied on the following nonlinear models: 2+2+2
(CO1)
(PO1)
 - i. Exponential model
 - ii. Power model
 - iii. Growth model
- c) Why do we normally use polynomials as interpolating functions? Can single polynomials always be used to accurately interpolate data? 2+5
(CO3)
(PO2)

4. a) For approximating $I = \int_a^b f(x)dx$ using Simpson's 3/8 rule, how are the points chosen over the interval $[a, b]$, and what are their exact coordinates in terms of a and b ? Provide necessary illustrations. (CO1) (PO1) 9
- b) The minimum number of segments for Simpson's 3/8 rule is 3. Given that the 3-segment formula is $I = \frac{3h}{8}[f(x_0) + 3f(x_1) + 3f(x_2) + f(x_3)]$, derive the general n -segment formula? (CO1) (PO2) 8
- c) What is the LU decomposition of A , where $A = \begin{bmatrix} 1 & 1 & -1 \\ 1 & -2 & 3 \\ 2 & 3 & 1 \end{bmatrix}$ (CO2) (PO1) 8
5. a) What is the motivation behind the use of LU decomposition? Provide a scenario where the use of LU decomposition can enhance the performance of a numerical analysis system. (CO3) (PO2) 5+5
- b) Given n data pairs $(x_1, y_1), \dots, (x_n, y_n)$, do the values of the constants a_0 and a_1 in the least square regression line model $y = a_0 + a_1x$ correspond to the absolute minimum of the sum of the squares of residuals? Are the constants of regression unique? (CO1) (PO2) 9+6
6. a) To maximize the catch of bass in a lake, it is suggested to throw the line to the depth of the thermocline. You can infer that there is a thermocline at a particular depth by noticing the sudden change in temperature. The following table provides us the depth vs temperature data for the lake: (CO2, CO3) (PO3) 6+7+3

Table 1: Depth vs Temperature

Depth, $h(m)$	Temperature, $T(^{\circ}C)$
0	19.1
-1	19.1
-2	19
-3	18.8
-4	18.7
-5	18.3
-6	18.2
-7	17.6
-8	11.7
-9	9.9
-10	9.1

It is noticed that there is a large difference in temperature from $h = -7$ to $h = -8$, so the thermocline must be somewhere between these two depths. The intermediate temperature data between these two depths is missing.

Determine the temperature at $h = -7.5$ using a **first order Lagrange polynomial** and then a **second order Lagrange polynomial** and find the absolute relative approximate error.

- b) Derive Simpson's 1/3 rule using the method of coefficients. Using necessary illustrations, determine the geometric interpretation of this derivation? (CO1) (PO1) 5+4

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 Hours

FULL MARKS: 150

HUM 4641: Accounting

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all 6 (six) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) What are the assumptions of CVP Analysis? 5
(CO1)
(PO1)
- b) Northwood Company manufactures basketballs. The company has a ball that sells for \$25. At present, the ball is manufactured in a small plant that relies heavily on direct labor workers. Thus, variable costs are high, totaling \$15 per ball, of which 60% is direct labor cost. 20
(CO2,
CO3)
(PO2)
- Last year, the company sold 30,000 of these balls, with the following results in Table-1.

Table 1: Northwood Company sales and expenses

Sales (30,000 balls)	\$750,000
Variable expenses	<u>450,000</u>
Contribution margin	300,000
Fixed expenses	210,000
Net operating income	<u>\$ 90,000</u>

Required:

- i. Compute the CM ratio, break-even point in balls (use formula method), margin of safety in dollar at last year's sales level.
- ii. Compute the degree of operating leverage.
- iii. Assume that through a more intense effort by the sales staff, the company's sales increase by 10% next year. By what percentage would you expect net operating income to increase? Use the degree of operating leverage to obtain your answer. Verify your answer to by preparing a new contribution format income statement showing 10% increase in sales.
- iv. Refer to the original data. The company is discussing the construction of a new, automated manufacturing plant. The new plant would decrease variable costs per ball by 40%, but it would cause fixed costs per year to double. If the new plant is built, prepare a contribution format income statement with the changes.
 - What would be the company's new CM ratio and new break-even point in dollar? (use equation method)
 - If the new plant is built, how many balls will have to be sold next year to earn

the same net operating income, \$90,000, as last year? (use equation method)

- Compute the new Margin of Safety in dollar and percentage. If you were a member of top management, would you have been in favor of constructing the new plant? Explain.

2. a) Describe Per Unit Variable Cost. Is per unit variable cost always remains same? Give your explanation with graphical example.
- b) From the information given below in Table-2, prepare a Cost Sheet for the period ended on 31st March, 2018.

Table 2: Stock

Opening stock of raw material	12,500
Purchases of raw material	1,36,000
Closing stock of raw material	8,500
Direct wages	54,000
Direct expenses	12,000
Factory overheads	100% of direct wages
Office and administrative overheads	20% of works cost
Selling and distribution overheads	26,000
Cost of opening stock of finished goods	12,000
Cost of Closing stock of finished goods	15,000
Profit on Selling Price	20%

3. a) "All future costs are relevant in decision making." Do you agree? Why?

- b) Gemini Products manufactures 30,000 units of part S-6 each year for use on its production line. At this level of activity, the cost per unit for part S-6 is as follows in Table-3:

Table 3: Gemini Products cost per unit of part S-6

Direct materials	\$ 4.00
Direct labor	10.00
Variable manufacturing overhead	3.00
Fixed manufacturing overhead	8.00
Total cost per part	<u>\$25.00</u>

An outside supplier has offered to sell 30,000 units of part S-6 each year to Gemini Products for \$21 per part. If Gemini Products accepts this offer, the facilities now being used to manufacture part S-6 could be rented to another company at an annual rental of \$80,000. The \$80,000 rental value of the space being used to produce part S-6 is an opportunity cost of continuing to produce the part internally. However, Gemini Products has determined that two-thirds of the fixed manufacturing overhead being applied to part S-6 would continue even if part S-6 were purchased from the outside supplier.

Required:

Should the outside supplier's offer be accepted? Show all computations.

4. a) What is Flexible Budget? Explain the two variances that are derived in the flexible budget performance report? 5
(CO1)
(PO1)
- b) Lavage Rapide is a Canadian company that owns and operates a large automatic carwash facility near Montreal. The following Table-4 provides data concerning the company's costs: 20
(CO2, CO3)
(PO2)

Table 4: Lavage Rapide costs

	Fixed Cost per Month	Cost per Car Washed
Cleaning supplies		\$0.80
Electricity	\$1,200	\$0.15
Maintenance		\$0.20
Wages and salaries	\$5,000	\$0.30
Depreciation	\$6,000	
Rent	\$8,000	
Administrative expenses	\$4,000	\$0.10

For example, electricity costs are \$1,200 per month plus \$0.15 per car washed. The company expects to wash 9,000 cars in August and to collect an average of \$4.90 per car washed.

Required:

- Prepare the company's Planning budget
- The company actually washed 8,800 cars in August. Prepare the company's flexible budget for August.
- Prepare the company's Flexible Budget Performance Report. The actual operating results for August appear below in Table-5:

Table 5: Lavage Rapide Income Statement For the Month Ended August 31

Actual cars washed	8,800
Revenue	<u>\$43,080</u>
<u>Expenses:</u>	
Cleaning supplies	7,560
Electricity	2,670
Maintenance	2,260
Wages and salaries	8,500
Depreciation	6,000
Rent	8,000
Administrative expenses	<u>4,950</u>
Total expense	<u>39,940</u>
Net operating income	<u>\$ 3,140</u>

5. a) Using the following Table-6 data from the comparative balance sheet of Rodenbeck Company, prepare a schedule showing the **Horizontal Analysis** and **Vertical Analysis**.

8
(CO2,
CO3)
(PO1)

Table 6:

	December 31, 2018	December 31, 2017
Accounts receivable	\$ 520,000	\$ 400,000
Inventory	\$ 840,000	\$ 600,000
Total assets	\$ 3,000,000	\$2,500,000

- b) Apple Corporation's comparative balance sheets are presented below in Table-7:

17
(CO2,
CO3)
(PO1)

Table 7: APPLE CORPORATION Balance Sheets December 31

	2018	2017
Cash	\$ 4300	\$ 3700
Accounts receivable	21200	23400
Inventory	10000	7000
Land	20000	26000
Building	70000	70000
Accumulated depreciation	(15000)	(10000)
Total	<u>\$110500</u>	<u>\$120100</u>
Accounts payable	\$ 12370	\$ 31100
Common stock	75000	69000
Retained earnings	23130	20000
Total	<u>\$110500</u>	<u>\$120100</u>

Apple's 2018 **income statement** included Net Sales of \$100,000, Cost of Goods Sold of \$60,000, Cash Dividends \$20,000 and Net Income of \$15,000.

Required:

Compute the following ratios for **2018**.

- i. Current ratio.
- ii. Acid-test ratio.
- iii. Receivables Turnover.
- iv. Inventory turnover.
- v. Profit margin.
- vi. Asset turnover.
- vii. Return on assets.
- viii. Return on common stockholder's equity.
- ix. Debt to total assets ratio.
- x. Payout Ratio.

6. a) "Pacioli described a unique system to ensure that financial information was recorded efficiently and accurately"-Explain.

5
(CO1)
(PO1)

- b) Josie Micheals is a licensed CPA. During the first month of operations of her business, the following events and transactions occurred. 20

May 1: Josie invested \$25,000 cash in her business. (CO2,

May 2: Hired a secretary-receptionist at a salary of \$2,000 per month. CO3)

May 3: Purchased \$2,500 of supplies on account from Barry Supply Company. (PO1)

May 7: Paid office rent of \$900 cash for the month.

May 11: Completed a tax assignment and billed client \$2,100 for services provided.

May 12: Received \$3,500 advance on a management consulting engagement.

May 17: Received cash of \$1,200 for services completed for Max Company.

May 31: Paid secretary-receptionist \$2,000 salary for the month.

May 31: Paid 40% of balance due Barry Supply Company.

Josie uses the following chart of accounts: No. 101 Cash, No. 112 Accounts Receivable, No. 126 Supplies, No. 201 Accounts Payable, No. 205 Unearned Revenue, No. 301 Josie Micheals, Capital; No. 400 Service Revenue, No. 726 Salaries Expense, and No. 729 Rent Expense.

Required:

- i. Journalize the transactions.
- ii. Post to the ledger accounts.
- iii. Prepare a trial balance on May 31, 2018.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**ORGANISATION OF ISLAMIC COOPERATION (OIC)****Department of Computer Science and Engineering (CSE)****SEMESTER FINAL EXAMINATION****SUMMER SEMESTER, 2020-2021****DURATION: 3 HOURS****FULL MARKS: 150****CSE 4643: Mobile Application Development****Programmable calculators are not allowed. Do not write anything on the question paper.**There are **6 (Six)** questions. Answer **all** of them.

Marks of each question and corresponding CO and PO are written in brackets.

-
1. a) Elucidate Native Applications and Hybrid Applications with appropriate examples and assess which is suited for your mobile development applications. 9
(CO1)
(PO2)
 - b) Answer the following questions:
 - i. Despite of Android applications in Google Play Store having much more downloads than Apple applications in iOS store, why is the revenue generated by Apple app downloads much more than Android Applications? 2
(CO2)
(PO2)
 - ii. What components and elements should be declared in the Manifest file for any Android Application? 3
(CO2)
(PO2)
 - iii. What is Intent in Android Applications? Explain the different types of intents used in mobile application development. 4
(CO2)
(PO1)
 - c) What is API? What features do they provide? Explain them with some modern API's that we use in our day to day lives. 7
(CO2)
(PO1)
 2. a) Describe the SDK version relationship with appropriate examples and what measures should you take for selecting SDK version/API Levels for your application. 8
(CO2)
(PO2)
 - b) In Shared Storage of any android application if a user wants to store video or audio type data then the system enables which directories to store them? Will these data disappear from those directories if the application is uninstalled, if not then explain why? 8
(CO3)
(PO2)
 - c) Answer the following questions: 3x3
 - i. "The data delay or sampling rate of Sensor Events should be set at maximum capability" – Justify this statement. (CO4)
(PO2)
 - ii. Why should you unregister Sensor Event Listener?
 - iii. Describe the parameters that are passed while registering listeners.
 3. a) Google's Voice Search require a lot of computational resources and processing power for speech processing and semantic analysis in mobile phones. Elucidate which technique is used to circumvent these shortcomings and what advantages does it offer to the users. 7
(CO3)
(PO2)
 - b) A finance mobile banking application named "**Vkash**" is gaining popularity within the general mass. This app contains features such as sending money to "**Vkash**" users, recharging mobile balance, paying utility bills, transferring money to bank accounts, adding money from debit/credit cards or banks, cashing out amongst many others. Before using this application, you need to register yourself using your National ID and your recent photo taken through the camera of your phone. This application requires your current location for smoothly operating various transactions. It also notifies you when a transaction is complete or if you have received money. 15
(CO4)
(PO3)
- Write a Java Code requesting various permissions (by **yourself method**) for this app.

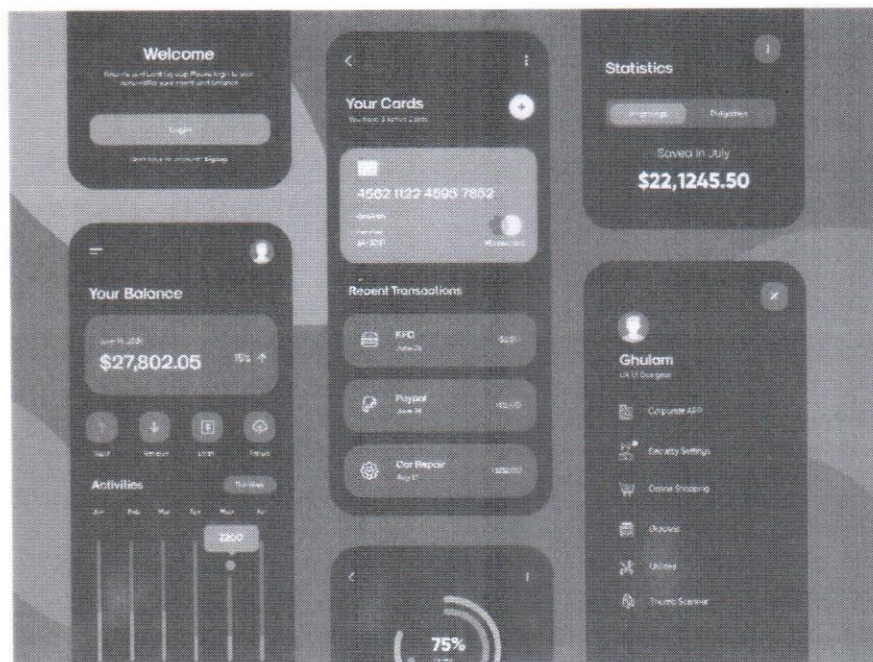


Figure 1: Vকাশ App user interface

- c) Briefly explain a workaround the App permissions with an example. 3
(CO4)
(PO1)
4. a) Is it suitable to use App Specific storage for storing pictures? Give your opinion. 5
(CO3)
(PO2)
- b) Explain the workflow of requesting permissions in Android Mobile Applications with appropriate diagrams and an example. 10
(CO4)
(PO1)
- c) Describe some of the challenges you faced while developing your application for the course “CSE 4644” that is in line with standard mobile application development challenges. 10
(CO5)
(PO2)
5. a) Describe the different parameters on which you should rely to select a storage type for your application. 5
(CO3)
(PO2)
- b) You have an app named “Gambare” which you developed by yourself. This app has a special button which generates a file “Cicada”. You want to store a cryptic message in this file whenever you click the button. Write the Java codes for the following: 5+10
(CO3)
(PO3)
- Store the string “Your_ID_Number’s birthday will be celebrated at Yokohama on Your_brith_date” in your file “Cicada”. For instance, “154419’s birthday will be celebrated at Yokohama on 3rd January, 2022”. Use different string variables to store your name and birthdate.
 - Access the file “Cicada” and check if the file contains the string you stored. If the match is found then print the **matched string** in the *Android console* or else print “Match not found”.
- c) Why is the Data Access Object an interface/abstract class? Briefly describe the design behind this model. 5
(CO4)
(PO3)

6. a) The callback methods that are exposed through the `SensorEventListener` method invokes the `onAccuracyChanged()` and `onSensorChanged()` methods.

8
(CO4)
(PO1)

```
@Override
Public final void onAccuracyChanged(Sensor sensor, int accuracy){
//Access Sensor capabilities
}

@Override
Public final void onSensorChanged(SensorEvent event){
//Access SensorEvent information
}
```

Code Snippet 1: Code Template for question 6.a)

Describe the **Sensor capabilities** from code snippet 1 that can be accessed via the `Sensor` class when the `onAccuracyChanged` method is triggered along with the **SensorEvent information** that is available if the `onSensorChanged()` method is invoked.

- b) Two entities named "*Otaku*" and "*Anime_list*" of the *Room Database* is provided. An otaku only has a single anime list. These entities represent the following tables in the database as shown in Figure 2.1 and Figure 2.2. A Data Access Object (DAO) as *MyAnimelist* is defined for this database. Using the Room Components write the following Java codes.

3+4+5
(CO3)
(PO2)

Otaku
<ul style="list-style-type: none"> • otakuID (primary key) • f_name (first name) • l_name (last name) • favoriteAnime

Figure 2.1: Otaku Entity

Anime_List
<ul style="list-style-type: none"> • animelistID (primary key) • otakuCreatorID (same as otakuID) • animelistName

Figure 2.2: Anime_list Entity

- Create the Entity Class for `Otaku` and `Anime_List` separately.
 - Write a DAO query for displaying the `otakuID` & `animelistID` whose favorite anime is "*Tonikaku kawai*".
 - Write a DAO query for displaying `otakuID`, `f_name`, `animelistID` and `animelistName` where the **length of the string of animelistName is greater or equal to the average length of the string favoriteAnime**.
- c) What is software-based sensors? Elucidate these sensor types with two examples.

5
(CO4)
(PO1)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION
DURATION: 3 HOURS

SUMMER SEMESTER, 2020-2021
FULL MARKS: 150

CSE 4649: Systems Programming

Programmable calculators are not allowed. Do not write anything on the question paper.
 Answer **all six (6)** questions. Figures in the right margin indicate marks along with COs and POs.

1. a) Consider the assembly code fragment shown below:

```
0x400446e3 <malloc+7>: call    0x400446e8 <malloc+12>
0x400446e8 <malloc+12>: popl    %eax
```

What would be the value in %eax register after the popl instruction executes? Provide brief reasoning for your answer.

- b) Table 1 shows an incomplete C code (left) and a complete assembly code (right). Based on the assembly code, fill the blanks of C source code.

Table 1: Codes for question 1.b)

<pre>int loop(int *arr, int n){ int i; for (____; ____; i++){ if (____) ____; } ____; }</pre>	<pre>movl \$0, %eax jmp .L2 .L4: movslq %eax, %rdx cmpl \$1569, (%rdi,%rdx,4) je .L5 addl \$1, %eax .L2: cmpl %esi, %eax jle .L4 movl \$0, %eax ret .L5: movl \$1, %eax ret</pre>
---	---

- c) For each of the following instructions, write down the contents of designated register after execution in *hex*:

```
movabsq $0x1111555566669999, %rax ; %rax
movl    $0xdeadbeef, %edx         ; %rdx
movw    $-38551, %ax              ; %rax
movswq  %ax, %rdx                 ; %rdx
cltq                                       ; %rax
```

The designated register is written after the semi-colon (;). Consider that the instructions are being executed one after another.

2. a) Consider the following C source code:

```
int high_divide(int n, int *arr, int high, int mid){
    high = (n < arr[mid]) ? mid : high;
    return high;
}
```

- i. Write the x86-64 assembly version of the above C source code using *Conditional Control Transfer*. 6
(CO2)
(PO1)
 - ii. Write the x86-64 assembly version of the above C source code using *Conditional Data Transfer*. 5
(CO2)
(PO1)
 - iii. Which one of the two approaches to implement Conditional Transfer is better? Provide justification in favor of your answer. Also, mention specific scenarios where one approach might be better than the other. 7
(CO1)
(PO2)
- b) With examples, explain how Carry Flag (**CF**) and Overflow Flag (**OF**) facilitates detection of signed and unsigned integer overflow. 7
(CO1)
(PO1)

3. a) Consider the following C *switch* skeleton (Table 2) and its corresponding assembly code with jump table on the right.

Table 2: Codes for question 3.a)

<pre>long switch_fun(long x, long n) { long result = x; switch(n) { case ____: case ____: ____; break; case ____: ____; break; case ____: ____; case ____: ____; default: ____; } return result; }</pre>	<pre>subq \$69, %rsi cmpq \$5, %rsi ja .L2 jmp *.L4(,%rsi,8) .L3: leaq 0(,%rdi,8), %rax ret .L5: movq %rdi, %rax sarq \$3, %rax ret .L6: movq %rdi, %rax salq \$4, %rax subq %rdi, %rax movq %rax, %rdi .L7: imulq %rdi, %rdi .L2: leaq 1569(%rdi), %rax ret</pre>	<pre>.L4: .quad .L3 .quad .L2 .quad .L3 .quad .L5 .quad .L6 .quad .L7</pre>
--	---	---

- i. What are the values for the case labels in the switch statement? 3+10
(CO3)
- ii. Complete the C source code. (PO2)

- b) C source code for a program's *main* function and assembly code for *hello* function shown in Table 3:

6+6
(CO2)
(PO2)

Table 3: Codes for question 3.b)

<pre>int main(){ long a = 0x2c29689, b = 0x156969; int c = 0x48; long result = hello(&a, &b, &c); printf("0x%lx\n", result); }</pre>	<pre>hello: mov %rdx,%rcx mov (%rdi),%rax cqto idivq (%rsi) movslq (%rcx),%rdx xor %rdx,%rax retq</pre>
--	---

- i. Draw the stack frame of *main* function showing only the locations of local variables. Values inside local variables and their position with respect to *%rsp* should be clearly annotated.
 - ii. What would be the output of the program after *hello* returns to *main*?
4. a) Suppose you're writing a program named *hello.c*. Explain the different phases that this program would go through to produce the final executable *hello*. Clearly mention what each phase does with inputs/outputs of every phase.
- b) Consider the two code snippet shown in Table 4:

10
(CO1)
(PO2)

Table 4: Codes for question 4.b)

<pre>void lower1(char *s) { int i; for (i = 0; i < strlen(s); i++) if (s[i] >= 'A' && s[i] <= 'Z') s[i] -= ('A' - 'a'); }</pre>	<pre>void lower2(char *s){ int i; int len = strlen(s); for (i = 0; i < len; i++) if (s[i] >= 'A' && s[i] <= 'Z') s[i] -= ('A' - 'a'); }</pre>
--	--

- i. Which of the above code snippet will give better performance in terms of execution speed? Provide reasoning in favor of your answer.
 - ii. Would the compiler automatically choose the better version? Why or why not?
- c) Consider the different storage locations inside a computer system: **Register**, **L1**, **L2** and **L3 cache**, **Secondary memory** and **Primary memory**. Now, write down the relation between these six storage locations in terms of *speed*, *storage size* and *cost*. (Relation can be written like: a → b → → c, for speed)

5+5
(CO1)
(PO2)
5
(CO3)
(PO4)

5. a) Consider *vulnerable* C code snippet and its corresponding assembly code shown in Table 5:

Table 5: Code snippet for question 5.a)

<pre> int main() { int a[2]; char buf[4]; a[0] = 0xCAFEBAFE; a[1] = 0xDEADFACE; gets(buf); printf("a[0]=0x%x,a[1]=0x%x,buf=%s\n", a[0], a[1], buf); } </pre>	<pre> push %rbp mov %rsp,%rbp sub \$0x20,%rsp movl \$0xcafebabe,-0x10(%rbp) movl \$0xdebeefed,-0xc(%rbp) lea -0x20(%rbp),%rax mov %rax,%rdi mov \$0x0,%eax callq 400450 <gets@plt> mov -0xc(%rbp),%edx mov -0x10(%rbp),%eax lea -0x20(%rbp),%rcx mov %eax,%esi mov \$0x40065d,%edi mov \$0x0,%eax callq 400430 <printf@plt> leaveq retq </pre>
--	---

- Why do you think the above code snippet is vulnerable? Explain in not more than 4 sentences. 2.5+3+8.5+4
 - What's the minimum number of bytes to be input by user so that %rbp is overwritten completely? (CO3)
(PO2)
 - If user gives input "AAAAAAAAAAAAAAAAAeviiiiil", then what would be the output of the program? [ASCII values: 'A'=0x41, 'e'=0x65, 'v'=0x76, 'i'=0x69, 'l'=0x6c]
 - Provide at least two recommendations so that the above program is safe from the current vulnerability.
- b) Why do we need to sign-extend %rax into %rdx before idiv? Explain with a suitable example. 7
(CO1)
(PO1)
6+6

6. a) Consider the following C code snippet:

```

void sum_rows1(double *a, double *b, long n) {
    long i, j;
    for (i = 0; i < n; i++) {
        b[i] = 0;
        for (j = 0; j < n; j++)
            b[i] += a[i*n + j];
    }
}

```

- With example, explain how the above code might fall victim to *memory-aliasing* problem which is a common optimization blocker.
- Rewrite the code to fix the aliasing problem.

b) Consider the following C source code:

```
int max (int a, int b){
    return a > b ? a : b;
}
int min (int a, int b){
    return a < b ? a : b;
}
int main(){
    printf("%d\n", max(69, 48) + min(0x15, 0x69));
}
```

5+8
(CO1)
(PO2)

- i. How can the above code snippet be an optimization blocker?
- ii. Which technique would you use so that the above program can be optimized by the compiler? Rewrite the code following that technique. Explain why this technique is not desired when debugging functions.

Appendix

Table 6: IDIV instructions

Instruction	Description
IDIV <i>r/m8</i>	Signed divide AX by <i>r/m8</i> , with result stored in: AL ← Quotient, AH ← Remainder.
IDIV <i>r/m8*</i>	Signed divide AX by <i>r/m8</i> , with result stored in AL ← Quotient, AH ← Remainder.
IDIV <i>r/m16</i>	Signed divide DX:AX by <i>r/m16</i> , with result stored in AX ← Quotient, DX ← Remainder.
IDIV <i>r/m32</i>	Signed divide EDX:EAX by <i>r/m32</i> , with result stored in EAX ← Quotient, EDX ← Remainder.
IDIV <i>r/m64</i>	Signed divide RDX:RAX by <i>r/m64</i> , with result stored in RAX ← Quotient, RDX ← Remainder.

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ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4671: Wireless and Mobile Communication**Programmable calculators are not allowed. Do not write anything on the question paper.**Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) What is the need of *Frequency Reuse* in cellular mobile communication? 7
(CO1)
(PO1)
- b) With the aid of a diagram clarify the following terminologies in wireless medium. 10
(CO1)
(PO1)
 - i. Transmission Range
 - ii. Detection Range
 - iii. Interference Range
 - iv. Signal to Noise Ratio (SNR)
- c) Consider a packet of length L which begins at end system A and travels over three links to a destination end system. These three links are connected by two packet switches. Let d_i , s_i , and R_i denote the length, propagation speed, and the transmission rate of link i , for $i = 1, 2, 3$. The packet switch delays each packet by d proc. Assuming no queuing delays, in terms of d_i , s_i , R_i , ($i = 1, 2, 3$), and L , formulate the necessary equations to calculate the total **end-to-end delay** for the packet? 8
(CO2)
(PO1)

Suppose, the packet is 1,500 bytes, the propagation speed on all three links is 2.5×10^8 m/s, the transmission rates of all three links are 2 Mbps, the packet switch processing delay is 3 msec, the length of the first link is 5,000 km, the length of the second link is 4,000 km, and the length of the last link is 1,000 km. For these values, calculate **end-to-end delay**.
2. a) Explain the necessity of Internet Standards. 4
(CO1)
(PO1)
- b) How are the *Mobile Ad Hoc Networks (MANET)* different from *Cellular Networks*? 6
(CO1)
(PO2)
- c) With the aid of an appropriate diagram clarify the fundamental idea of Sensor MAC (S-MAC) protocol in extending the node life time in battery powered Wireless Sensor Networks (WSNs). 8
(CO1)
(PO1)
- d) A *Vehicular Ad-hoc Network (VANET)* consists of groups of moving or stationary vehicles connected by a wireless network. VANET allows vehicles to communicate with the roadside equipment. Propose two promising VANET applications for developing countries. 7
(CO1)
(PO2)

3. a) *Wi-Fi MultiMedia (WMM) ad hoc network* needs to maintain the priority of **audio and video**, over other applications which are less time critical. Hence, for QoS support mechanisms in such networks, random access based *Distributed Coordination Function at Medium Access Control (MAC)* sublayer requires modifications.
- Mention the appropriate IEEE MAC standard as a supplement to the IEEE 802.11 standard which will support quality-of-service (QoS) in the given network. Justify your answer with proper arguments. 7
(CO1)
(PO2)
 - Draw a Timeline Diagram representing the sequence of actions for one successful transmission and one unsuccessful transmission. Note that the x-axis of the diagram shows time and y-axis shows the contending stations. An action (i.e., transmission of a frame) is represented by a horizontal line where the line is placed in the same horizontal line of the station with line length representing period. 10
(CO1)
(PO2)
- b) Consider an application that transmits data at a steady rate (for example, the sender generates an N -bit unit of data every k time units, where k is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why? 8
(CO1)
(PO2)
4. a) List six (6) general strategies in extending the life time of sensor nodes in battery powered Wireless Sensor Networks (WSNs). 7
(CO1)
(PO1)
- b) Consider a *Basic Service Set (BSS)* of IEEE 802.11 Wireless LAN (WLAN) consists of three stations (A , B , and C). Assume that all the stations operate in same frequency band and they can all hear each other's transmissions. Consider the *RTS/CTS* transmission is enabled in this scenario. 18
(CO1)
(PO2)
- Draw a Timeline Diagram representing the sequence of actions for a successful re-transmission from *Station A* to *Station B* after two data collisions.
- The diagram should depict the detailed backoff procedure performed by all the stations in the *BSS*. Consider the minimum *Contention Window*, CW_{min} value is five (5). Note that the x-axis of the diagram shows time and y-axis shows the contending stations in *BSS*. An action (i.e., transmission of a frame) is represented by a horizontal line where the line is placed in the same horizontal line of the station with line length representing period.
5. a) Define *Access Networks* along with an appropriate diagram. 5
(CO1)
(PO1)
- b) Mention the fundamental requirements addressed by *Delay-Tolerant Network (DTN)*. 6
(CO1)
(PO1)
- c) With the aid appropriate figure, clarify the fundamental concept of wastage aware routing in energy harvesting wireless sensor networks (*EH-WSNs*). 8
(CO1)
(PO1)
- d) Compare the *Frequency Division Multiple Access (FDMA)*, and *Space Division Multiple Access (SDMA)* with appropriate diagram. 6
(CO1)
(PO1)

6. a) How does a wireless station detect its collided transmission? Is there any difference in collision detection mechanism in wired and wireless networks? 7
(CO1)
(PO1)
- b) What is meant by *Routing Metric*? 4
(CO1)
(PO1)
- c) Find the path that minimizes the *Expected Transmission Count* from **node A** to **node F** in the given network topology depicted in Fig. 1. Table 1 contains the values of different link parameters. 14
(CO1)
(PO1)

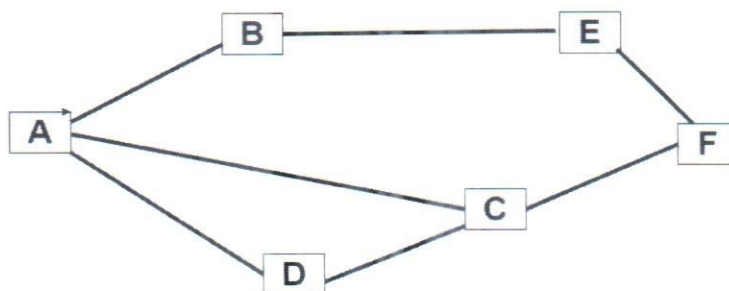


Figure 1: Network topology for question 6.c

Table 1: Network parameters for question 6.c

Link	Forward Delivery Ratio, R_{fwd}	Reverse Delivery Ratio, R_{rev}
A—B	0.85	0.92
A—C	0.70	0.93
A—D	0.92	0.87
B—E	0.76	0.73
C—F	0.88	0.90
D—C	0.77	0.87
E—F	0.88	0.66

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**ORGANISATION OF ISLAMIC COOPERATION (OIC)****Department of Computer Science and Engineering (CSE)****SEMESTER FINAL EXAMINATION****SUMMER SEMESTER, 2020-2021****DURATION: 3 HOURS****FULL MARKS: 150****CSE 4681: Database Management and Information System****Programmable calculators are not allowed. Do not write anything on the question paper.**Answer **all 6 (Six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

-
1. a) Briefly explain the factors that should be considered to measure the performance of a disk with respect to database. 5
(CO1)
(PO1)
 - b) Justify the following two statements: 4+4
 - i. Improvement of Reliability via Redundancy (CO4)
 - ii. Improvement in Performance via Parallelism (PO2)
 - c) Consider the following SQL statements in which each character/number occupies one byte. 3+5+4
 create table instructor (CO3)
 (
 ID varchar2(5),
 name varchar2(15),
 dept_name varchar2(10),
 salary number(10)
); (PO1)
 - i. Calculate the required number bytes will allocated for each record.
 - ii. Find two problems with this simple allocation techniques.
 - iii. How the record can be represented in a variable length storage assuming the offset and length values are taken in two bytes each?
-
2. a) Define indexing with a simple example. What factors are considered to evaluate indexing? 4+4
(CO1)
(PO1)
 - b) Consider the following schema with four attributes: 2+8
instructor (ID, Name, Department, Salary) (CO2)
 Insert at least five records and explain dense and sparse indexes considering ID as a search key. (PO2)
 - c) State the reasons for bucket overflow for Hash-based indexing. 7
(CO1)
(PO2)
-
3. a) Consider the following schema: 3+5
instructor (ID, Name, Department, Salary) (CO2)
 The schema has two indices: one for **Department** and one for **Salary**. (PO1)
 Now, answer the following questions:
 - i. Write a query for finding all instructors (ID only) in the Finance department with salary equal to \$80000.
 - ii. Discuss the possible strategies to process the query.

- b) Consider the precedence graph in Figure 1. Is the corresponding schedule conflict serializable? Explain your answer.

10
(CO4)
(PO2)

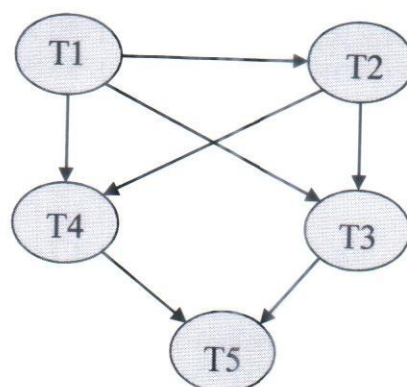


Figure 1: Precedence Graph for Question 3.b)

- c) Consider the following schema:

employee(emp_id, emp_name, job_name,| manager_id, hire_date,| salary,| commission, dep_id)

7
(CO3)
(PO1)

Write a PL/SQL code to display the employee name, job details and salary of top 5 highest paid employees from the below employee table.

4. a) Consider the following transaction:

T1:
read(A)
A=A-50
write(A)
read(b)
B = b+ 50
write(B)

8
(CO4)
(PO1)

Analyze the transaction properties of T1 to maintain the database consistency.

- b) What are the two basic reasons for allowing transaction concurrency? Provide a brief explanation.

5
(CO1)
(PO1)

- c) Consider two transactions T1 and T2. T1 transfers \$1000 from account A to account B and T2 transfers 10% of the balance from account A to account B.

4×3
(CO4)
(PO5)

- Write a schedule in which T1 followed by T2.
- Write a schedule in which T2 followed by T1.
- Convert the schedule in (i) into an equivalent concurrent schedule.

5. a) Consider the following transactions:

12
(CO4)
(PO2)

T1: lock-X(B) read(B) B = B-50 write(B) unlock(B) lock-X(A) read(A) A=A+50 write(A) unlock(A)	T2: lock-S(A) read(A) unlock(A) lock-S(B) read(B) unlock(B) display(A+B)
--	--

Are the above two transactions consistent? If any transaction is in an inconsistent state, what is the solution without altering the order of the transaction?

- b) What is a deadlock in concurrent transactions? Explain with an example. 5
(CO1)
(PO1)
- c) Explain the two phase locking protocol with its basic property. How the locking table is maintained? 8
(CO1)
(PO1)
6. a) Explain the basic principles for dealing with a deadlock. 5
(CO1)
(PO1)
- b) How does the timestamp-ordering protocol operate? Explain with an example. 8
(CO1)
(PO1)
- c) Consider the following schema: 12
Student(*Roll_No*, *Student_Name*, *Course*, *Gender*)
Write a PL/SQL code to create Package specification and Package body in which the procedures can perform insert, select, update and delete operations on the Student table. (CO3)
(PO2)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4801: Compiler Design**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all 6 (six) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. Consider the context-free grammar shown below and answer the following questions:

$$\begin{aligned}
 G &\rightarrow L \\
 L &\rightarrow E ; L \\
 L &\rightarrow E \\
 E &\rightarrow E + T \\
 E &\rightarrow T \\
 T &\rightarrow \text{id} \\
 T &\rightarrow \text{id} () \\
 T &\rightarrow \text{id} (L)
 \end{aligned}$$

- | | |
|---|------------|
| a) Find the set of FIRST(x) and FOLLOW(x), where x is a non-terminal. | 4 |
| | (CO2, PO1) |
| b) Generate canonical LR(0) collection of items for the grammar. | 8 |
| | (CO2, PO1) |
| c) Generate the SLR parse table | 10 |
| | (CO2, PO1) |
| d) Is the grammar SLR(1)? Justify your answer. | 3 |
| | (CO2, PO2) |
| 2. a) List the contents of an activation record (for a procedure call) along with brief description. | 5 |
| | (CO4, PO1) |
| b) Design syntax-directed definitions to generate intermediate codes for the following statements: | 20 |
| | (CO5, PO3) |
| $S \rightarrow \text{if } E \text{ then } S1$ | |
| $S \rightarrow \text{if } E \text{ then } S1 \text{ else } S2$ | |
| $S \rightarrow \text{do } S1 \text{ while } E$ | |
| $S \rightarrow \text{while } E \text{ do } S1$ | |
| 3. a) Draw the block diagram of a language processing system and briefly discuss each of its components. | 10 |
| | (CO1, PO1) |
| b) As a member of a compiler construction team you are asked to implement a <i>symbol table</i> along with <i>symbol table manager</i> . Discuss the implementation strategy you would follow to complete the task with fast access time and efficient memory uses. | 10 |
| | (CO5, PO3) |
| c) Discuss the transformation of a grammar which are needed to apply top-down parsing. | 5 |
| | (CO2, PO1) |

4. a) Consider the context-free grammar shown below and respective parse table shown in Table 1:

13
(CO2, PO2)

$G \rightarrow L$
 $L \rightarrow L P$
 $L \rightarrow P$
 $P \rightarrow (P)$
 $P \rightarrow ()$

Table 1: Parsetable

state	action			goto	
	(	)	\$	L	P
0	s3			1	2
1	s3		accpt		4
2	r3		r3		
3	s6	s7			5
4	r2		r2		
5		s8			
6	s6	s10			9
7	r5		r5		
8	r4		r4		
9		s11			
10		r5			
11		r4			

Show in full detail, the steps that an LR(1) parser would follow to parse the string $(()) ()$ using the above grammar. For each step of the parsing, show the contents of the stack, present input symbol and the action taken.

- b) A compiler designer writes following grammar to support *if-then-else* statement:

12
(CO2, PO2)

$stmt \rightarrow if\ expr\ then\ stmt$
 $\quad | if\ expr\ then\ stmt\ else\ stmt$
 $\quad | other$

Then he realizes that the grammar is ambiguous. So he rewrites the grammar as follows to remedy the dangling-else ambiguity:

$stmt \rightarrow if\ expr\ then\ stmt$
 $\quad | matched_stmt$
 $matched_stmt \rightarrow if\ expr\ then\ matched_stmt\ else\ stmt$
 $\quad | other$

Show that the grammar is still ambiguous.

5. a) Write a *Lex* program which can recognize presence of an even number of alphabetic strings followed by an odd number of integers in a text file. Text file name will be supplied as an argument to the program. The *Lex* program will report start and end position of such sequence(s) present in the provided text file.
- b) In C language, variables can be declare as per following format-

10
(CO1, PO3)

$data_type\ var_1, var_2, var_3, \dots, var_n;$

10
(CO2, PO3)

Common data type keywords in C are *int*, *char* and *float*.

Design a grammar to recognize multiline of variable declarations as per C syntax.

6. a) Write a program using *Lex* and *Yacc* that can convert a prefix expression into postfix expression.
- b) A compiler is needed to provide recursive call for functions. The compiler designer chose *static allocation* strategy for run-time memory allocation for functions. Explain why the selected run-time memory allocation strategy will fail to support the required recursive function call.
- c) Design a tree traversal algorithm to evaluate L-Attributed definitions. Write down the pseudocode to implement the algorithm.

10
(CO1, PO3)

10
(CO4, PO2)

10
(CO3, PO3)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

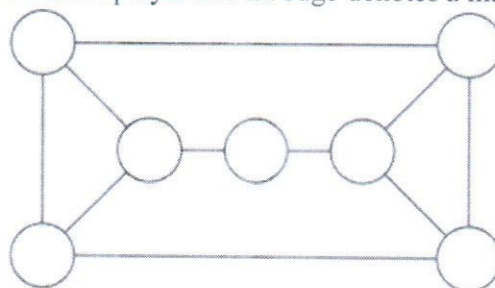
SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4803: Graph Theory**Programmable calculators are not allowed. Do not write anything on the question paper.**Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) There is an ancient city of *Zwishik* where the people of the *Torme* tribe live. The biggest celebration of this city is "Togatuk" which can be roughly translated as the annual beef party. On this day, they arrange different types of games to celebrate. One of such games is named "ncaws pob" where participants take part in 1v1 knockout matches. To keep track of the winners they use a special diagram where the names of the competitors are engraved in circles in the stone wall. An arrow is drawn between two circles indicating that the winner is pointing to the defeated competitor. This diagram can be converted into a directed graph of n vertices considering the circles as vertices and arrows as arcs. 3+4
(CO1)
(PO1)
- i. How many matches does the champion need to win? Justify.
- ii. Find out the diameter and radius of the underlying graph.
- b) In the game of "tsho", competitors paint their body with different colors. Players can paint with the same color if they do not compete against each other. The graph at Figure 1 denotes the fixtures where a circle means player and an edge denotes a match between the players. 4+5
(CO1)
(PO1)

**Figure 1: "tsho" game fixture for Question 1.b)**

- i. What is the minimum number of colors needed to paint the players?
- ii. If the game committee wants to assign a color for each of the games where all the games of a player will have different colors, what is the minimum number of colors needed?
- c) The grand feast of "Togatuk" is arranged by chief *Rkushia* in his central palace. The foods are served in large dishes and kept along the hallways. To prevent stealing and therefore food shortage, a number of special security guards are assigned to different points. Figure 2 shows the design of the dining hall. If a guard is posted in a point where multiple hallways meet, then he can observe all the hallways. What is the minimum number of guards needed to keep all the foods under surveillance? 9
(CO3)
(PO2)

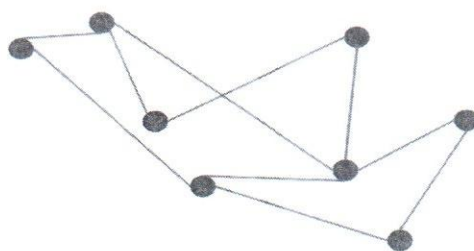


Figure 2: Dining Hall

2. a) The bipartite graph G has parts A and B with labeled vertices as below:

$$A = \{10a + 1, 10a + 2, 10a + 3, 10a + 4, 10a + 5\},$$

$$B = \{10a + 6, 10a + 7, 10a + 8, 10a + 9, 10a + 10\},$$

**The value of a is the last digit of your student ID.

The (undirected) edge set is defined as:

$$E = \{xy : x \in A, y \in B, \gcd(x, y) = 1\}$$

In this graph, find the followings:

- A maximal matching and explain why it is maximal.
- A maximum matching.
- A matching that is maximal but not maximum (if it exists).

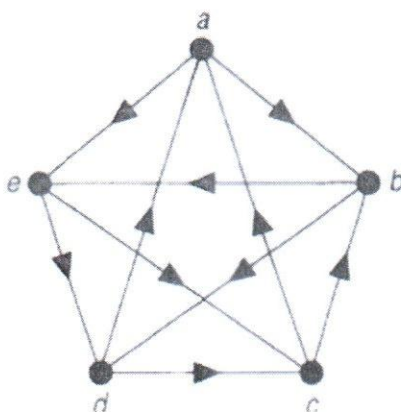
- b) Find out the chromatic polynomial of the following graphs:

- The complete bipartite graph $K_{2,5}$
- The graph at Figure 1.
- A cycle of length 5.

9
(CO1)
(PO1)

4+7+5
(CO1)
(PO1)

3. The *Torme* tribe plays another game called “Pab Koomtes” where every player competes against each other. The graph in Figure 3 depicts such a game where an arc from a to b denotes player a has defeated player b .

Figure 3: A tournament graph, T for Question 3.

- a) Verify the handshaking lemma for the tournament, T in Figure 3.

- b) Justify the following statements based on the graph of Figure 3:

- T has a Hamiltonian circuit.
- T has an Eulerian path.
- T contains a cycle of length 5.

- c) Let D be a simple digraph with n vertices and m arcs.

- Show that if D is connected, then $n - 1 \leq m \leq n(n - 1)$.
- Obtain corresponding bounds for m if D is strongly connected.

5
(CO1)
(PO1)

12
(CO2)
(PO2)

8
(CO1)
(PO1)

4. a) Another game at "Tugatuk" is named "nkawm" which is played in pairs. Team formation is one of the most challenging tasks here. Team is formed through a special kind of auction where a set of n players is given the opportunity to propose any other player from another set of n players. Then based on the preferences set by the players earlier, teams are formed. A list is given in Table 1 where each player has ranked all members of the opposite set in order of preference. 10
(CO1)
(PO1)

Table 1: Preference List

Set A preferences			Set B Preferences	
A	L, O, P, N, M		L	A, B, D, E, C
B	P, L, M, O, N		M	C, A, D, E, B
C	O, M, N, L, P		N	E, B, A, D, C
D	M, O, N, P, L		O	B, A, C, E, D
E	O, N, L, P, M		P	A, B, C, E, D

Form the teams such that there are no two players of opposite set who would both rather have each other than their current partners. (Show all the steps).

- b) The game of "daim npav" is played with a regular deck of 52 cards where each card has an integer from 1 to 13 written on it, and each such number is written on exactly four cards. Suppose these cards are shuffled and dealt face-down into 13 piles, each pile containing four cards. 10
(CO3)
(PO3)

Prove that it is possible for a player to examine each pile, then pick exactly one card from each pile so that in total the player has picked exactly one card of each integer (1 to 13).

- c) Determine whether the following statements are true or false: 5
(CO1)
(PO1)
- The number of spanning trees in the C_n is n .
 - Chromatic index of K_5 is an even number.
 - Every connected bipartite graph contains a cycle of even length.
 - A weakly connected digraph with $\deg^+(v) = \deg^-(v)$ for all vertices v is strongly connected.
 - Arborescence can be used as a tournament graph.

5. a) Use Fleury's algorithm to produce an Eulerian trail for the graph in Figure 4. 10
(CO1)
(PO1)

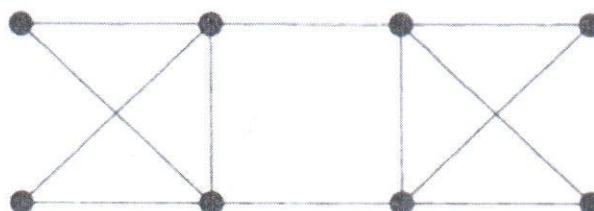


Figure 4: Graph for Question 5(a)

- b) The line graph $L(G)$ of a simple graph G is the graph whose vertices are in one-one correspondence with the edges of G , two vertices of $L(G)$ being adjacent if and only if the corresponding edges of G are adjacent. 4+6
(CO1)
(PO1)
- i. Show that K_3 and $K_{1,3}$ have the same line graph.
 - ii. Show that the line graph of a simple Eulerian graph is Eulerian.
- c) Show that $K_{3,4}$ has crossing number 2. 5
(CO1)
(PO1)
6. a) How many continuous pen-strokes are needed to draw the diagram in Figure 4 without repeating any line? 5
(CO1)
(PO1)

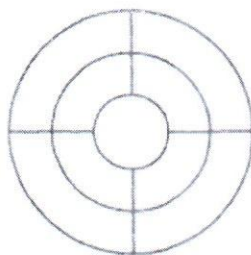


Figure 5: Diagram for Question 6(a)

- b) The *girth* of a graph is the length of its shortest cycle. Write down the girths of the following graphs: 10
(CO1)
(PO1)
- i. K_9
 - ii. $K_{5,7}$
 - iii. C_9
 - iv. W_8
 - v. Q_3
- c) Give an example of the following objects or give a short (one or two sentences should suffice) explanation why no example exists. 10
(CO2)
(PO2)
- i. A simple connected graph with 7 vertices and 6 edges that contains an odd number of distinct cycles. For this problem, two cycles are counted as being “the same” if they use the same set of vertices.
 - ii. A simple connected graph G with ≥ 3 vertices such that both G and $G-e$ have an Eulerian circuit for some $e \in E(G)$.
 - iii. A simple connected graph G with ≥ 3 vertices such that both G and $G-e$ have a Hamiltonian cycle for some $e \in E(G)$.
 - iv. A simple graph with n vertices ($n > 2$) and degree sequence $(n-1, n-2, \dots, 3, 2, 1, 0)$.
 - v. A simple connected graph G such that the maximum size of a matching in G is 2, and the minimum size of a vertex cover in G is 3.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4807: IT Organization and Management

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin.

-
- | | | |
|-------|--|-----------------------|
| 1. a) | Mention the building blocks of an organizational structure. Explain advantages and disadvantages of different “ <i>Centralization</i> ” and “ <i>Formalization</i> ” for an IT organization. | 2+6
(CO1)
(PO1) |
| b) | Briefly explain two different scenarios where you can follow the “ <i>Matrix</i> ” and “ <i>Boundaryless</i> ” formation in an organization. Mention disadvantages of both formations. | 4+4
(CO1)
(PO1) |
| c) | Suppose, you are in a managerial position of a mobile app development company. Identify the reasons for which you have to incorporate organizational changes. Explain how these changes will be related to the growth of the organization. | 4+5
(CO2)
(PO2) |
| 2. a) | Explain “ <i>Leadership</i> ” from the perspective of a team leader in an IT organization. Briefly explain how different types of “ <i>Intelligence</i> ” impacts the activities and personality of the team leader in that organization. | 3+6
(CO1)
(PO1) |
| b) | Mention four types of leadership style. Explain appropriate scenarios of application of each style. | 2+8
(CO1)
(PO1) |
| c) | Explain how you can conduct team meetings to boost the effectiveness of the team. | 6
(CO2)
(PO2) |
| 3. a) | Explain “ <i>Organizational Control</i> ”. Briefly mention the costs and benefits of control in an organization. | 2+8
(CO1)
(PO1) |
| b) | Mention different types of control you can follow as a manager based on proactivity. | 5
(CO1)
(PO1) |
| c) | Briefly explain “ <i>Human Resource Management</i> ”. Explain the scopes of work for HRM according to the American Society for Training and Development (ASTD). | 2+8
(CO1)
(PO1) |

- | | | | |
|----|----|---|-------------------------|
| 4. | a) | Define " <i>Project</i> ". Mention the characteristics of a Project. Give an example of a project and map all the characteristics. | 2+6+6
(CO1)
(PO1) |
| | b) | Explain different types of reporting tools for Project Management. | 6
(CO1)
(PO1) |
| | c) | Explain how you can be a good project manager from the perspective of an IT organization. | 5
(CO1)
(PO1) |
| 5. | a) | Explain " <i>Groupthinking</i> ". Mention the symptoms of groupthinking. | 2+4
(CO1)
(PO1) |
| | b) | Recommend some techniques that each individual, group and group leaders should follow to avoid groupthinking. | 9
(CO1)
(PO1) |
| | c) | Differentiate between individual decision making and group decision making. Explain their pros and cons. | 4+6
(CO1)
(PO1) |
| 6. | a) | Explain the levels of decision - Strategic, Tactical and Operational. Give examples of each type of decision for a web app development firm. Mention the level of employees related to each level of decision making process. | 6+6+3
(CO1)
(PO1) |
| | b) | Briefly explain the following types of bias in decision making process with examples - Anchoring, Hindsight, Framing and Escalation of commitment. | 10
(CO1)
(PO1) |

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4835: Pattern Recognition

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Suppose a dataset contains 10,000 RGB images belonging to n different classes. A linear classifier was used to correctly classify these samples. To achieve better accuracy, K-fold cross-validation was performed. Each of the K-folds ($fold_1, fold_2, \dots, fold_k$) contained an equal number of images. 12
(CO2)
(PO4)
 Firstly $fold_1$ was considered as the test set, $fold_2$ as the validation set and all other $(k - 2)$ folds as training set which led to the accuracy: ' acc_1 '. In the next iteration, $fold_2$ was considered as the test set, $fold_3$ as the validation set and all other $(k - 2)$ folds as training set leading to another accuracy: ' acc_2 '. In this way, the train, test and validation splits were exchanged k times leading to k accuracies ($acc_1, acc_2, \dots, acc_k$). The final performance was claimed to be 95% by averaging all these acc_i values.
 Explain the effectiveness of this experimental method. How much can this result be trusted? Write your remarks with possible comments on improving the methodology (if any).
- b) **Keywords:** {Score, Weight vector, Gradient Descent, Loss Function, Input data, Backpropagation, Regularization} 13
(CO2)
(PO3)
 Draw a flow-chart by arranging the *keywords* mentioned above according to their roles in solving a *classification problem*. Mention their roles & relation with each other properly in the chart.
2. a) Why does a Convolutional Neural Network (CNN) work exceptionally well on image data compared to traditional Neural Network (NN)? Is there any scenario where the traditional NN can have a similar level performance like CNN? 3+4
(CO1)
(PO1)
 b) What is the role of *filters* in CNNs? How does it know what to look for in an image? Suppose, a Deep CNN model has been successfully trained on a *Face Emotion Recognition* dataset. What do you expect the filters in different layers to learn? 3+3+5
(CO3)
(PO2)
 c) Mention the benefits of introducing Batch Normalization (BN) in a CNN architecture. What is the intuition behind introducing *Learnable parameters* in the equation of BN? 5+2
(CO1)
(PO1)
3. a) i. How can *Max-Pooling* introduce shifting invariance in a CNN architecture? 5
(CO1)
(PO1)
 i. Usually, the filters in pooling operation move in the height and width dimensions; not in the channel dimension. Suppose, a new type of pooling operation is introduced which will move in the channel dimension as well. Discuss on the usefulness on this idea. 5
(CO3)
(PO2)
 ii. With proper justification, mention a scenario where *Average-pooling* is found to be a better choice than *Max-pooling*. 5
(CO3)
(PO2)
 b) Explain drawbacks of Stochastic Gradient Descent (SGD) algorithm. How can the concept of SGD+Momentum improve the scenario? 6+4
(CO1)
(PO1)

4. Figure 1 presents the LeNet-5, the 'first architecture' for CNNs (especially when trained on the MNIST dataset, an image dataset for handwritten digit recognition). The architecture is small and easy to understand, yet large enough to provide interesting results. Throughout the network, filters of size 5×5 has been used with stride value of 1 and padding value of 0. Here, each ' C_i ' denotes convolution operation, ' S_i ' represents pooling operation and ' F_i ' represents dense connection.

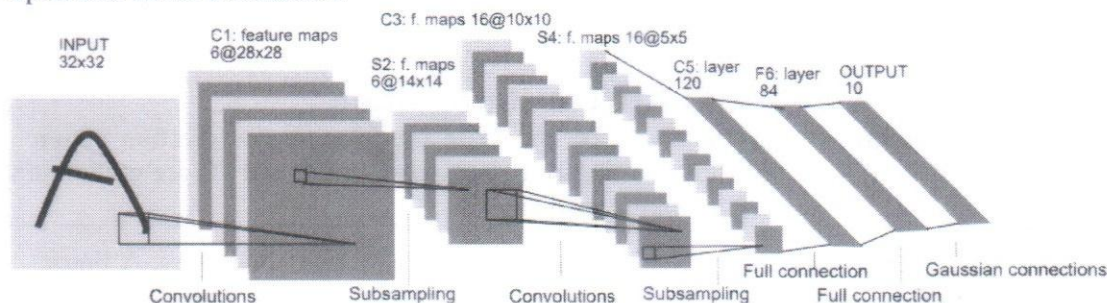


Figure 1: Architecture of LeNet-5, a Convolutional Neural Network. Each plane is a feature map, i.e., a set of units whose weights are constrained to be identical

Based on the scenario, answer the following questions:

- a) Showing detailed steps, compute the total number of trainable parameters, memory requirements and Flops count involved in training the LeNet-5 architecture. (Ignore the bias terms) 15
(CO1)
(PO1)
 - [Note: ' C_5 ' is the result of applying filters of size 5×5 on the activation map provided by ' S_4 '.]
 - b) If this architecture is needed to be applied on a complex dataset, LeNet-5 often fails to provide high performance. Propose a few guidelines to modify the vanilla architecture that might lead to a better performance in such scenario. 10
(CO2)
(PO4)
5. a) AlexNet is a CNN architecture which won the 2012 ImageNet competition with a top-5 error rate of 15.3%, compared to the second-place top-5 error rate of 26.2%. It is the first convolutional network which used GPU to boost performance. The architecture consists of 5 convolutional layers, 3 max-pooling layers, 2 normalization layers, 2 fully connected layers, and 1 Softmax layer. The authors used different filter sizes like 3×3 , 5×5 , 11×11 in the convolution layers and 3×3 in the pooling layers. 5x3
(CO3)
(PO2)

On the other hand, the Visual Geometry Group (VGG) Networks won the competition in 2014 with a top-5 error rate of 7.9%. The authors followed three basic design principles throughout the networks which are:

- i. Instead of using different filter sizes like AlexNet, all convolution operations use filters of size 3×3 , stride and padding value of 1.
- ii. All max pooling operations use 2×2 filters with stride value of 2.
- iii. After each pooling operation, the number of channels should be double.

Justify the intuitions behind each of the design principles of VGG networks and discuss on how they contributed to the overall improvement in performance.

- b) How does 1×1 convolution work? Explain the usefulness of this operation in the different positions of the Inception Module mentioned in Figure 2.

2+8
(CO3)
(PO2)

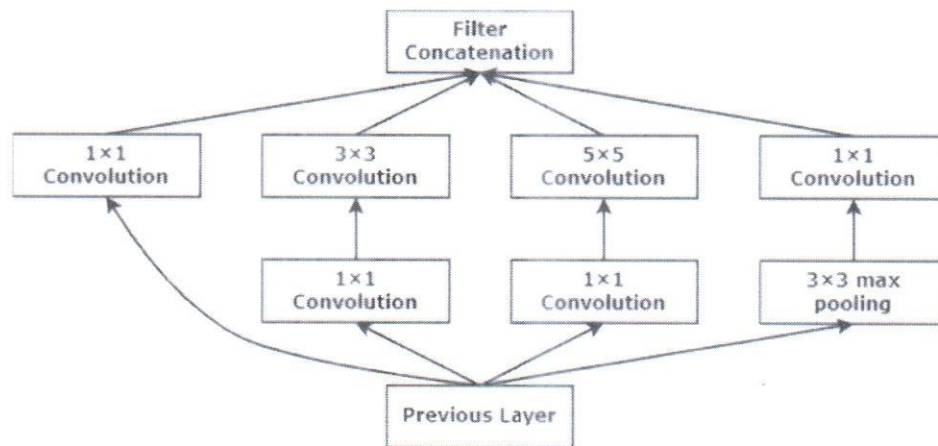


Figure 2: GoogLeNet - Inception Module

6. a) Explain the role of 'Additive shortcut' of the Residual Networks (ResNets) in training very deep CNN models. How does a ResNet-50 architecture offer better performance compared to ResNet-34 despite having less computation cost?
- b) Discuss on how the concept of *Depthwise Separable Convolution* can be applied on the Network mentioned in Figure 3. (Assume that the height and width of the image is denoted by 'H' and 'W').

5+5
(CO2)
(PO2)
8
(CO2)
(PO2)

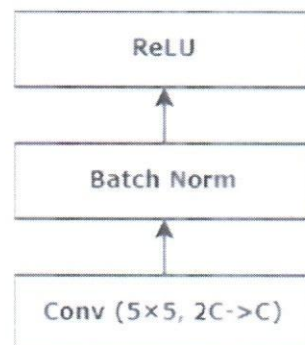


Figure 3: Standard Convolution Block

- c) Draw the *Computational Graph* for the following equation and derive the necessary equations to calculate the gradients of 'x' and 'y'.

3+4
(CO1)
(PO1)

$$f(x, y) = \frac{x + \sigma(x)}{\sigma(x) + (x + y)^2}$$

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION
DURATION: 3 HOURS

SUMMER SEMESTER, 2020-2021
FULL MARKS: 150

CSE 4839: Internetworking Protocols

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin.

1. a) Two Hosts *A* and *B* are connected in a large network. Host *A* is 5000 km apart from Host *B*. A packet in the network is transmitted with a transmission rate of $2.7 \times 10^8 \text{ ms}^{-1}$. Let us consider there is no other delay in the network. The clock of Host *A* is 5 ms slower than the clock of Host *B*.
 Assume Host *B* receives an ICMP message with the header (in hexadecimal).
0D 00 EA F9 00 03 00 02 00 00 08 01 00 00 00 00 00 00 00
 Generate an appropriate ICMP reply message (in hexadecimal) that will be sent by the Host *B*.
 10 (CO3) (PO1)
- b) Host *A* sends a datagram to host *B*. Host *B* never receives the datagram, and host *A* never receives the notification of failure. Give different explanations why host *B* does not receive the datagram. Why does host *A* not receive the failure notification?
 10 (CO1) (PO1)
- c) Why is there a restriction on the generation of an ICMP message in response to a failed Multicast Packets?
 5 (CO1) (PO1)
2. a) Explain the importance of different path attributes in finding the best path using the BGP protocol for any network topology. Differentiate between Internal-BGP session and External BGP session with appropriate examples.
 10 (CO2) (PO1)
- b) Explain the differences of the path-vector routing protocol with the link-state and the distance vector routing protocols. How effective is this path vector in inter-domain routing?
 10 (CO3) (PO1)
- c) Each router inside an AS has its intra-domain routing table (RIP, OSPF, etc.) for forwarding packets inside its own AS. Why does the speaker router not share this routing information with neighbor ASs? How does the i-BGP help in this regard?
 5 (CO2) (PO1)

3. Consider the following ARP Cache table

State	Queue	Attempt	Time-out	Protocol Addr.	Hardware Addr.
R	3		80	188.11.8.71	E34573242ACA
P	2	1		129.34.4.8	
P	12	3		16.1.7.82	
R	18		60	180.14.15.2	457342ACAE32
F					
P	5	5		201.11.56.7	
F					

Figure 1: ARP Cache Table

a) An ARP package of a host computer encounter the following events. 20

(CO2)

- The ARP output module receives an IP datagram (from the IP layer) with the following information in the Header.

45 00 00 54 00 03 00 00 20 06 00 00 7C 4E 03 02 B4 0E 0F 02

- Twenty seconds later, the ARP output module receives an IP datagram (from the IP layer) with the following information in the Header.

45 00 00 C8 00 64 00 00 20 06 00 00 7C 4E 03 02 13 01 07 6E

- Fifteen seconds later, the ARP input module receives an ARP packet with target protocol (IP) address 188.11.8.71 and physical address ACAE32457342.

Show the updated cache table after each event. Also, show the cache table after 100 seconds. (Cache-control module update the entry of cache table after every 40 seconds)

b) Explain the importance of the Address Resolution Protocol (ARP) in packet transmission. Explain why ARP is in between the IP layer and the Data-link layer. 5
(CO2)
(PO1)

4. a) A diskless client on an Ethernet network 192.168.16.0/24 uses DHCP. The DHCP server is on another Ethernet network 128.32.44.0/24. Draw a figure of the networks with appropriate IP addresses (assume the IP addresses from the given network range) for the client, server, and relay agent. Fill out a DHCP request and reply packet. Explain the role of the relay agent in this scenario. 10
(CO5)
(PO1)

b) Can all the information required for a host while booting be retrieved from DHCP? Explain your answer. 5
(CO2)
(PO1)

c) What does Domain refer to in the context of DNS (Domain Name System)? On the internet, the domain namespace is divided into three different sections. Differentiate those domain sections with appropriate examples. 10
(CO2)
(PO1)

5. a) A college professor needs to create a group address to communicate with her students. The AS number that the college belongs to is 23452. Select the best suitable multicast address block for the college. And also assign a unique IP address to the professor. 10
(CO3)
(PO1)
Differentiate between Multiple unicasting and multicasting in packet transmission.
- b) Discuss the limitations of Reverse Path Broadcasting (RPB). Explain how Reverse Path Multicasting (RPM) tries to solve that limitation. Does RPM create the shortest path tree? Explain. 10
(CO3)
(PO1)
- c) What is the purpose of including the IP header and the first 8 bytes of datagram data in the error reporting ICMP messages? 5
(CO2)
(PO1)
6. a) After a mobile host has moved to a foreign network and discovered the foreign agent, it must register. Explain all the aspects of the registration phase in Mobile IP after discovering the foreign agent. Is registration required if the mobile host acts as a foreign agent? Explain your answer. 10
(CO3)
(PO1)
- b) You have the semester final examination ahead. You need the admit card to be eligible to sit for the exam. You want to download it from the SIS (Student Information System) database stored in the IUT server. 10
(CO3)
(PO1)
How will HTTP protocol and different parts of an URL (Universal Resource Locator) help you download it from the IUT server? Explain your answer. (Assume all the information that you need).
- c) How do Cookies help to provide services in today's variety range WWW? 5
(CO1)
(PO1)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

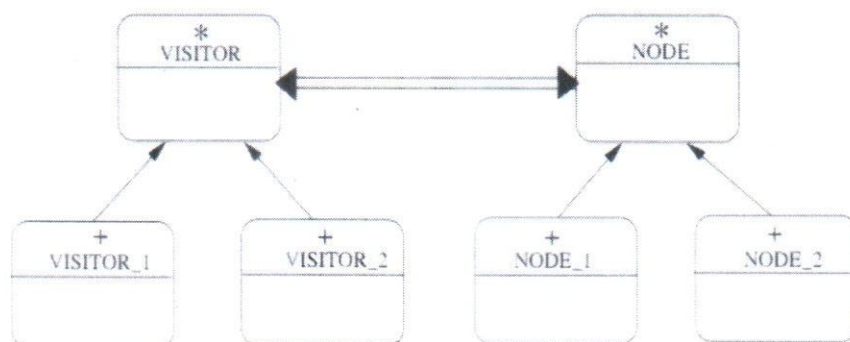
DURATION: 3 Hours

FULL MARKS: 150

CSE 4851: Design Pattern**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) What are the main components of OOP? Discuss the advantage and disadvantage of using **Composition** over **Inheritance**. 2+3
(CO1)
(PO1)
6
(CO4)
(PO2)
- b) **Indicate** for each case which **design pattern** you will use: 6
(CO4)
(PO2)
 - i. Be able to replace the implementation of an interface at run time.
 - ii. Decouple clients of a system X from dependencies on subsystems of X.
 - iii. Provide clients with a reference to an object of type X but defer the creation of an expensive object of type X until it is needed.
 - iv. Define a new operation without changing the classes of the elements on which it operates.
 - v. Used to restore state of an object to a previous state.
 - vi. Promote "invocation of a method on an object".
- c) Explain a scenario where **Bridge** pattern can be used. Write the corresponding code for that scenario. Also, draw the UML diagram for that scenario. 4+5+5
(CO4)
(PO2)
5
(CO3)
(PO2)
15
(CO4)
(PO2)
2. a) What are the relationships between the **Facade** and **Abstract Factory** patterns? 5
(CO3)
(PO2)
15
(CO4)
(PO2)
- b)



Answer the following questions according to the above diagram.

- i) Describe the features required in each deferred class, and a typical effective class in each hierarchy, to support the pattern.
- ii) Suppose a class **NODE_C** is added as a subclass of **NODE**. List and describe the required changes to all of the classes affected by the addition.
- iii) Would you advise using the Visitor Pattern if the **NODE** hierarchy changed frequently? Explain your answer.

- iv) Describe the type of applications that are suitable for the Visitor Pattern.
 - v) Explain the term "*Double Dispatch*" in Visitor pattern.
- c) Explain **low coupling** and **high cohesion** with example. 5
(CO1)
(PO1)
5+6+4
(CO4)
(PO4)
- 3. a) An application for optimizing nurse rosters contains people with shifts that make up individual rosters, and sub-shifts that are parts of shifts. A person has a number of shifts in his roster, and each shift may be divided into several sub-shifts if the person works in different departments during his or her workday. You are part of a group tasked to build a general roster traversal algorithm to generate new rosters based on existing ones. 4
 - i. Sketch out how you would represent people, rosters, shifts, and sub-shifts using **UML**
 - ii. How you would traverse rosters to summarize shift times using your **implementation** (code/ pseudo code).
 - iii. **Name** the relevant design patterns used as part of your design and **explain** how they are used.
- b) Explain the terms related to **MVC** pattern. When and why, you may use **MVC** pattern. 4
(CO3)
(PO4)
- c) Perform a comparative analysis among **Singleton**, **Prototype** and **Flyweight**. 6
(CO3)
(PO4)
- 4. a) Use the **Composite pattern**, to model the notion of a folder in Windows XP. Folders may be nested and may also contain text files and binary files. Files may be opened, closed, and drawn on the screen. Folders may also have items added to and removed from them. Draw the UML diagram for the described model. 5
(CO4)
(PO4)
- b) In object-oriented programming one is advised to avoid case (and if) statements. Select one design pattern that helps avoid case statements and explain how it helps. 10
(CO4)
(PO4)
- c) Describe the intent and motivation of **Adapter** pattern. Explain a scenario satisfying the motivation. 10
(CO3)
(PO4)
- 5. a) Draw a UML diagram for **Mediator pattern** between web services and web clients. As web services, the Ebay auction house and Amazon are available. Plan functions to search for an item with a textual description, and to buy an item from the service that gives you the best price. 5
(CO4)
(PO2)
- b) **Identify** a pattern which can define a one-to-many dependency between objects so that when one object changes state, all its dependents are notified and updated automatically. Briefly explain that pattern with code. Also discuss the advantages and disadvantages of that pattern. 15
(CO4)
(PO2)
- c) It has been suggested that the Decorator design pattern is a degenerate instance of the Composite Design pattern. Explain the statement. 5
(CO3)
(PO2)
- 6 a) Explain the difference between "**Refactoring**" and "**Design pattern**". 5
(CO2)
(PO2)
- b) Write short notes on – "**Duplicated code**" and "**Speculative Generality**". 5
(CO2)

- c) Consider the following code snippets –

(P01)

```

public class Rental {
    private Movie _movie;
    Private int _daysRented;

    public Rental (Movie movie, int daysRented) {
        _movie = movie;
        _daysRented = daysRented
    }

    public int getDaysRented() {
        return _daysRented;
    }

    public Movie getMovie() {
        return _movie;)
    }

    public double amountFor() {
        double thisAmount = 0;
        //determine amounts for each line
        switch (getMovie().getPriceCode()) {
            case Movie.REGULAR:
                thisAmount += 2;
                if (getDaysRented() > 2)
                    thisAmount += (getDaysRented() - 2) * 1.5;
                break;
            case Movie.NEW_RELEASE:
                thisAmount += getDaysRented() * 3;
                break;
            case Movie.CHILDRENS:
                thisAmount += 1.5;
                if (getDaysRented() > 3)
                    thisAmount += (getDaysRented() - 3) * 1.5;
                break;
        }
        return this.Amount; }
    }

public class Movie {
    public static final int CHILDRENS = 2;
    public static final int REGULAR= 0;
    public static final int NEW_RELEASE = 1;

    private String _title;
    private int _priceCode

```

5+5+5

(C02)

(P02)

```
public Movie (String title, int priceCode) {  
    _title = title;  
    _priceCode = priceCode;  
  
    public int getpriceCOde() {  
        return _priceCode;  
    }  
    public void setPriceCode(int arg) {  
        _priceCode = arg;  
    }  
    public String getTitle {  
        return _title;  
    }  
}}
```

- i. Briefly **explain** the terms code refactoring and code smell.
- ii. **Identify** two code smells which occur in the code.
- iii. **Refactor** the code removing the smells.

B.Sc. TE 2nd Semester (1-Yr)
B.Sc. TE 4th Semester (2-Yr)

06 April 2022

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4873: IT Project Management

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin.

-
- | | | |
|-------|--|-------------------------|
| 1. a) | Mention the building blocks of an organizational structure. Explain advantages and disadvantages of different “ <i>Centralization</i> ” and “ <i>Formalization</i> ” for an IT organization. | 2+6
(CO1)
(PO1) |
| b) | Briefly explain two different scenarios where you can follow the “ <i>Matrix</i> ” and “ <i>Boundaryless</i> ” formation in an organization. Mention disadvantages of both formations. | 4+4
(CO1)
(PO1) |
| c) | Suppose, you are in a managerial position of a mobile app development company. Identify the reasons for which you have to incorporate organizational changes. Explain how these changes will be related to the growth of the organization. | 4+5
(CO2)
(PO2) |
| 2. a) | Explain “ <i>Leadership</i> ” from the perspective of a team leader in an IT organization. Briefly explain how different types of “ <i>Intelligence</i> ” impacts the activities and personality of the team leader in that organization. | 3+6
(CO1)
(PO1) |
| b) | Mention four types of leadership style. Explain appropriate scenarios of application of each style. | 2+8
(CO1)
(PO1) |
| c) | Explain how you can conduct team meetings to boost the effectiveness of the team. | 6
(CO2)
(PO2) |
| 3. a) | Explain “ <i>Organizational Control</i> ”. Briefly mention the costs and benefits of control in an organization. | 2+8
(CO1)
(PO1) |
| b) | Mention different types of control you can follow as a manager based on proactivity. | 5
(CO1)
(PO1) |
| c) | Briefly explain “ <i>Human Resource Management</i> ”. Explain the scopes of work for HRM according to the American Society for Training and Development (ASTD). | 2+8
(CO1)
(PO1) |
| 4. a) | Define “ <i>Project</i> ”. Mention the characteristics of a Project. Give an example of a project and map all the characteristics. | 2+6+6
(CO1)
(PO1) |

- b) Explain different types of reporting tools for Project Management. 6
(CO1)
(PO1)
- c) Explain how you can be a good project manager from the perspective of an IT organization. 5
(CO1)
(PO1)
5. a) Explain "*Groupthinking*". Mention the symptoms of groupthinking. 2+4
(CO1)
(PO1)
- b) Recommend some techniques that each individual, group and group leaders should follow to avoid groupthinking. 9
(CO1)
(PO1)
- c) Differentiate between individual decision making and group decision making. Explain their pros and cons. 4+6
(CO1)
(PO1)
6. a) Explain the levels of decision - Strategic, Tactical and Operational. Give examples of each type of decision for a web app development firm. Mention the level of employees related to each level of decision making process. 6+6+3
(CO1)
(PO1)
- b) Briefly explain the following types of bias in decision making process with examples - Anchoring, Hindsight, Framing and Escalation of commitment. 10
(CO1)
(PO1)

B.Sc. Engg. B.Sc. TE (1-Yr)
B.Sc. Engg. B.Sc. TE (2-Yr)

28 March 2022

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4885: Human Computer Interaction

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

Based on the following scenario and story, answer question number 1, 2, 3 and 4.

Restaurant 'Seasonal Platter' is a special kind of restaurant. During different seasons, like summer, winter or fall, they offer different types of specialty dishes. A special software is used to offer the dishes to the *customers for their choice*. At the end of the season, the customers who have an account with the restaurant can upvote or downvote the dishes, which would then affect the dishes of the later seasons. Dishes are actually *offered by the chefs themselves*, since they are responsible for offering their own specialty. A *manager oversees the whole process* and can modify, update or remove a dish offered by any chef.

Upon interviewing a famous chef, Mr. Rordon Gamsey from 'Seasonal Platter', a description of the overall process of offering a new dish was found and is attached below.

"Yeah, I remember the whole process. It is a bit tedious, but nothing too complex. First you need to log in with your chef account. Once there, you can offer new dishes. But before you offer, first you got to check whether your dish already exists or not. Like my Pineapple Smoothie is an all season favorite and it is there, always. So I do not need to re-offer it every time. However they did not like my Chicken Pot Pie last season, so it got removed from the display automatically by the system. I am offering it this season again though, since I believe it deserves a second chance. Since it was already offered once before, I just need to put it in the display using a single click, nothing an old chef cannot handle. I am also offering Chocolate Naga Cake this season, a completely new recipe. For this one though, I first need to create a new dish, put the name and the list of all the ingredients etc. Like you know, people have personal preferences, right? Once the dish is created, I can offer it to the whole world by a single click."

The owner of 'Season Platter' has decided to integrate an interactive display in each of the tables of the restaurant so that the customers can easily browse the dishes, order and register themselves and give their feedback. He has also decided to put the systems in the kitchen so that the chefs can fully utilize their eureka moments while inventing new dishes and register them right away.

1. a) With respect to the scenario, extract 3 requirements for each of the following cases that could have been used to build the system. Give a 1 or 2 line justification for each of them.
 - i. Functional Requirements
 - ii. Data Requirements
 - iii. Environmental Requirements
 - iv. User Requirements
 - v. Usability Requirements

5×3=15
(CO4)
(PO2)

- b) Based on the user story written above, create a Hierarchical Task Analysis with Plans and Graphs for *offering a new/existing dish by a chef*. 10
(CO4)
(PO2)
2. a) Briefly elaborate on two data gathering methods that you would find suitable in the above context if you were asked to implement the system from scratch. For each of the methods, explain how the specific method's advantage is going to fit the system and how the disadvantage needs to be overcome. 2□4=8
(CO4)
(PO2)
- b) What are the different personas that can be taken into consideration while designing the aforementioned system based on the three roles, customers, chef and manager? Mention 6 personas with just their abilities or shortcomings with respect to the system in 2-3 sentences. You can choose your own distribution of persona under each role, for instance, 3 personas under customers, 2 under chefs and 1 under manager etc. 6□2=12
(CO4)
(PO2)
- c) Can the process of affinitization help the development of the aforementioned system? Give proper reasoning behind your answer within 10 simple sentences. 5
(CO4)
(PO2)
3. a) Different prototyping techniques are suitable for different tasks. For instance, the above story can be represented using storyboarding or a series of sketches. Now, for the following tasks, mention a suitable prototyping method with 3 sentences explaining each why they are suitable. 3□3=9
(CO5)
(PO2)
- i. Creating UI for the chefs for offering recipe
ii. Describing the interaction sequence of voting to the users
iii. Taking feedback from the users on the system
- b) Represent a chef offering a new dish using storyboarding. The drawings need not be very good, but clear and understandable drawings are required. 10
(CO5)
(PO2)
- c) Explain the sentence, "Though prototyping might prove to be costly in the initial phase, it may save valuable time and resources in the long run". 6
(CO1)
(PO1)
4. a) With respect to the scenario and aforementioned questions, illustrate how the Star Model can facilitate a user centric design process. 5
(CO3)
(PO2)
- b) Suppose the owner of the restaurant wants to find an answer to the research question, "Does the color of the customer's UI influence the purchase decision and amount of a specific type of food (appetizer, main course and/or dessert)?". With respect to the research question, 5+10+5=20
(CO5)
(PO2)
- i. Describe an experiment with steps that may facilitate the answer to the question.
ii. Formally construct the independent, dependent, control, random and confounding variables of the experiment.
iii. Choose and justify a proper evaluation approach for the experiment.
5. Suppose you want to design a command line application for a certain task. The application has upto 30 configurable parameters. In your current design, the user may pass the value of each of the arguments or parameters while calling it from the terminal. Though 'help' can be called to list down all the possible parameters, novice users still find it difficult to properly use the application. And in many cases, for a certain user or environment, a lot of the parameters remain the same. For the simplicity of understanding, invocation of a command line tool, gcc for compiling a single C file is given below.

```
$ gcc Filename.c -o Application
```

The program takes 3 arguments, first one being the file name to compile, then '-o' to indicate that the next argument would be output file name/path and then accordingly, the output file name. Now based on this scenario, answer the following questions.

- | | | |
|-------|--|----------------------|
| a) | Point out how human memory, both short term and long term, can affect the usability of the aforementioned application. | 8
(CO2)
(PO2) |
| b) | Propose an ideal solution (a single one based on your decision) to the problem of having 30 parameters in the aforementioned program. You cannot decrease the number of parameters | 9
(CO2)
(PO2) |
| c) | Exemplify how the characteristics of reading text of human beings should influence the design of terminals and the output of command line programs. | 8
(CO2)
(PO2) |
| 6. a) | Based on your understanding from the classes, define what HCI is and where it is used under 15 simple sentences. | 10
(CO1)
(PO1) |
| b) | Note down and describe at least 3 domains that you think contributed in making this question paper. It was written in Google Docs. Each domain description should not exceed more than 5 simple sentences. | 8
(CO1)
(PO1) |
| c) | Define interface metaphors and how they influence the design of user interface in computer science under 7 sentences. | 7
(CO1)
(PO1) |

M. Engg. (CSE)

29 March, 2022

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 6205: Advanced Operating Systems

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

-
1. a) Consider a multicore processor with four heterogeneous cores labeled A, B, C, and D. Assume cores A and D have the same speed. Core B runs twice as fast as core A, and core C runs three times faster than core A. Assume that all four cores start executing the following application at the same time and no cache misses are encountered in all core operations. Suppose an application needs to compute the square of each element of an array of 256 elements. Assume 1 unit time for core A or D to compute the square of an element. Thus, core B takes 1/2-unit time and core C takes 1/3-unit time to compute the square of an element. Given the following division of labor in four cores:
 - Core A 32 elements
 - Core B 128 elements
 - Core C 64 elements
 - Core D 32 elements
 - i. Compute the total execution time (in time units) for using the four-core processor to compute the squares of 256 elements in parallel. The four cores have different speeds. Some faster cores finish the job and may become idle, while others are still busy computing until all squares are computed.
 - ii. Calculate the processor utilization rate, which is the total amount of time the cores are busy (not idle) divided by the total execution time they are using all cores in the processor to execute the above application.
 - b) What are the differences between multicore CPUs and GPUs in terms of architecture and usage? 8
 - c) What are the differences between multicore Gird and cloud computing? 5
 2. a) Discuss the drawbacks in disruptive changes in processor architecture. Why is the memory wall a major problem in achieving scalable changes in performance? 7
 - b) Why is power consumption critical to data-center operations? 8

- c) Why are virtual machines and virtual clusters suggested in cloud computing systems? What are the impacts of cloud platforms on the future of the HPC and HTC industry? 10
3. a) Explain the differences between hypervisor and para-virtualization and give one example VMM (virtual machine monitor), that was built in each of the two categories. 10
- b) What are the different levels of Virtualization implementation? Compare the hardware-level virtualization with OS-level virtualization in term of performance, application flexibility and application isolation. 10
- c) What are the enabling technologies for the Internet of Things (IoT)? 5
4. a) Differentiate and exemplify the following terms related to clusters: 12
- i. Compact versus slack clusters
 - ii. Centralized versus decentralized clusters
 - iii. Homogeneous versus heterogeneous cluster
- b) Assume that when a node fails, it takes 10 seconds to diagnose the fault and another 30 seconds for the workload to be switched over. 10
- i. What is the availability of the cluster if planned downtime is ignored?
 - ii. What is the availability of the cluster if the cluster is taken down one hour per week for maintenance, but one node at a time?
- c) What is GPGPU? 3
5. a) What is application-level virtualization, and how does it work? Do you have any experience with application-level virtualization? Use an example to illustrate your position. 12
- b) Define and differentiate, "Scalability over machine size", in terms of scalability. 5
- c) Today's multicore CPUs deploy a hierarchy of caches. Discuss different levels of cache in terms of performance and cache size. 8
6. a) Briefly define the following basic techniques and technologies that represent recent related advances in computer architecture and distributed system: 9
- i. High-performance computing (HPC) system
 - ii. High-throughput computing (HTC) system
 - iii. Computer cluster versus computational grid
- b) An increasing number of organizations in industry and business sectors adopt cloud systems. Discuss different ways for cloud service providers to maximize their revenues. 6
- c) P2P networks are classified into four categories based on their application. Briefly explore each group's attractive application and operational problems. 10

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**ORGANISATION OF ISLAMIC COOPERATION (OIC)****Department of Computer Science and Engineering (CSE)****SEMESTER FINAL EXAMINATION****SUMMER SEMESTER, 2020-2021****DURATION: 3 Hours****FULL MARKS: 150****CSE 6215: Neural Network****Programmable calculators are not allowed. Do not write anything on the question paper.**There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

1. a) What is the purpose of parietal lobe in the human brain? Differentiate between supervised learning and unsupervised learning techniques with their respective algorithms and applications. 13
- b) What is the purpose of Inhibitory inputs in McCulloch-Pitts neurons? Consider the following example of classifying trucks given their masses and lengths. How do you construct a neural network that can classify any Lorry and Van according to the cookbook recipe of building a neural network? 12

Table 1: Truck classification given mass and length

Mass	Length	Class
10	6	Lorry
20	5	Lorry
5	4	Van
2	5	Van
2	5	Van
3	6	Lorry
10	7	Lorry
15	8	Lorry
5	9	Lorry

2. a) What types of limitations can be solved by the non-linear activation functions? Explain the advantages and limitations of ReLU (Rectified Linear Unit) activation function. 12
- b) What factors decide the best number of hidden units? Explain the mathematics behind the following equation of weight change from the hidden layer unit j to the output layer unit k in a Backpropagation algorithm: 13

$$\Delta w_{jk} = \eta \delta_k o_j, \text{ where, } \delta_k = (y_{\text{target},k} - y_k) y_k (1 - y_k)$$
3. a) What is Radial Basis Function? Explain how Radial Basis Function Network (RBFN) measures the input's similarity to the examples from the training set in order to perform classification. 12
- b) What is the purpose of reinforcement learning? Explain the mathematics behind the update rule for Q-learning algorithm. 13
4. a) What is hetero-associative memory? Why spurious states are faced by Hopfield network? Explain the Hopfield algorithm with an example. 13

- b) What is Hebbian learning technique? How does BAM (Bidirectional Associative Memory) store the following two associations, A1:B1 and A2:B2. Where, 12

$$A1 = (1, 0, 1, 0, 1, 0), B1 = (1, 1, 0, 0)$$

$$A2 = (1, 1, 1, 0, 0, 0), B2 = (1, 0, 1, 0)$$

5. a) What are the drawbacks of Kohonen Maps? Explain the self-organizing map (SOM) algorithm. 12
 b) Explain the stability-plasticity dilemma which is common in designing intelligent learning systems. Briefly explain the ART-1 architecture. 13
6. a) What are the limitations of Convolutional Neural Network (CNN)? Explain the following terms in respect to CNN: 13
 i. Local Receptive Fields
 ii. Feature Map
 iii. Shared Weights
 b) When should we use a Recurrent Neural Networks (RNN)? How to train a RNN? 12
7. a) What Are Generative Adversarial Networks (GAN)? Distinguish between Discriminative and Generative Modeling. 12
 b) What is the concept behind VGG (Visual Geometry Group) Net? What is the problem with VGG Net and why do we need ResNets (Residual Learning for Image Recognition)? Explain your answer. 13
8. a) Why is batch normalization used in neural network? Explain the general architecture of the real time object detection algorithm – 'YOLO (You Only Look Once)'. 13
 b) What are the applications of BERT (Bidirectional Encoder Representations from Transformers)? How does the BERT work? 12

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)**

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 Hours

FULL MARKS: 150

CSE 6255: Advanced Internet Computing

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **6 (six)** questions. Answer **All** of them.

Figures in the right margin indicate marks.

1. Suppose you have to design and implement a web application for community policing service. There are three main features that you have to design. First, the police can send 'alerts' directly to the community, providing important information such as local events, traffic incidents and matters of public safety. Then, users can report selected quality of life and criminal incidents. Finally, the web application provides various forms of municipal information and a link to make emergency calls if necessary.
 - a) What are the Java web technologies suitable to implement the application? Justify your choice. 8
 - b) Draw and explain the J2EE architectural components that you will choose to implement. 10
 - c) Justify that your chosen technology can make the internet communication faster and secure. 7

2.
 - a) With a suitable example, briefly explain how the Servlet technology is used as a controller while developing a web application. 10
 - b) Suppose a user submits a request through a webpage to know his tax return information. The national board of revenue (NBR) website requires user information logged in their log file for future reference. However, the users' authentication process needs to be ensured to access server resources. If the user is not authenticated, the NBR website will redirect the user to a login page and after that the user can know his tax return information. Draw an architectural diagram to give a solution of this scenario using Servlet Filter technology. Explain how the Filter will work in this case. 10
 - c) Briefly explain how *HttpSession* works. 5

3.
 - a) What is Singleton pattern? With an example code show how the Singleton pattern can be used to develop shopping cart instance of a classical e-commerce web application. 10
 - b) Suppose you have to develop an online Medical Health Record (MHR). The system consists of Java application client through which a user can check his electronic health reports, and manage the access credentials of those reports for the other users (e.g. Doctors, Caregiver, Nurse, Consultant etc.) to view, update or edit. Your business logics and information about MHR and access credentials kept in required session beans and separate entities. 15

Draw a diagram to show the façade pattern indicating appropriate entities and session beans. Describe how you will implement the project with different web technologies. [Use code snippets if necessary]

4.
 - a) What are the different scripting elements available in JSP? Write a page counter example using JSP scripting elements. 10
 - b) Give an example implementation of Model-2 web architectural model of a web application using JSP, JavaBean, and Servlet technologies. 12
 - c) Write the advantages of JSP expression language (EL). 3

5. a) Different e-commerce websites use countdown timer that starts a certain time before the arrival of any product or offer. Write a JavaScript code to implement countdown timer that starts from a specific date and ends to a target date. The scripting code should display in days, hours, minutes, and seconds. 7
- b) What is RMI? Explain how RMI works according to the Figure 1 below: 9

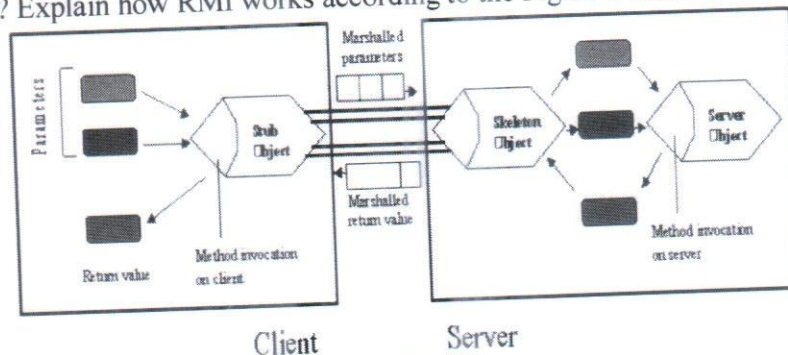


Figure 1: RMI model

- c) Write a socket-based java server program that responds to client messages as stated: "When it receives a message from a client, it simply converts the message into all uppercase letters and sends back the same to the client". Write both client and server programs demonstrating the scenario. 9
6. a) Explain the usage of DAO, DTO pattern used in web application development according to Figure 2 with an example implementation. 12

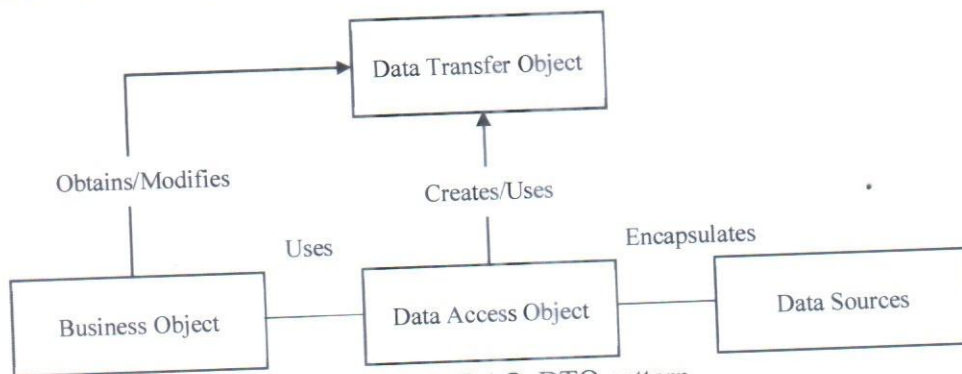


Figure 2: DAO, DTO pattern

- b) A Java EE container contains three essential components: a web (i.e., Servlet/JSP) container, an EJB container, and a persistence provider. Describe the functionalities of these three components. 9
- c) Briefly explain the relationship between Entity Manager and Persistence Context in EJB 3.0 specification. 4

Islamic University of Technology

Organisation of Islamic Cooperation (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2021-2022

Duration: 3 Houres

Full Marks: 150

CSE 6279: Big Data Analysis and Management

Programmable calculators are not allowed. Do not write anything on the question paper. There are 06 (six) questions. Answer **all** of them. Figures in the right margin indicate marks.

1. (a) Consider one application was built using the traditional relational database system. The application addresses the following query: [10]
Find the list of employees and students who work or study at IUT, Boardbazar campus.
 Your task is to modify or add new features so that big data platform suits here. Also mention the major challenges in your new design.
- (b) Explain base line of the Bonferroni's Principle (BP) to avoid "bogus" false positive. Consider the following scenario: [15]
Objective: To detect "evil doers" We hold the following assumptions:
 - There are 150 million people who might be evil doers.
 - Everyone goes to a hotel one day out of 90 days.
 - A hotel's capacity is 200 persons.
 - Total observation period is 300 days.
 - As a pattern for an evil doer we consider: for a given hotel 3 persons visit the hotel on 3 different dates for a common purpose.
 Your task is to apply the BP to test if this approach to detecting evil doers is feasible.
2. (a) Machine Learning (ML) algorithms are frequently used to deal with big data applications. One of the major challenges in ML algorithm is that it is often produces accurate result but not able to explain the result. Is it always necessary to explain ML algorithm? Justify your position with suitable examples. [5]
- (b) Given two objects represented by the tuples (19, 3, 42, 10) and (21, 1, 36, 7): [10]
 - Compute the Euclidean distance between the two objects.
 - Compute the Manhattan distance between the two objects.
 - Compute the supremum distance between the two objects.
- (c) Comment on the upper limit of Jaccard Similarity of Bags. Explain how it can be used to find similarity of start ratings. Use a suitable example to explain the basic motivation of Cosine Similarity measurement. [10]
3. (a) For document similarity 3 concepts are closely related (i) Shingling (ii) Minhashing and (iii) Locality Sensitive Hash (LSH). Explain the bigger picture in short. [10]
- (b) Consider the following Boolean Matrix against 4 Elements/Shingles. Show each step to generate Minhash Signature based on Random Hash Function. Use 2 random hash functions. Be careful to choose the hash function so that it is uniformly distributed and free from collision. Finally verify its correctness against Jaccard Similarity. [15]

Table 1: For Question 3.(b)

Elements	d1	d2	d3	d4
a	1	0	1	0
b	1	1	1	0
c	1	1	0	0
d	0	1	0	1

4. (a) In Page Rank algorithm the importance of a page is the sum of the votes on its in-links, not on its out-links. Strengthen the fact with suitable argument and example. [5]
- (b) Can Gaussian Elimination Method solve the flow equations considering today's network structure? Justify your position. [5]
- (c) Page Rank matrix formulation has 2 major components and 1 flow formulation. Briefly discuss them. [5]
- (d) Dead-end and spider-trap are the two major problems in Page Rank. Briefly outline them. To overcome the problem "random teleports" are used. Use this concept to convert the Stochastic Adjacency Matrix M into its equivalent Google Matrix A. [10]
5. (a) Data collection is an important part in building a recommendation system. Both explicit and implicit methods are used for this purpose. Briefly outline their relative merits and demerits. [5]
- (b) Consider the following ratings for movies by 3 users: [10]

Table 2: For Question 5.(b)

	HP1	HP2	TW	SW1	SW2
U1		4			
U2	1	5	4	4	
U3	5		1		5

First derive the intuitions about the movie preferences of these users. Can these intuitions be verified by Jaccard Similarity? Justify.

- (c) Use the same example of question 5.(b) and show how it can be addressed by cosine similarity measure. Show each step. Can you identify any weakness in this approach? How can you eliminate it? Explain. [10]
6. (a) State the main challenge of storing Stochastic Adjacency Matrix M used in Page Rank algorithm. How can you overcome this challenge? Explain. Suppose you have a smart phone with only few Megabytes of memory. Can you apply Page Rank update algorithm in your smart phone. Present a comprehensive analysis on your position. [10]
- (b) Content-based recommendation system has a number of benefits. Briefly outline them. At the same time discuss the major two problems of this approach. [5]
- (c) Explain the concept of "Perceptrons". *The perceptron algorithm will converge to a separator.* Justify your position. [10]

M. Sc.T.E.

29 March, 2022

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)**

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 6295: Distributed Operating Systems

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

-
1. a) Briefly define the following basic techniques and technologies that represent recent related advances in computer architecture and distributed system: 9
 - i. High-performance computing (HPC) system
 - ii. High-throughput computing (HTC) system
 - iii. Computer cluster versus computational grid
 - b) An increasing number of organizations in industry and business sectors adopt cloud systems. Discuss different ways for cloud service providers to maximize their revenues. 6
 - c) P2P networks are classified into four categories based on their application. Briefly explore each group's attractive application and operational problems. 10
 2. a) Consider a multicore processor with four heterogeneous cores labeled A, B, C, and D. Assume cores A and D have the same speed. Core B runs twice as fast as core A, and core C runs three times faster than core A. Assume that all four cores start executing the following application at the same time and no cache misses are encountered in all core operations. Suppose an application needs to compute the square of each element of an array of 256 elements. Assume 1 unit time for core A or D to compute the square of an element. Thus, core B takes 1/2-unit time and core C takes 1/3-unit time to compute the square of an element. Given the following division of labor in four cores: 12
 - Core A 32 elements
 - Core B 128 elements
 - Core C 64 elements
 - Core D 32 elements
 - i. Compute the total execution time (in time units) for using the four-core processor to compute the squares of 256 elements in parallel. The four cores have different speeds. Some faster cores finish the job and may become idle, while others are still busy computing until all squares are computed.

- ii. Calculate the processor utilization rate, which is the total amount of time the cores are busy (not idle) divided by the total execution time they are using all cores in the processor to execute the above application.
- b) What are the differences between multicore CPUs and GPUs in terms of architecture and usage? 8
- c) What are the differences between multicore Gird and cloud computing? 5
- 3. a) Discuss the drawbacks in disruptive changes in processor architecture. Why is the memory wall a major problem in achieving scalable changes in performance? 7
- Why is power consumption critical to data-center operations? 8
- c) Why are virtual machines and virtual clusters suggested in cloud computing systems? What are the impacts of cloud platforms on the future of the HPC and HTC industry? 10
- 4. a) Explain the differences between hypervisor and para-virtualization and give one example VMM (virtual machine monitor), that was built in each of the two categories. 10
- b) What are the different levels of Virtualization implementation? Compare the hardware-level virtualization with OS-level virtualization in term of performance, application flexibility and application isolation. 10
- c) What are the enabling technologies for the Internet of Things (IoT)? 5
- 5. a) Differentiate and exemplify the following terms related to clusters: 12
 - i. Compact versus slack clusters
 - ii. Centralized versus decentralized clusters
 - iii. Homogeneous versus heterogeneous cluster
- b) Assume that when a node fails, it takes 10 seconds to diagnose the fault and another 30 seconds for the workload to be switched over. 10
 - i. What is the availability of the cluster if planned downtime is ignored?
 - ii. What is the availability of the cluster if the cluster is taken down one hour per week for maintenance, but one node at a time?
- c) What is GPGPU? 3
- 6. a) What is application-level virtualization, and how does it work? Do you have any experience with application-level virtualization? Use an example to illustrate your position. 12
- b) Define and differentiate "Scalability over machine size" in terms of scalability 5
- c) Today's multicore CPUs deploy a hierarchy of caches. Discuss different levels of cache in terms of performance and cache size. 8

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)**

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 Hours

FULL MARKS: 150

CSE 6491: Advanced Internet Computing

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **6 (six)** questions. Answer **All** of them.

Figures in the right margin indicate marks.

1. Suppose you have to design and implement a web application for community policing service. There are three main features that you have to design. First, the police can send 'alerts' directly to the community, providing important information such as local events, traffic incidents and matters of public safety. Then, users can report selected quality of life and criminal incidents. Finally, the web application provides various forms of municipal information and a link to make emergency calls if necessary.
 - a) What are the Java web technologies suitable to implement the application? Justify your choice. 8
 - b) Draw and explain the J2EE architectural components that you will choose to implement. 10
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 - a) With a suitable example, briefly explain how the Servlet technology is used as a controller while developing a web application. 10
 - b) Suppose a user submits a request through a webpage to know his tax return information. The national board of revenue (NBR) website requires user information logged in their log file for future reference. However, the users' authentication process needs to be ensured to access server resources. If the user is not authenticated, the NBR website will redirect the user to a login page and after that the user can know his tax return information. Draw an architectural diagram to give a solution of this scenario using Servlet Filter technology. Explain how the Filter will work in this case. 10
 - c) Briefly explain how *HttpSession* works. 5

3.
 - a) What is Singleton pattern? With an example code show how the Singleton pattern can be used to develop shopping cart instance of a classical e-commerce web application. 10
 - b) Suppose you have to develop an online Medical Health Record (MHR). The system consists of Java application client through which a user can check his electronic health reports, and manage the access credentials of those reports for the other users (e.g. Doctors, Caregiver, Nurse, Consultant etc.) to view, update or edit. Your business logics and information about MHR and access credentials kept in required session beans and separate entities. 15

Draw a diagram to show the façade pattern indicating appropriate entities and session beans. Describe how you will implement the project with different web technologies. [Use code snippets if necessary]

4.
 - a) What are the different scripting elements available in JSP? Write a page counter example using JSP scripting elements. 10
 - b) Give an example implementation of Model-2 web architectural model of a web application using JSP, JavaBean, and Servlet technologies. 12
 - c) Write the advantages of JSP expression language (EL). 3

5. a) Different e-commerce websites use countdown timer that starts a certain time before the arrival of any product or offer. Write a JavaScript code to implement countdown timer that starts from a specific date and ends to a target date. The scripting code should display in days, hours, minutes, and seconds. 7
- b) What is RMI? Explain how RMI works according to the Figure 1 below: 9

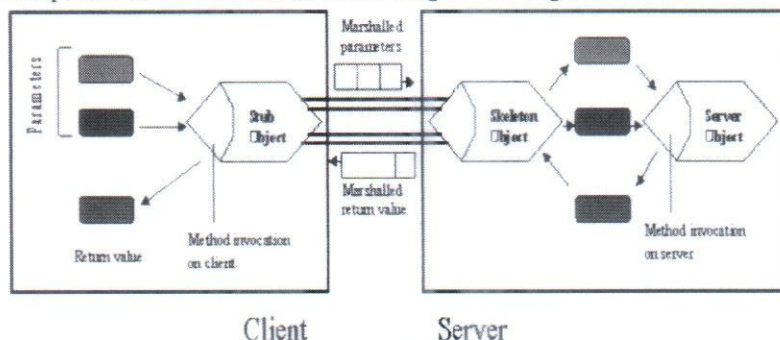


Figure 1: RMI model

- c) Write a socket-based java server program that responds to client messages as stated: "When it receives a message from a client, it simply converts the message into all uppercase letters and sends back the same to the client". Write both client and server programs demonstrating the scenario. 9
6. a) Explain the usage of DAO, DTO pattern used in web application development according to Figure 2 with an example implementation. 12

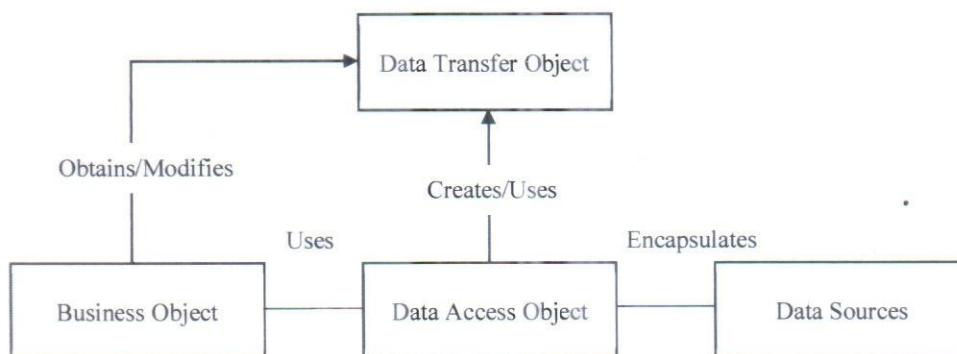


Figure 2: DAO, DTO pattern

- b) A Java EE container contains three essential components: a web (i.e., Servlet/JSP) container, an EJB container, and a persistence provider. Describe the functionalities of these three components. 9
- c) Briefly explain the relationship between Entity Manager and Persistence Context in EJB 3.0 specification. 4

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER: FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

SWE 4201: Object Oriented Concepts I**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. A product management software for a superstore maintains a *List* of products to keep track of the items in the store. Pencils, notebooks, chocolates, and other items may be available in the super shop. Each type of product has its own set of attributes as well as some common ones like quantity, price, etc.
 - a) Create a *UpdateProductList* utility class comprising two methods: *AddProduct* and *RemoveProduct*, that adhere to the following criteria:
 - Any instance of a class that inherits the *Product* class will be allowed to be passed as a parameter to the methods. You should use *Generics* to implement this feature.
 - The *AddProduct* method will increase the quantity of a product if it already exists in the *ProductList*. Otherwise, it will add a new type of product to the existing list.
 - The *RemoveProduct* method will decrease the amount of an existing product by a certain quantity.
 - You should be able to utilize these two methods without creating an instance of the *UpdateProductList* class.

10
(CO2)
(PO2)
 - b) The *RemoveProduct* method will not be able to remove a product from the list if it does not exist in the *ProductList*. In addition, if the number of items to be reduced exceeds the current quantity of a product, the system will be in a state of inconsistency. To prevent this from happening, the *RemoveProduct* method should throw exceptions in both of these scenarios.
Create two custom exception classes, and update the *RemoveProduct* method's code to implement the required features.

10
(CO2)
(PO2)
 - c) "Having separate *AddProduct* and *RemoveProduct* methods rather than adding (*Array.Add*) to the *ProductList* directly from other classes is beneficial"- Do you agree with the statement? Justify your answer.

5
(CO1)
(PO1)
2. Dr. Gregory House leads a team of diagnosticians as the Head of Diagnostic Medicine at the Princeton-Plainsboro Teaching Hospital in Princeton, New Jersey. His team comprises the following members:
 - Dr. Eric Foreman, Neurologist.
 - Dr. Allison Cameron, Immunologist.
 - Dr. Robert Chase, Surgeon.

This hospital has a Hospital Management System in place. This system already has a *Physician* class for storing doctor information. *GroupLeader* and *Fellow* are the subclasses of the *Physician* class.

Dr. House belongs to the *GroupLeader* class, whereas the other doctors belong to the *Fellow* class. Each physician has a method called *CallForEmergency* that takes two arguments, *PatientID* and *WardName*, and returns *void*. If the *IsOccupied* attribute of a physician is *false*, only then he or she can respond to an emergency call.

- a) Create a delegate that can refer to any physician's *CallForEmergency* method. Then create a method called *GetEmergencyDoctor* that will assign a method to this delegate while adhering to the constraints listed below. 2+5
(CO3)
(PO3)
- You can check the availability of the fellow doctors of the Diagnostic Medicine department in any order. You can delegate the *CallForEmergency* method to the first doctor whose *IsOccupied* attribute is *false*.
 - If none of them are available, you will assign Dr. House.
- b) When a patient gets admitted to the Princeton-Plainsboro Hospital, the following information is stored in the system: 10
(CO2)
(PO2)
- PatientID (auto-incrementing, starting from 0)
 - Name
 - Admitted Department (default value is 'Diagnostic Medicine')

Write the codes for the following classes:

- *Patient*
- *PatientAdmission*

The responsibility of the *PatientAdmission* class is as follows:

- Admitting a patient.
- Raising an *Event* when the patient gets admitted.
- Calling the *EventHandler*. The *EventHandler* should follow the Open-Close Principle.

- c) Based on the scenario from Question 2.b), Write codes for a method that will handle the following responsibilities: 8
(CO2)
(PO2)
- I. Create a patient with arbitrary attribute values.
 - II. Create an instance of the *PatientAdmission* class to admit new patients.
 - III. Add a subscriber '*PagerService*' to the created *Event*.

The codes for the *Subscriber(PagerService)* should also be included. It will write a line to the console: "Informing Diagnostic Medicine Department"

3. ESILES Digital Platforms is a renowned software firm in Eriador, Middle-Earth. They are developing an employee management system. So far, they have come up with the following system architecture:

There is a base *Employee* class that will have two child classes: *BusinessEmployee*, and *DeveloperEmployee*. There is also another type of employee that handles client-side operations as well as development issues. So, they have created another class named, *ProductEngineer*. The *ProductEngineer* class inherits both from *BusinessEmployee* and *DeveloperEmployee* class. Some information regarding these four classes shown in Figure 1.

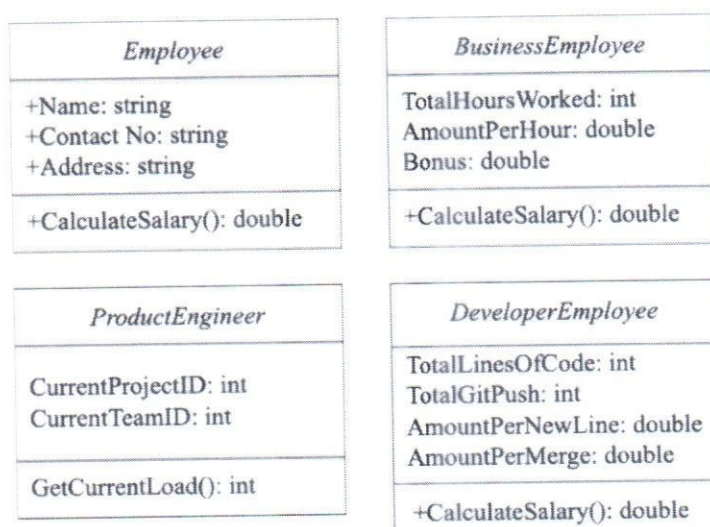


Figure 1: Classes associated with the Employee Management System

The *Employee* class is an abstract class since it contains an abstract method, *CalculateSalary*. *BusinessEmployee* and *DeveloperEmployee* classes override this method.

- a) Is it possible to use C# to construct this same class architecture? Provide relevant explanations for your answer. 7
(CO2)
(PO2)
 - b) Write necessary codes to implement the aforementioned scenario considering the four types of employees adhering to the following constraints: 12
(CO2)
(PO2)
 - Multiple inheritance is permitted only when there is at most one base class and the rest are interfaces.
 - For the class methods (*CalculateSalary*, *GetCurrentLoad*), you can use any implementation that makes use of the existing class attributes.
 - c) Draw the final class diagram based on your solution. 6
(CO1)
(PO1)
4. In the game "Guess It Right", the user is shown a random number and asked to guess whether the next number to be shown is greater or lesser than the current number. As long as the player's guess is correct, the game continues. The player receives one point for each correct guess. The numbers that appear are always even and between 10 and 100. The game also saves the player's name, score of the previous game, and the all-time highest score. If someone beats the highest score, the prior scorer's name is removed and replaced with the new scorer's name. A player's name cannot exceed 20 characters and must begin with an uppercase letter and end with a lowercase letter. The game also tracks how many times it has been played. After the game begins, it reads prior records from a file called "data.txt," and when the game is closed, it rewrites the new information into the same file. 25
(CO3)
(PO3)

To imitate the game mentioned above, create a class called *GuessGame* and include the necessary and appropriate member variables and functions. In order to play the game, the following functionality must be implemented.

- Both parameterized and non-parameterized constructors should be available. The highest score as well as the name of the scorer will be passed to the parameterized

319

constructor.

- There should be a *private* method with the method signature:
private bool VerifyName (string name)
This method will return *true* if the player's name is valid and *false* otherwise.
- There should be two *private* methods that will contain the following method signatures:
private bool UpdateLastScore (string name, int score)
private bool UpdateHighScore (string name, int score)
These methods will be responsible for updating the score information in the text file.
- There should be a *public* method, *Play* that will coordinate all the functions and simulate the game.

Inclusion of any attributes or member methods to simulate the game is permitted.

5. Assume that the information shown in Table 1 is saved in your project directory as a CSV (comma-separated-value) file. Also, imagine that the tables have more rows than the four shown in the example. *PersonalInfo* and *ContactInfo* are the two classes you have previously built. The class attributes are similar to the respective table column names.

Table 1: Personal Information

ID	Name	Birthday	Age	Gender
1	Michael Scott	March 15, 1965	57	Male
2	Angela Martin	November 11, 1974	47	Female
3	Jim Halpert	October 1, 1978	43	Male
4	Pam Beesly	March 25, 1979	42	Female

Table 2: Contact Information

ID	Phone	City	State
1	(526) 251-2198	Scranton	Pennsylvania
2	(936) 238-2315	Dayton	Ohio
3	(875) 419-8651	Columbus	Ohio
4	(462) 668-3406	Harrisburg	Pennsylvania

- a) Write the code for a method that reads data from the CSV files and stores it in two distinct Lists that correspond to the two classes you previously defined, *PersonalInfo* and *ContactInfo*. 10
(CO2)
(PO2)
- b) Write the code for a method to perform the following information operations: 15
(CO2)
(PO2)
- Print the first name, age, gender, and city of the first person in the list who lives in 'Pennsylvania' state.
 - Print the name of the state, gender, and average age of males and females for every state in descending dictionary order of the state name. An example is given below:

```

Pennsylvania    male    57
Pennsylvania    female  42
Ohio            female  47
Ohio            male    43

```

(Any type of query or iteration on the previously created *Lists* must be performed using *LINQ*.)

6. a) Consider the following code snippet:

10
(CO1)
(PO1)

```

1.  class Ride {
2.      String vt;
3.      int distance;
4.      int nop;
5.
6.      int gFare() {
7.          int f;
8.          if (vt == "sedan") {
9.              f = (50 + distance * 30) / nop;
10.         } else if (vt == "motorBike") {
11.             f = Math.max(25, distance * 20) / nop;
12.         } else {
13.             if (distance < 10)
14.                 f = 300 / nop;
15.             else
16.                 f = distance * 30 / nop;
17.         }
18.
19.         return f - (f % 5);
20.     }
21.
22.     boolean isRideValid() {
23.         if (vt == "sedan") {
24.             return nop <= 4 && distance <= 25;
25.         } else if (vt == "sevenSeater") {
26.             return nop <= 7 && distance >= 10;
27.         } else {
28.             return nop == 1 && distance <= 10;
29.         }
30.     }
31. }

```

Code Snippet 1: Ride Class for question 6.

Your objective is to locate as many code smells as possible (At least 5). Mention the line numbers where there is a code smell.

b) Refactor the code by removing the code smells from Code Snippet 1.

8
(CO1)
(PO1)

c) *"Any fool can write code that a computer can understand
Good programmers write code that human can understand"*
— Martin Fowler

7
(CO1)
(PO1)

Give your opinion for or against this statement and provide necessary justification.

B. Sc. in SWE 2nd Semester

1 April, 2022

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

SEMESTER FINAL EXAMINATION
DURATION: 3 HOURS

SUMMER SEMESTER: 2020 - 2021
FULL MARKS: 150

CSE 4203: Discrete Mathematics

Programmable calculators are not allowed. Do not write anything on the question paper.
 Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

-
- | | | |
|----|--|---------------------|
| 1. | a) Use rules of inference and quantifiers to determine if the following argument is valid, where the universe of discourse (domain) is all people. "Some students in the class did not read the textbook", "Every student in the class passed the test." Therefore, someone who passed the test did not read the textbook. | 9
(CO1)
(PO1) |
| | b) Use logical equivalences to determine whether the statements $(p \rightarrow r) \wedge (q \rightarrow r)$ and $(p \vee q) \rightarrow r$ are logically equivalent (you cannot use truth tables). | 8
(CO1)
(PO1) |
| | c) Use proof by contraposition technique to prove the following theorem: "If $n^2 - 1$ is an even integer, then n is an odd integer." | 8
(CO1)
(PO1) |
| 2. | a) Determine the $(f \circ g)^{-1}(x)$, where $(x) = x + 3$ and $g(x) = 5x - 2$. | 9
(CO2)
(PO1) |
| | b) Using iterative approach find the solution of the following recurrence relations with the given initial conditions.
$a_n = a_{n-1} + 2n + 3$, where $a_0 = 4$ | 8
(CO2)
(PO1) |
| | c) Analyze the given complexity of an algorithm and determine Big-O representation for the following function:
$f(n) = 2^n(n^3 + \log(n!))$ | 8
(CO2)
(PO2) |
| 3. | a) Use mathematical induction to prove the following equality, where n is a nonnegative integer:
$1.1! + 2.2! + \dots + n.n! = (n + 1)! - 1$ | 9
(CO3)
(PO1) |
| | b) Show that if that $a \mid c$ and $b \mid d$, then $ab \mid cd$, where a, b, c , and d are integers, and $a \neq 0$. | 8
(CO3)
(PO1) |
| | c) Use the extended Euclidean algorithm to express $\gcd(26, 91)$ as a linear combination of 26 and 91. | 8
(CO3)
(PO1) |

4. a) Use the construction in the proof of the Chinese remainder theorem to find all solutions to the system of congruences:

$$x \equiv 1 \pmod{2}$$

$$x \equiv 2 \pmod{3}$$

$$x \equiv 3 \pmod{5}, \text{ and}$$

$$x \equiv 4 \pmod{11}$$

- b) Solve the given congruence using the modular inverses:

$$55x \equiv 34 \pmod{89}$$

- c) Which positive integers less than 30 are relatively prime to 30?

5. a) Determine in-degrees and out-degrees of all vertices of the graph in Figure 1.

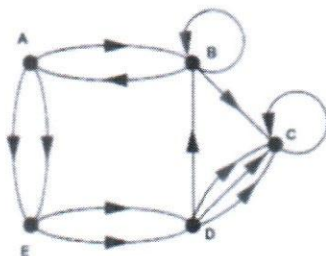


Figure 1: Graph for Question 5.(a)

- b) Represent the graph in Figure 2 using an adjacency matrix.

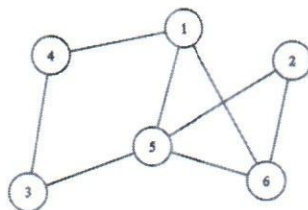


Figure 2: Graph for Question 5.(b)

- c) Determine whether the graph in Figure 3 is bipartite or not.

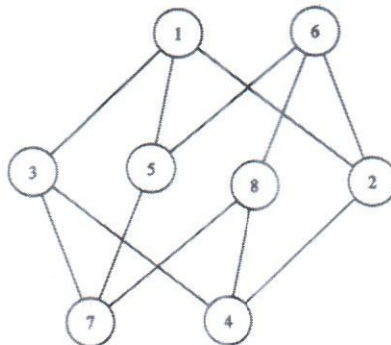


Figure 3: Graph for Question 5.(c)

6. a) A full 4-ary tree has 3 internal vertices. Determine the number of vertices and number of leaves of that tree?

5
(CO4)
(PO1)

- b) Determine the order in which a **preorder** and **postorder** traversal visits the vertices of the given ordered rooted tree in Figure 4.

10
(CO4)
(PO1)

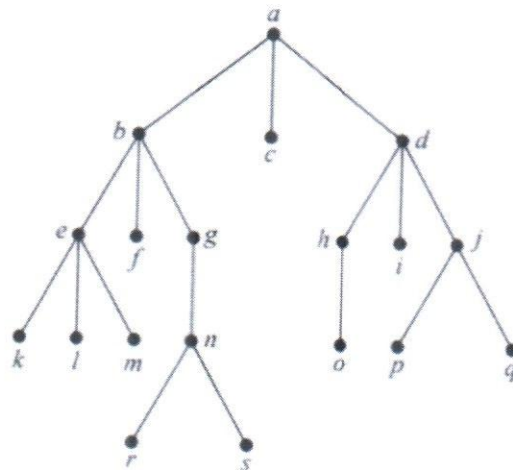


Figure 4: Ordered rooted tree for Question 6.(b)

- c) Analyze and determine whether the given pair of graphs in Figure 5 is isomorphic. Provide a rigorous argument in favor of your answer.

10
(CO4)
(PO2)

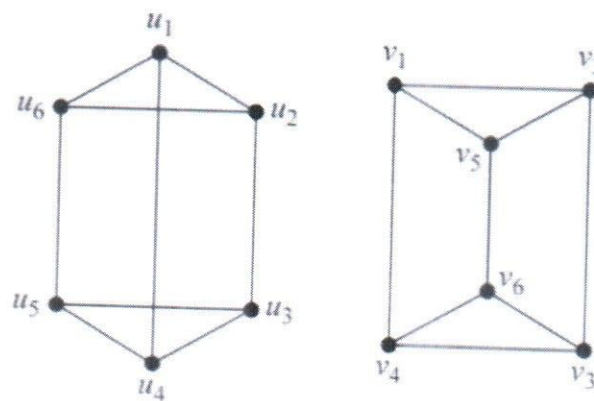


Figure 5: Graphs for Question 6.(c)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER: FINAL EXAMINATION**SUMMER SEMESTER, 2020-2021****DURATION: 3 Hours****FULL MARKS: 150****HUM 4247: Accounting****Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all 6 (six) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

-
1. a) "The double-entry system determines the equality of accounting equation efficiently"- 5
 Explain. (CO1)
(PO1)
- b) Moinul Hasan is a licensed dentist. During the first month of the operation of her business, 20
 the following events and transactions occurred. (CO2,
CO3)
(PO1)
- April 1:** Invested \$40,000 cash.
- April 1:** Hired a secretary-receptionist at a salary of \$600 per week payable monthly.
- April 2:** Paid office rent for the month \$1,000.
- April 3:** Purchased dental supplies on account from Smile Company \$4,000.
- April 10:** Provided dental services and billed insurance companies \$5,100.
- April 11:** Received \$1,000 cash advance from Trudy Borke for an implant.
- April 20:** Received \$2,100 cash for services completed and delivered to John Stanley.
- April 30:** Paid secretary-receptionist for the month \$2,400.
- April 30:** Paid \$1,600 to Smile Company for accounts payable due.
- Moinul uses the following chart of accounts: No. 101 Cash, No. 112 Accounts Receivable, No. 126 Supplies, No. 201 Accounts Payable, No. 205 Unearned Revenue, No. 301 M.Hasan, Capital; No. 400 Service Revenue, No. 726 Salaries Expense, and No. 729 Rent Expense.
- Required:**
- i. Journalize the transactions.
- ii. Post to the ledger accounts.
- iii. Prepare a trial balance on April 30, 2018.
2. a) The following information in Table-1 is related to the sole proprietorship of Leonard Mac, 8
 attorney. (CO2,
CO3)
(PO1)

Table 1: Information of Leonard Mac, Attorney

Legal service revenue, 2018	\$350,000
Total expenses, 2018	211,000
Assets, January 1, 2018	85,000
Liabilities, January 1, 2018	62,000
Assets, December 31, 2018	168,000
Liabilities, December 31, 2018	85,000
Drawings—2018	?

Required:

Prepare the 2018 **Statement of Owner's Equity** for Leonard Mac's legal practice by calculating "Leonard Mac, Drawings" in 2018.

- b) Dell Corporation's comparative balance sheets are presented below in Table-2:

Table2: Del Corporations Comparative Balance Sheet

	2018	2017
Cash	\$ 4300	\$ 3700
Accounts receivable	21200	23400
Inventory	10000	7000
Land	20000	26000
Building	70000	70000
Accumulated depreciation	(15000)	(10000)
Total	<u>\$110500</u>	<u>\$120100</u>
Accounts payable	\$ 12370	\$ 31100
Common stock	75000	69000
Retained earnings	23130	20000
Total	<u>\$110500</u>	<u>\$120100</u>

17
(CO2,
CO3)
(PO1)

Dell's 2018 **income statement** included Net Sales of \$100,000, Cost of Goods Sold of \$60,000, Cash Dividends \$20,000 and Net Income of \$15,000.

Required:

Compute the following ratios for **2018**.

- i. Current ratio.
- ii. Acid-test ratio.
- iii. Receivables Turnover.
- iv. Inventory turnover.
- v. Profit margin.
- vi. Asset turnover.
- vii. Return on assets.
- viii. Return on common stockholder's equity.
- ix. Debt to total assets ratio.
- x. Payout Ratio.

3. a) What are the differences between Financial Accounting and Management Accounting?

5

(CO1)

(PO1)

b) Top Gear is a Canadian company that owns and operates a large automatic carwash facility near Montreal. The following Table-4 provides data concerning the company's costs:

20

(CO2,

CO3)

(PO1)

Table 3: Top Gear Costs

	Fixed Cost per Month	Cost per Car Washed
Cleaning supplies		\$0.80
Electricity	\$1,200	\$0.15
Maintenance		\$0.20
Wages and salaries	\$5,000	\$0.30
Depreciation	\$6,000	
Rent	\$8,000	
Administrative expenses	\$4,000	\$0.10

For example, electricity costs are \$1,200 per month plus \$0.15 per car washed. The company expects to wash 9,000 cars in August and to collect an average of \$4.90 per car washed.

Required:

- Prepare the company's Planning budget
- The company actually washed 8,800 cars in August. Prepare the company's flexible budget for August.
- Prepare the company's Flexible Budget Performance Report. The actual operating results for August appear below in Table-4:

Table 4: Top Gear Income Statement for the Month Ended August 31

Actual cars washed	8,800
Revenue	<u>\$43,080</u>
<u>Expenses:</u>	
Cleaning supplies	7,560
Electricity	2,670
Maintenance	2,260
Wages and salaries	8,500
Depreciation	6,000
Rent	8,000
Administrative expenses	<u>4,950</u>
Total expense	<u>39,940</u>
Net operating income	<u>\$ 3,140</u>

4. a) Which costs are never relevant in decision making?

5

(CO1)

(PO1)

b) Max Products manufactures 30,000 units of part S-6 each year for use on its production line. At this level of activity, the cost per unit for part S-6 is as follows in Table-5:

20

(CO2,

Table 5: Max Products Cost Per Unit of Part S-6

Direct materials	\$ 4.00
Direct labor	10.00
Variable manufacturing overhead	3.00
Fixed manufacturing overhead	8.00
Total cost per part	<u>\$25.00</u>

CO3)
(PO1)

An outside supplier has offered to sell 30,000 units of part S-6 each year to Max Products for \$21 per part. If Max Products accepts this offer, the facilities now being used to manufacture part S-6 could be rented to another company at an annual rental of \$80,000. The \$80,000 rental value of the space being used to produce part S-6 is an opportunity cost of continuing to produce the part internally. However, Max Products has determined that two-thirds of the fixed manufacturing overhead being applied to part S-6 would continue even if part S-6 were purchased from the outside supplier.

Required:

Should the outside supplier's offer be accepted? Show all computations.

5. a) Describe Total Fixed Cost. Is total fixed cost always remains same? Give your explanation with graphical example. 5
- b) From the given information in Table-6, prepare a Cost Sheet for the period ended on 31st March, 2018. 20

(CO1)
(PO1)
(CO2,
CO3)
(PO1)**Table 6: Stock Information**

Opening stock of raw material	12,500
Purchases of raw material	1,36,000
Closing stock of raw material	8,500
Direct wages	54,000
Direct expenses	12,000
Factory overheads	100% of direct wages
Office and administrative overheads	20% of works cost
Selling and distribution overheads	26,000
Cost of opening stock of finished goods	12,000
Cost of Closing stock of finished goods	15,000
Profit on Selling Price	20%

6. a) Explain operating leverage. 5
- b) Nike Company manufactures basketballs. The company has a ball that sells for \$25. At present, the ball is manufactured in a small plant that relies heavily on direct labor workers. Thus, variable costs are high, totaling \$15 per ball, of which 60% is direct labor cost. Last year, the company sold 30,000 of these balls, with the following results in Table-7: 20

(CO1)
(PO1)
(CO2,
CO3)
(PO2)**Table 7: Nike Company Sells**

Sales (30,000 balls)	\$750,000
Variable expenses	<u>450,000</u>
Contribution margin	300,000
Fixed expenses	210,000
Net operating income	<u>\$ 90,000</u>

Required:

i. Compute the CM ratio, break-even point in balls (use formula method), margin of safety in dollar at last year's sales level.

ii. Compute the degree of operating leverage.

iii. Assume that through a more intense effort by the sales staff, the company's sales increase by 10% next year. By what percentage would you expect net operating income to increase? Use the degree of operating leverage to obtain your answer.

Verify your answer to by preparing a new contribution format income statement showing 10% increase in sales.

iv. Refer to the original data. The company is discussing the construction of a new, automated manufacturing plant. The new plant would decrease variable costs per ball by 40%, but it would cause fixed costs per year to double. If the new plant is built, prepare a contribution format income statement with the changes.

- What would be the company's new CM ratio and new break-even point in dollar? (use equation method)
- If the new plant is built, how many balls will have to be sold next year to earn the same net operating income, \$90,000, as last year? (use equation method)
- Compute the new Margin of Safety in dollar and percentage. If you were a member of top management, would you have been in favor of constructing the new plant? Explain.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION**SUMMER SEMESTER, 2020-2021****DURATION: 3 HOURS****FULL MARKS: 150****Hum 4249: Business Psychology and Communications****Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Chris was simultaneously enrolled in a university writing course and working as a co-op student at the Widget Manufacturing plant. As part of his co-op work experience, Chris shadowed his supervisor/mentor on a safety inspection of the plant and was asked to write up the results of the inspection in a compliance memo. In the same week, Chris's writing instructor assigned the class to write a narrative essay based on some personal experience. Chris, trying to be efficient, thought that the plant visit experience could provide the basis for his essay assignment as well. 15
(CO2)
(PO2)

He wrote the essay first, because he was used to writing essays and was pretty good at it. He had never even seen a compliance memo, much less written one, so was not as confident about that task. He began the essay like this:

On June 1, 2018, I conducted a safety audit of the Widget Manufacturing plant in New City. The purpose of the audit was to ensure that all processes and activities in the plant adhere to safety and handling rules and policies outlined in the Workplace Safety Handbook and relevant government regulations.

Chris finished the essay and submitted it to his writing instructor. He then revised the essay slightly, keeping the introduction the same, and submitted it to his co-op supervisor. He "aced" the essay, getting an A grade, but his supervisor told him that the report was unacceptable and would have to be rewritten – especially the beginning, which should have clearly indicated whether or not the plant was in compliance with safety regulations. Chris was aghast! He had never heard of putting the "conclusion" at the beginning. He missed the company softball game that Saturday so he could rewrite the report to the satisfaction of his supervisor.

Explain the communication error.

- b) A carefully chosen story can help the leader of an organization translate an abstract concept into a meaningful mandate for employees. That's because most executives operate with a particular—and generally justified—mind-set. Analysis is what drives business thinking. It cuts through the fog of myth, gossip, and speculation to get to the hard facts. It goes wherever the observations and premises, and conclusions take it, undistorted by the hopes or fears of the analyst. Its strength lies in its objectivity, its impersonality, its heartlessness. 10
(CO2)
(PO10)

Write a story to encourage your staffs to work from office during Covid'19.

- b) Sparking Action: Leadership is, above all, about getting people to change. To achieve that goal, you need to communicate the sometimes-complex nature of the changes required and inspire an often-skeptical organization to enthusiastically carry them out. This is the place for what I call a "springboard story," one that enables listeners to visualize the transformation needed in their circumstances and then to act on that realization. 10
(CO2)
(PO3)

Write a Sparking Action story for your teammates to come with workable plan to solve a problem.

3. a) Entrepreneurship for Engineers need a new pair of eyes to see what business is about- discuss with examples and diagrams. 10
(CO2)
(PO2)
- b) The Acme Electric Company worked day and night to develop a new current regulator designed to cut the electric power consumption in aluminum plants by 35%. They knew that, although the competition was fierce, their regulator could be produced more cheaply, was more reliable, and worked more efficiently than the competitors' products. 15
(CO3)
(PO2)

The owner, eager to capture the market, personally but somewhat hastily put together a 120-page proposal to the three major aluminum manufacturers, recommending that their regulators be installed at all company plants.

She devoted the first 87 pages of the proposal to the mathematical theory and engineering design behind his new regulator, and the next 32 to descriptions of the new assembly line she planned to set up to produce regulators quickly. Buried in an appendix were the test results that compared her regulator's performance with present models, and a poorly drawn graph showed how much the dollar savings would be.

Acme Electric didn't get the contracts, despite having the best product. Six months later, the company filed for bankruptcy.

- What went wrong in terms of communication?
4. Engineering writing should be concise. Just as an engineering drawing should have no unnecessary lines and a machine no unnecessary parts, a sentence should contain no unnecessary words and a paragraph no unnecessary sentence. "Trimming" your expression communicates the engineering issues or problems more clearly, because problems become visible instead of hiding in the wordy expression. 25
(CO2)
(PO4)

Highlight the 'trimming' strategies with examples.

5. a) We know that there are three main ways of active writing: 15
i. Put a doer before the verb. (CO2)
ii. Drop part of the verb. (PO2)
iii. Change the verb.

Use the above insights and write an essay about the common problems people face when start a new business.

- b) Use the above insights in Question 5 (a) and write an essay giving insight to solve the above-mentioned problems. 10
(CO2)
(PO1)
6. Explain the Theory of Completed Staff Work with an example. 25
(CO4)
(PO1)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION**SUMMER SEMESTER, 2020-2021****DURATION: 3 HOURS****FULL MARKS: 150****SWE 4401: Software Requirement and Specifications****Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

Scenario for questions 1, 2, 3

Graduate Records Validation System

Every year many graduates complete their bachelor's degrees and apply to different foreign universities for higher study. Graduates have to send their academic transcripts to those universities using courier services. They have to pay a certain amount for each submission. This process has several drawbacks like the validity of transcripts, lack of a central monitoring authority, lack of annual reporting, lack of a simple payment option, etc. Besides universities, other organizations may require valid documents of students for job purposes.

University Grant Commission (UGC) wants to build a software that can solve the above-mentioned problems. Nimbus Software Ltd. is asked to build the software. A team of 5 persons is formed with the appropriate role (Rashiq is the team lead; Anik, Rahat, Minhaz are developers; Shaon is the tester). The Deputy Director of UGC is acting as the client.

In the initial meeting between clients and team members, all agree to build a web application. There will be an admin who will be responsible for controlling the system. This admin will be one assigned by UGC. Admin can create registrar roles for listed universities. Each registrar can create some staff role for their university. Staff are responsible to add students' credentials into the system which will be saved in a database. The credentials could be but are not limited to name, picture, institutional email address, department name, unique registration number, passing year, semester-wise grades of every course, etc. The system can generate a transcript for a student using his/her basic and academic information.

Each student has access to the system by following a standard authentication system. They can fill up a form (containing some information about a foreign university) to send a transcript. Each time a student submits a request to send a transcript, he/she has to pay a certain amount using a payment service. After successful payment, a code will be sent to his/her email address. If the code is added to an existing request, a digital signature will be added to the transcript automatically to validate the document. Finally, the transcript will be sent to the desired university and a confirmation message will be sent to the student's email.

Registrar can generate yearly reports of applicants of her university. Admin can generate yearly reports of all universities. There will be a search option for the registrar/admin. They can search based on foreign university name, student registration number, location, year, or a combination of these options.

[UGC can change features now and then. After analyzing requirements, the team decided to build the system following Scrum.]

- | | | | |
|----|----|---|-----------------------|
| 1. | a) | Identify user roles from the scenario. Write a persona for the most important role containing not more than 6 sentences. | 4+5
(CO3)
(PO2) |
| | b) | Identify at least 6 user stories from the scenario. Use the following template for the stories:
<i>As a (role), I want (function)</i> | 12
(CO3)
(PO2) |
| | c) | Write acceptance testing criteria or notes for 2 user stories. | 4
(CO3)
(PO2) |
| 2. | a) | Suggest 4 non-functional testable requirements that are relevant for the scenario. | 8
(CO3)
(PO2) |
| | b) | Identify 2 combined user stories/epic and disaggregate them into smaller ones. | 6
(CO3)
(PO2) |
| | c) | The Nimbus team wants to estimate some of the stories for next few weeks. Mention the names of the people who must participate in the estimation process and how they estimate each story. | 5
(CO3)
(PO2) |
| | d) | Suppose, the searching feature is estimated 6 story points and will be implemented in the next iteration. Decompose the story into some tasks by considering developers expertise and assign each of the tasks. | 6
(CO3)
(PO2) |
| 3. | a) | Identify class and object from the scenario. Draw Class Responsibility Collaboration (CRC) diagrams along with class details by using UML notations. | 12
(CO4)
(PO3) |
| | b) | Identify 2 events, their initiators and collaborators from the scenario. | 3
(CO4)
(PO2) |
| | c) | Identify entities, data and their flow. Draw a data flow diagram upto level-1. Use proper notations of the data flow diagram. | 10
(CO4)
(PO3) |
| 4. | a) | A user story has three parts. What are the three parts? What are the purposes of each of them? | 5
(CO1)
(PO1) |
| | b) | Which of the following are not good stories? Why?
i. The system will use Log4J to log all error messages to a file.
ii. All graphing and charting will be done using a third-party library.
iii. The software will be written in Python.
iv. The user can select a date range using a calendar widget.
v. The user can export data to JSON and XML format. | 5*2
(CO5)
(PO2) |
| | c) | Describe any four guidelines with examples for writing good stories. | 10
(CO1)
(PO1) |

5. a) Which **INVEST** properties are violated in the story card below? What is the consequence of this violation? Write a possible version of this card where the property is not violated. 5
(CO5)
(PO2)

A user can pay car rent charges using mobile banking.

Note: Accept sCash, tCash, and mCash (mobile bank). On rent over 3 months, give a 5% discount on sCash and 2% for others. But the discount should not exceed 500 Taka. Usually, the monthly rent fee is BDT 4000 Taka.

The system should collect car preferences to improve user satisfaction.

- b) What techniques can be used to collect user stories iteratively? Describe each of them with an applicable scenario. 16
(CO5)
(PO2)

Note:

- Your scenario should cover time and money constraints.
- User base and their background
- Advantages and disadvantages of each techniques

- c) What is an “ideal day of work”? Why the “ideal day of work” is better than “elapsed time” in terms of estimating user stories. 4
(CO1)
(PO1)

6. a) Innovator company’s Ninja team follows the Scrum software development methodology. The team has two developers. For a project, the team has Table 1 user stories in the backlog. Here, **B**, **C** are compound stories and the story point can be split into 3+4, 4+4 respectively. Each point indicates an ideal day of work. The customer prioritized the user story as ↑ High, ↔ Medium, ↓ Low. They want the release after four weeks. 8
(CO5)
(PO2)

Do an iteration plan with the stories. Each iteration takes two weeks.

Table 1: User stories with story points and priority

A	B	C	D	E	F	G	H
6	7	8	4	3	1	3	4
↑	↓	↔	↑	↔	↓	↔	↑

- b) Why Elicitation and capture are not suitable terms to mean requirements gathering? How does the term trawling suit more to mean requirements gathering? 6
(CO1)
(PO1)
- c) Suppose, a team followed Agile methodology to build a software. The team initially thought they could complete 35 story points per iteration. However, new stories were added in the backlog and some story points modified during the iterations. The Table 2 represents story points from start to end of the project with some missing value. 3+4
(CO5)
(PO2)

Table 2: Iterations wise story points distribution

	Iteration 1	Iteration 2	Iteration 3
Story points at start of iteration	100		
Completed during iteration	35	40	36
Changed estimates	5	-5	0
Story points from new stories	6	3	
Story points at end of iteration	76		0

Complete the table and draw a burndown chart showing story points in Y-axis and iterations in X-axis.

- d) A team identified some constraints for the system. Manager put those constraints in the To Do list. Do you agree that constraints can be treated as user stories? If yes, mention the reasons, if not, how constraints should be managed? 4
(CO3)
(PO2)

Islamic University of Technology
Organisation of Islamic Cooperation (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

Duration: 3 Hours

Full Marks: 100

CSE 4409: Database Management Systems II

Programmable calculators are not allowed. Do not write anything on the question paper. There are **06 (six)** questions. Answer **all** of them. Marks for each question and corresponding CO and PO are written at the right margin.

1. (a) Foreign Key can be used to enforce data validation. Strengthen the argument using a suitable example. [5]
(CO1,PO1)

- (b) Consider the following definitions : [5]
(CO2,PO2)

```
CREATE OR REPLACE VIEW V1
AS
SELECT NAME,SALARY
FROM EMP
ORDER BY NAME;
```

Is it possible to exercise regular DML (i.e. INSERT and UPDATE) on this view? (You can assume the entity EMP exists.) Justify your position.

- (c) Create one database user as *myuser* with all admin privileges. [5]
Newly created user has 3 entities such as *T1*, *T2* and *T3* (you can assume any structure for these entities). Ensure the space management in such a way that by default all entities data will be stored at C:\mydata\general while for only *T2* its data will be stored at C:\mydata\secure. (CO1,PO1)
Write DDL statements for the requirement mentioned above.

2. (a) Consider the following declaration of a variable inside a PL/SQL block: [5]
(CO2,PO2)

```
DECLARE
NAME VARCHAR2(20);
.....
```

The variable NAME can store 20 characters irrespective of the language setting. Justify the statement.

- (b) Explain the basic purpose of %ROWTYPE attribute. Can it be used to inherit the constraints of the underlying entity? [5]
(CO1,PO1)
- (c) Present a simple application of INOUT parameter with required PL/SQL code. [5]
(CO1,PO1)

3. (a) Consider the following 2 scenarios : [5]
(CO2,PO2)
Scenario 1: A Library Management System of a university where Students borrow Books.
Scenario 2: A Library Shop where Customers buy Books.

Since the application is almost identical, they should have similar mapping cardinality. Justify your position with required implementation code.

- (b) Consider a typical Result Processing System (RPS) where there are the following entities : (Note: *pk* stands for primary key while *fk[x]* indicates foreign key referencing entity *x*) [10]
(CO1,PO1)
- Students(SID (pk),Name)
 - Courses(CID (pk), Titile, Credit)
 - Grades (SID fk[Students], CID fk[Courses],LetterGrade)

Write a PL/SQL function as follows:

Input : Student ID

Outputs : - Total Credit of Theory Course Completed
- Total Credit of Lab Course Completed

Algorithm: The last digit of each course ID determines its type, if it is odd then it is a theory course otherwise it is lab. *For instance* CSE 4409 is theory course while CSE 4410 is lab course. A student is considered to complete a course if any letter grade other than F is found.

4. (a) Consider the citizen entity as follows:

[5]

Citizens(CID(pk), Name, Address, DOB(date of birth))

(CO3, PO3)

Format of the CID: You are free to choose the format of ID. But you must follow the standards of setting primary key. How would you select the format of ID? Justify your position.

Finally your task is to write a PL/SQL function to generate the CID as you mentioned and place it within a trigger to fully automate the generation of ID.

- (b) Consider the following entities:

[15]

(CO3, PO3)

Students(SID(pk), Name, CGPA, PocketAllowanceAmnt (amount to be received each month))

PocketAllowances(SID(fk[Students]), PaymentDate, Amount)

Misconducts(SID(fk[Students]), event, datetime)

The university now declares a special scholarship called Merit-based Awards (MBA). But the available fund for MBA is not prefixed, it varies in each year. Primary eligibility for MBA states that students who have no *Misconduct* record can apply for it. But the selection is prioritized on CGPA (i.e. highest CGPA should be given the first priority and so on) and the university can not guarantee all students for the awards. Students will receive as long as the fund is available. Remember the *PocketAllowanceAmnt* amount is not identical to all students since it depends on program types (i.e. undergrad or post-grad). The scholarship amount will be always 10% of the current payable *PocketAllowanceAmnt* amount. The payment is done in the appropriate entity (i.e. *PocketAllowances*) using current date. The process should be running as long as the fund is available.

Your task is to design the system to automate the process with required sub-programs so that payments can be made accordingly in one go for the present month.

5. (a) Present the definition of data warehouse given by William H. Inmon. The definition leads to a number of key components of data warehouse. Briefly discuss them.

[5]

(CO1, PO1)

- (b) Briefly explain the different types of OLAP operations with suitable diagram. For each operation also present an example of its equivalent SQL statement.

[10]

(CO1, PO1)

- (c) Snowflake Schema has some advantage over Star Schema. Briefly explain it. Finally explain why star schema is commonly used despite its disadvantage.

[5]

(CO1, PO1)

6. (a) The term "Big Data" is a misnomer. Explain. Although there are a number of different ways to define big data, IBM uses three parameters for big data. Briefly explain each of them with relevant reference data and example.

[5]

(CO1, PO1)

- (b) What is aggregate in NoSQL database? Consider the inventory of IUT Cafeteria. There are a number of suppliers. After placing orders with Quantity and Unit Price, goods are procured. Payments are made only by credit cards.

[10]

(CO3, PO3)

First model the given scenario in Relational model and then with Aggregate model. Also discuss the main advantages of Aggregate over Relational in this context.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4411: Data Communication and Networking

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

-
- | | | |
|-------|---|----------------------|
| 1. a) | Draw the flow diagram of CSMA/CD and CSMA/CA. Criticize the advantages and disadvantages of these two techniques for different transmission medium. | 12
(CO3)
(PO3) |
| b) | In data transfer of TCP protocol, sender can use two techniques called pushing data and urgent data. Justify the necessity of these two techniques with example scenarios. | 8
(CO2)
(PO2) |
| c) | Draw the TCP/IP protocol suite. Hint: In your answer you need to mention different protocols in each layer of TCP/IP protocol suite. | 5
(CO1)
(PO1) |
| 2. a) | TCP protocol is a connection-oriented protocol which undergoes several steps in connection establishment. Show the steps of connection establishment with necessary diagram. Mention the disadvantages of this process and explain how these disadvantages can be overcome. | 12
(CO3)
(PO3) |
| b) | UDP is connectionless transport layer service. Though this service is unreliable, justify its application in different services including Routing Information Protocol (RIP). | 8
(CO2)
(PO2) |
| c) | Define socket address. Give an example of socket address. | 5
(CO1)
(PO1) |
| 3. a) | In IUT there are more than 2500 internet users. However, IUT has only 4 public IP addresses. Explain the procedure with necessary diagram by which IUT can provide services to 2500 user with only 4 registered public IP.
What are the disadvantages an IUT internet user is facing for this? | 12
(CO3)
(PO3) |
| b) | In internet, different network follows one of the two IP protocols - IPv4 or IPv6. Why different protocol is chosen and how can they prevail simultaneously. | 8
(CO2)
(PO2) |
| c) | Draw the flow diagram of p-persistent method? | 5
(CO1)
(PO1) |

4. a) Which data link control protocol is represented by the flow diagram in figure 1. Explain the advantages and disadvantages of this protocol from the given scenario.

12
(CO3)
(PO3)

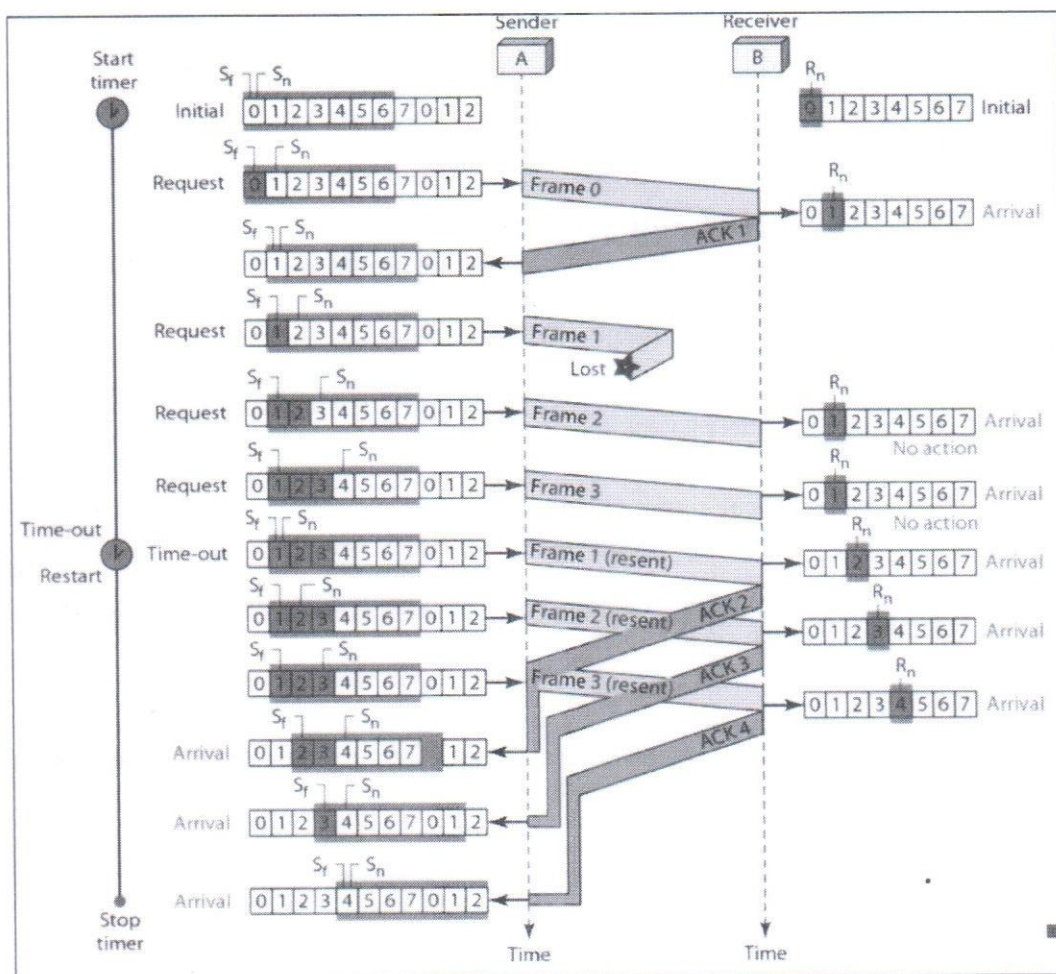


Figure 1: Flow diagram of a data link control technique

- b) Explain with necessary diagram how a burst error can be handled with single-bit error correction method. Justify the handling procedure of the burst error with single-bit error correction instead of a unique burst error solution.
- c) Write down the differences between circuit switched network and packet switched network.
5. a) An ISP is granted a block of addresses starting with 150.80.0.0/16. The ISP wants to distribute these blocks to 2600 customers as follows.
- The first group has 200 medium-size businesses; each need 128 addresses.
 - The second group has 400 small businesses; each need 16 addresses.
 - The third group has 2000 households; each need 4 addresses.

8
(CO2)
(PO2)

5
(CO1)
(PO1)

12
(CO3)
(PO3)

Design the subblocks and give the slash notation for each subblock. Find out how many addresses are still available after these allocations.

- b) Justify the categorization of different port addresses by IANA.

8
(CO2)
(PO2)

- c) In IPv4 there is an 8-bit field called service type. Write down the significance of each bit of the field. 5
(CO1)
(PO1)
6. a) In network layer intermediary router may fragment a received IP datagram. 12
i. When did a router fragment a datagram? Is it possible to avoid fragmentation? (CO3)
ii. What are the changes applied on a received datagram before sending out? (PO3)
Case 1: A non-fragmented datagram needs to be fragmented.
Case 2: A fragmented datagram (not the last datagram) needs to be fragmented.
Case 3: A fragmented datagram (last fragment) needs to be fragmented.
- b) An IPv4 datagram has arrived with the following information in the header (in hexadecimal) 8
hexadecimal) (CO2)
Ox 45 00 00 54 00 13 58 50 20 06 00 00 7C 4E 03 02 B4 0E 0F 02 (PO2)
- i. How many bytes of option is present?
ii. Is the packet fragmented?
iii. What is the size of the payload?
iv. How many more routers can the packet travel to?
v. What is the identification number of the packet?
vi. What is the type of service?
- c) Write down the unabbreviated form of following IPv6 address 5
i. 0::0 (CO1)
ii. 0::FFFF:0:0 (PO1)
iii. 582F:1234::2222
iv. 4821::14:22
v. 54EF::A234:2

Annexure

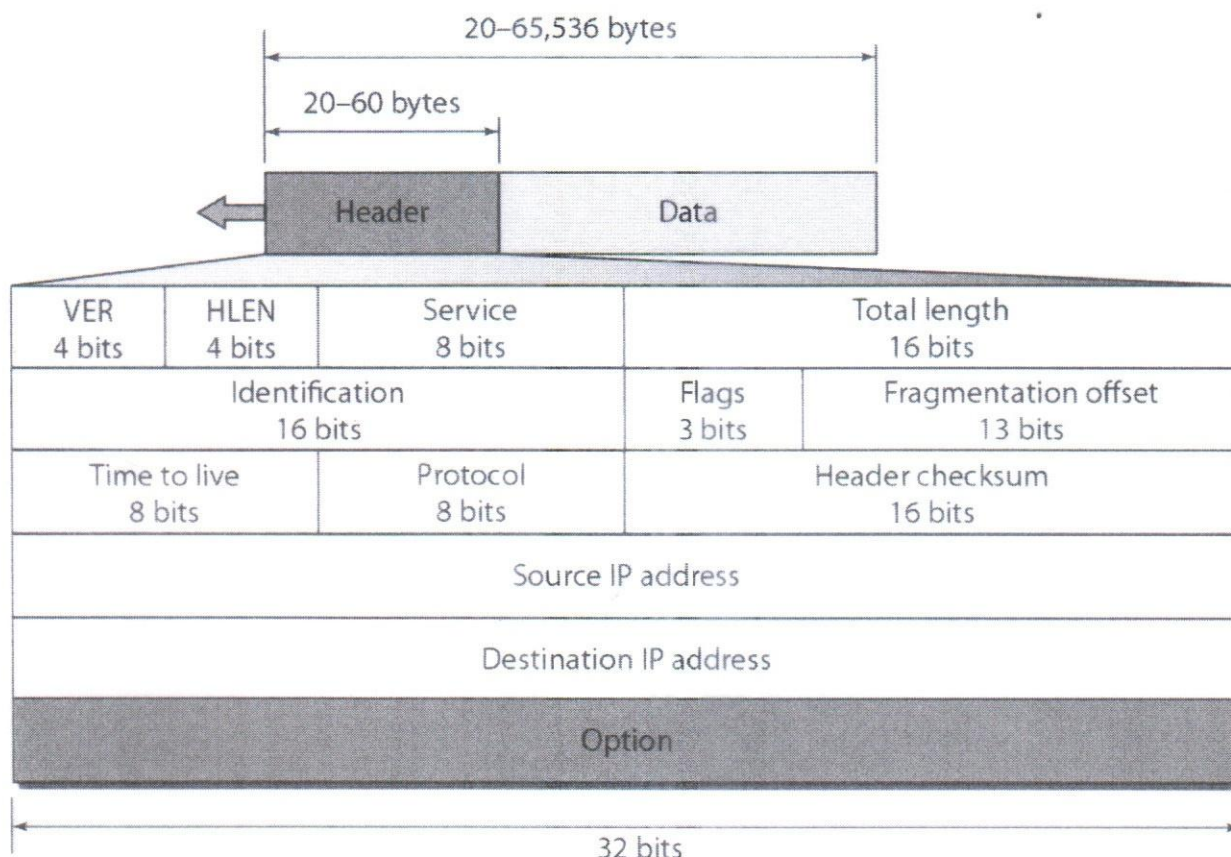


Figure 1: IPv4 datagram format

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ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

SWE 4601: Software Design and Architecture

There are 6 (six) questions. Answer all of them. Figures in the right margin indicate marks. For each question, corresponding CO and PO are written in the brackets.

1. a) What is startup latency? Differentiate *cold start* and *warm start* in "*Function as a Service (FaaS)*". 5
(CO2)
(PO2)
 - b) Suppose, a web application has to give an immediate response for some kind of user interaction (e.g., ad clicking event). The application has to perform some calculation asynchronously and does not require maintaining session state during such events. The number of events at a time could not be anticipated. So, running multiple instances of the application to meet certain performance is not worthwhile. (CO4)
(PO2)
 - i. Which design architecture would be appropriate for this situation? You can consider either server-based or serverless architecture. 2
 - ii. Justify your solution by designing and describing the architecture. 10
 - iii. Mention possible advantages and drawbacks of your selected architecture? 8
2. XSoft built an electronics shop (e-commerce) without considering any architectural design. After some releases, managing the software became difficult with the increasing number of features along with an increasing number of team members, having knowledge of different technology stacks. They shifted to 3-layered monolithic architecture. After some releases, XSoft identified some parts of the application require more performance than others. A few team discussions reveal that migrating to a microservice architecture will solve this. They immediately migrate to microservice architecture without giving proper thought and maintaining any architectural pattern. Now, they are facing the following problems.
 - Changing one microservice requires changes to other microservices.
 - Duplicating codes across multiple services to support some functionality like authentication and authorization.
 - Scaling the shared database for multiple services
 - Not capable of designing different database schema for frequently requested immutable data and mutable transactional data
 - Discovering active instances of microservices

Based on the above scenario answer the following.

- a) Write the characteristics of layered architecture prompt XSoft to migrate. 5
(CO2)
(PO2)
- b) Identify design issues that create the above-mentioned problems. Propose and justify a solution by considering the following microservice patterns: 4 × 5
(CO4)
(PO3)

Circuit Breaker, Client/Server-side discovery, Strangler, API Gateway, Decompose by business capability, CQRS, Event Sourcing, Saga, Log Aggregation, Service registry.
[To fix the problems multiple patterns could be required.]

3. a) Gono Library of Dhaka was established in 1983. It has numerous collections of books. 10
Each book has a **title**, **author**, **publication date**, and **genre** whether it is a **novel**, **story**, (CO3)
biography, or **fiction**. Any person can have an account there. Library maintains those (PO3)
accounts by a unique number, date the account opened, and state whether the account
is **active**, **frozen**, or **closed**. A person borrows books using his/her account and can be
an author as well.

Based on the above scenario, XSoft has to build a library management.

Now, design the corresponding UML class diagram by giving proper details of each **class**, its **properties**, **methods**, **relations**, and **dependencies**. Modularize your design by identifying **packages** or **modules**.

- b) Consider the interaction scenario with the system: 10
The library system has an existing database of all books. New books can be added by (CO3)
librarians. Any person can be a member of the library and borrow books for reading. (PO3)
To borrow books, a user has to be registered to the system through an account. Users
can search multiple times by specifying the **title** or **author name**.

Now, design the interaction with the system using a sequence diagram. Use appropriate notations.

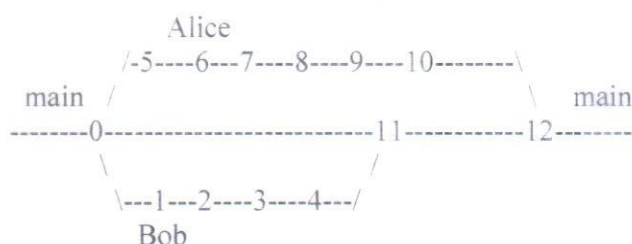
- c) In Evolutionary Database Design, how **change_log** of database schema should be 5
maintained in version control? (CO2)
(PO1)
4. a) DreamSoft has hired you to review their new software project plan where they are 5+5
planning to have two software architects, who will make a detailed design of a specific (CO2)
scenario in the form of **blueprint UML**. The blueprint will then be passed to four (PO2)
programmers for implementation.

State your opinion about this plan in no more than 5 sentences. What alternative approach do you suggest?

- Software is always changing so "design first then code" is not a practically feasible approach.
- Sketch of UML can be prepared through discussion between architects and programmers.

- b) Do you think architectural smells are responsible for architectural decay of software? 5
Justify your answer. (CO2)
(PO1)
- c) Continuous Integration (CI) of source code is considered best practice for large scale 10
systems. However, poorly managed CI is responsible for anti-patterns. Shortly describe (CO2)
any four CI anti-patterns. (PO2)

5. a) Consider the following revision history of a project done using a basic **Version Control System (VCS)**. Two developers namely Alice and Bob split into two branches from the main branch at revision 0. Bob merged his changes in the main branch in revision 11 while Alice merged in the main at revision 12. 5+5
(CO3)
(PO3)



Based on the above scenario answer the following-

- i. Alice and Bob both changed a file *thecode.c* in their respective branches. The VCS, unfortunately, cannot track which files were changed. Explain a problem that may happen in this situation.
 - ii. The system has an auto-sync feature - "*pull changes automatically when any change is pushed*". Bob has enabled this feature. For a critical bug, he had to manually check all the 30 files in a folder. When he was looking into the 20th file (sorted alphabetically), Alice pushed 3 files in that folder. What problem can happen in this situation?
- b) What is session state? Briefly describe session state patterns by giving an example - 10
Notes: (CO3)
 (PO3)
- Your example should include client and server machine capabilities, data security and ease of implementation.
 - when to use one pattern over another.
- c) Differentiate Optimistic and Pessimistic Concurrency Control. 5
 (CO1)
 (PO1)
6. a) What are the golden rules of user interface design? Shortly describe each of them. 7
 (CO1)
 (PO1)
- b) Shortly describe user interface design process 10
 (CO1)
 (PO1)
- c) In a microservice architecture, you have two microservices. One is Book-Service, which is responsible for serving the details of books and the other is Author-Service, which is responsible for serving the details of authors. 8
 (CO4)
 (PO2)

Book Service Endpoints	Comments	Author Service Endpoints	Comments
GET /	get all books	GET /	get all authors
GET /id	get book details, including author_ids	GET /id	get author details, including book_ids
POST /	create a new book.		Create new author

Now, you have to implement a search feature which will return all authors, where the name starts with 'A' and all books written by the authors where the book title starts with 'B'. Assume, there will be millions of calls to the services and you have to uphold specific availability and throughput of those services.

- i. What problems will you encounter if you keep the aforementioned two services and implement the search feature?
- ii. What are the alternative solutions that can be used? Give your constructive feedback.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 Hours

FULL MARKS: 150

SWE 4603: Software Testing and Quality Assurance**Programmable calculators are not allowed. Do not write anything on the question paper.**Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Define 'Driver' and 'Stub'. Explain their usage with code example.

2+2

(CO1)

(PO1)

- b) Consider the following program:

3+3+3+6

(CO3)

(PO5)

```

main() {
    int work;
    double payment = 0;
    scanf("%d", &work);
    if (work > 0) {
        payment = 40;
        if (work > 20) {
            if (work <= 30)
                payment = payment + (work- 25) * 0.5;
            else {
                payment = payment + 50 + (work- 30) * 0.1;
                if (payment >= 3000)
                    payment = payment * 0.9;
            }
        }
    }
    printf("Final payment %d", payment);
}

```

- i. Draw a CFG graph for the program.
- ii. Calculate the **cyclomatic complexity** of the program using all the methods.
- iii. Draw the **data flow** graph for all the variables.
- iv. Derive all AU, APU and ACU paths using data flow testing.

- c) Differentiate between :

3+3

- i. Load and Stress Testing

(CO1)

- ii. Alpha and Beta Testing

(PO1)

2. a) ABBL wants to develop a new mobile banking application for their customers. What security issues and test conditions are needed to be considered for
- Security Testing**
- of such application?

7

(CO2)

(PO3)

344

- b) Figure 1 shows the MM-path as a darkened line. Perform **path-based integration** calculating source nodes, sink nodes, MEPs, and MM-path graph.

12
(CO3)
(PO3)

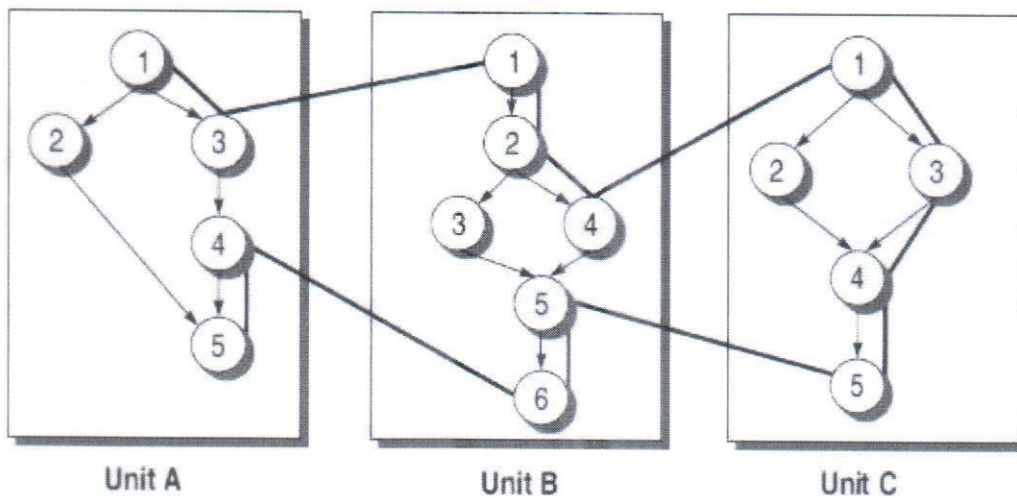


Figure 1: MM- Path

- c) Explain the process of function testing. Differentiate between unit and function testing.

4+2
(CO1)
(PO1)

3. a) Perform **top-down** and **bottom-up** integration procedure from the system hierarchy given in Figure 2.

10
(CO3)
(PO3)

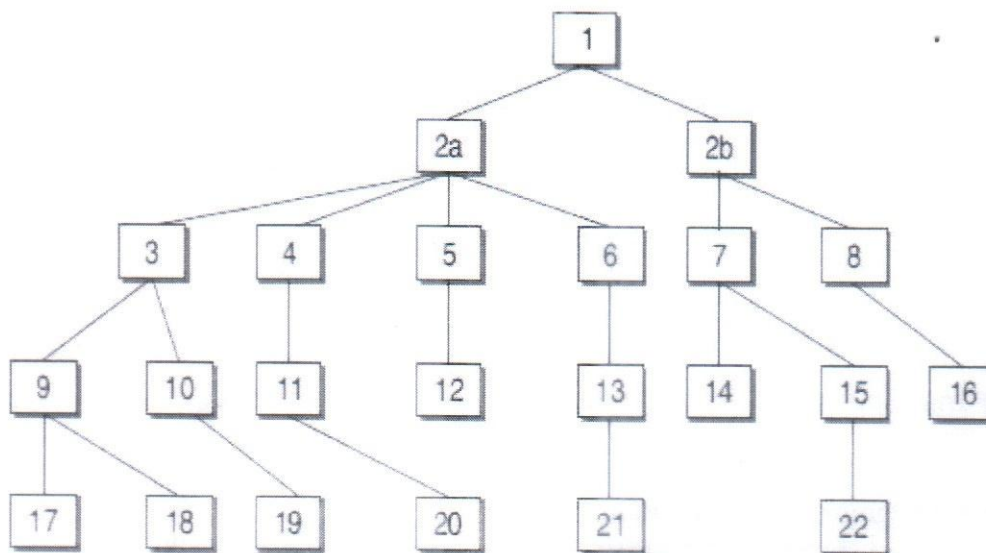


Figure 2: Decomposition Tree

- b) Calculate the **number of test sessions** for the decomposition tree shown in Figure 2.

10
(CO3)
(PO1)

- c) Design a modified sandwich testing approach for Figure 2.

5
(CO3)
(PO1)

4. a) Is regression testing a problem? Discuss with an example. Explain Regression Test Prioritization technique.
- b) T contains 90 tests of which 20 are modification-revealing for P and P' and M selects 12 of these 20 tests, then calculate the **inclusiveness** and **precision** of M relative to P, P', and T.
- c) What is selective retest technique? Describe the Strategies for Test Case Selection of selective retest technique.
5. There is a system for railway reservation system. There are many functionalities in the system, as given in Table 1:

Table 1: Functionalities for railway reservation system

S. NO.	Functionality	Function ID	Test Cases
1	Login the System	F3.4	T1
2	View Reservation Status	F3.5	T2
3	View Train Schedule	F3.6	T3
4	Reserve Seat	F3.7	T4
5	Cancel Seat	F3.8	T5
6	Exit the System	F3.9	T6

- a) Design **six test cases** corresponding to T1, T2, T3, T4, T5, T6 for railway reservation system given in Table 1.
- b) Define Test Log. To check the functionality corresponding to 'View Reservation Status' create a **test specification report** and corresponding **test log**.
6. a) Consider a project with the following parameters: EI= 60, EO= 40, EQ = 45, ILF = 06, ELF = 08. Assume all weighing factors are average. In addition, the system requires significant data communications, performance is very critical, designed code may be moderately reusable, and other factors are average. Compute the function points using **FPA**.
- b) Calculate the number of test sessions for the **pair-wise** and **neighbourhood** call graph based integration testing for the call graph shown in Figure 3.

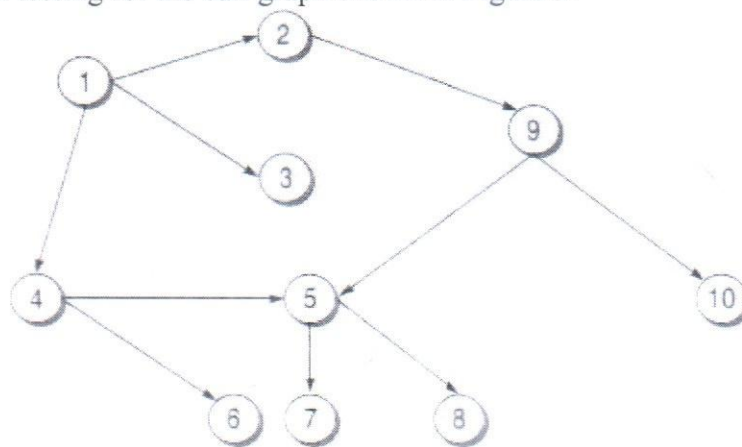


Figure 3: Call Graph

- c) Draw a **connection matrix** for the call graph given in Figure 3.

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Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

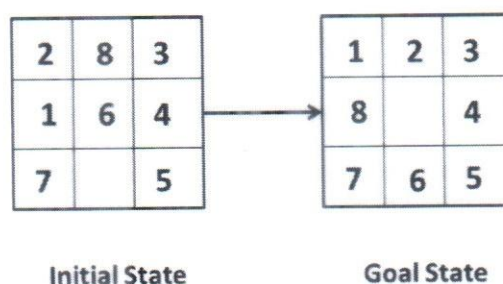
SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

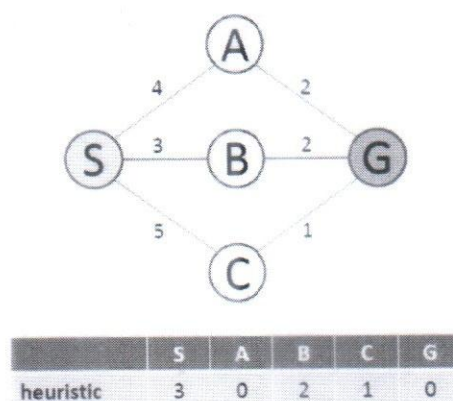
FULL MARKS: 150

CSE 4617: Artificial Intelligence**Programmable calculators are not allowed. Do not write anything on the question paper.**Answer **any 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) What are the following environment properties of a chess game with a clock: observability, determinism, episodic, static, and discrete? Given the following initial and goal states in Figure 1 of an 8-puzzle problem. Perform an A* search starting from the initial state to find the goal state. Stop the search as soon as the search expands a state at level three (the start state belongs to level 0). Use the "the number of misplaced tiles" as a heuristic to guide the search. 4+8
(CO1,
CO3)
(PO1,
PO2)

**Figure 1:** Initial and goal states of an 8-puzzle problem.

- b) "We need to trade-off the accuracy of heuristic against the overhead for computing that heuristic on every search state" – Justify the statement. Step-wise perform SMA* search (memory: 3 nodes) on the following graph in Figure 2, where S and G are the start and goal nodes respectively. The heuristic value of each node is given in the table underneath. 5+8
(CO2)
(PO2)

**Figure 2:** Graph and table for question 1.b)

2. a) Describe the terms 'plateau' and 'ridge' in respect of a state space landscape. Briefly explain different types of mutation operations in genetic algorithms. 4+6
(CO1)
(PO1)

- b) "Starting from a randomly generated 8-queens state, steepest-ascent hill climbing gets stuck 86% of the time, solving only 14% of problem instances" – but is there any good side of it, and how can we improve this scenario? Perform a local search up to 5 steps on an 8-queens problem starting from an initial configuration as shown in the Figure 3 below (the numbers represent the total conflicts against respective queens). Here, each queen is dedicated to its existing column, and one single (usually the most aggressive) queen can be moved at a time.

7+8
(CO2,
CO3)
(PO2,
PO4)

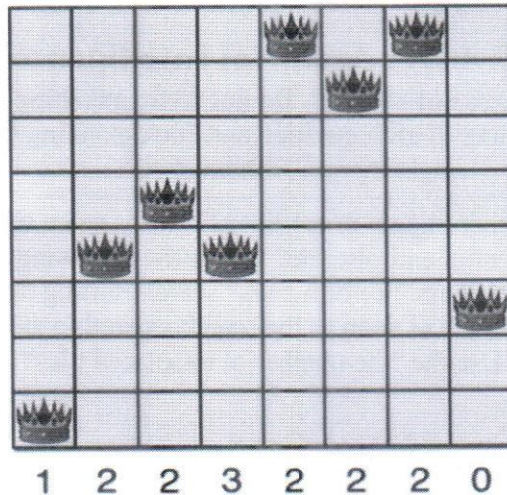


Figure 3: 8-queens problem for question 2.b)

3. a) What is higher order constraint in a constraint satisfaction problem (CSP)? What is Thrashing problem in Backtracking search? How can you avoid that? Explain with an example.
- b) Encode the following graph colouring problem, given in Figure 4, into a constraint satisfaction problem (CSP) having a finite set of variables, a finite domain for each variable, and a set of constraints. In this problem each vertex of the following graph has to be coloured by either red, green, or blue, such that no two adjacent vertices share the same colour. Solve the problem using backtracking considering the order in which you choose variables and their values, which may have a huge impact on search space size. Apply arc-consistency for earlier detection of failure.

2+4+4
(CO1)
(PO1)
15
(CO3)
(PO3)

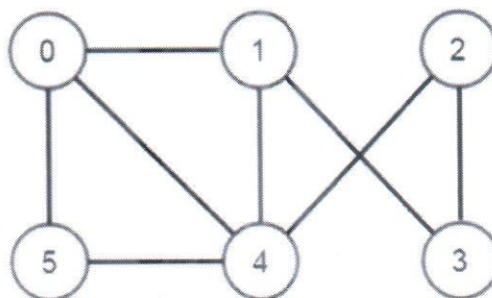


Figure 4: Graph for question 3.b)

4. a) How can you calculate the heuristic value of a state in the tic-tac-toe game? Explain with necessary diagram how you can apply the two-ply minimax algorithm to the opening move of the tic-tac-toe.
- b) How can you exploit the following two facts of an adversary:
- If a position is provably bad
 - If the adversary can force a bad position?

4+8
(CO3)
(PO3)
4
(CO1)
(PO2)

- c) Given the following search tree in Figure 5, step-wise show how the alpha and beta cuts can be applied to the tree using alpha-beta pruning technique, and which parts of the search tree are pruned as a result.

9
(CO2)
(PO4)

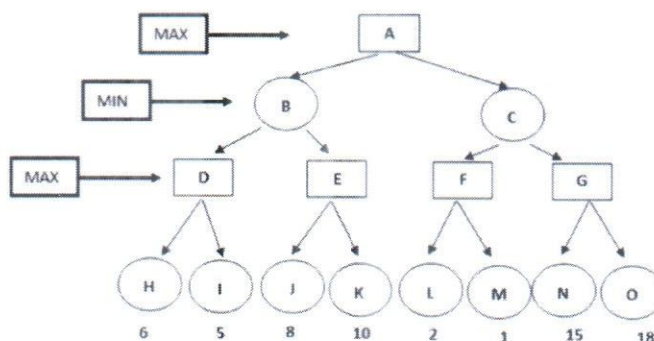


Figure 5: Search tree for question 4.c)

5. a) What is meant by conjunctive normal form (CNF) in propositional logic? Find out whether the following statements are valid, satisfiable, or unsatisfiable.
- $(A \vee B) \wedge (\neg C \vee \neg D \vee E) \models (A \vee B)$
 - $(A \vee B) \wedge \neg(A \Rightarrow B)$
 - $(\text{Smoke} \Rightarrow \text{Fire}) \Rightarrow (\neg \text{Smoke} \Rightarrow \neg \text{Fire})$
- b) What are the criteria for a knowledge base to be in horn form? Given the following Knowledge Base (KB). Prove that "It will not rain" by converting the KB into its Horn form in propositional logic, and then by applying forward chaining.
- The humidity is high or the sky is cloudy.*
 - If the sky is cloudy, then it will rain.*
 - If the humidity is high, then it is hot.*
 - It is hot.*
6. a) Explain the advantages of first-order logic (FOL) over propositional logic (PL). Illustrate the common mistakes to avoid in universal and existential quantification.
- b) What is generalized modus ponens? Given the following sentences:
- Jack owns a dog.*
 - Every dog owner is an animal lover.*
 - No animal lover kills an animal.*
 - Either Jack or Jill killed the cat, who is named Tuna.*
- Now, write them in first-order logic (FOL), convert the FOL sentences into an inferentially equivalent sentence in conjunctive normal form (CNF), and finally prove, by resolution refutation (contradiction), that *Jill kills the cat*.
7. a) What is the purpose of causal links in partial plan representation? Step-wise generate a partially ordered plan of the "Wearing Socks and Shoe" problem, where the problem allows four actions, namely *left-sock* (pre: CleanLeftSock; add: LeftSockOn), *right-sock* (pre: CleanRightSock; add: RightSockOn), *left-shoe* (pre: LeftSockOn; add: LeftShoeOn), *right-shoe* (pre: RightSockOn; add: RightShoeOn). The initial state represents {CleanLeftSock, CleanRightSock} and the goal requires LeftShoeOn and RightShoeOn. Explain how a causal link is protected during the above partial plan generation if the *right-sock* action additionally removes the atom LeftSockOn.

- b) Given a four knights problem in a 3×3 grid board, where the goal is to get each knight into the opposite corner. (A knight can move to an unoccupied space according to an L-shape movement: it must move two spaces horizontally and one vertically, or two spaces vertically and one horizontally.) 8+5
(CO4)
(PO3,
PO4)
- i. Represent the problem in classical planning representation by writing a domain file and a problem file in PDDL.
 - ii. What could be an admissible heuristic for this problem? Write a solution (as sequence of actions) according to your domain action descriptions, and prove the correctness of the solution by showing that successively applying that action sequence leads the initial state to a goal state.

Initial positions of the four knights 1..4:

1 _ 2

3 _ 4

Goal positions of those four knights:

4 _ 3

2 _ 1

8. a) What is the PDDL expression of the statement, "A people p is not healthy or the people p is playing" using the "imply" keyword? Explain Sussman anomaly with respect to a block world problem. 4+7
(CO1)
(PO1)
- b) Distinguish between admissible and consistent heuristics. Given a set of seven coins, a player takes a set and divides it into two unequal sets. The player who cannot do uneven split, loses. Give an explicit description of the problem showing the complete state space, actions, and goals. 6+8
(CO1,
CO2)
(PO1,
PO2)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4621: Machine Learning

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets. Symbols have their usual meaning.

1. a) Suppose the following 2D data is given.

Table 1

x_1	x_2
3	3
4	4
5	5

Show all numeric calculations required to perform Principal Component Analysis (PCA) to transform the original data into 1D data with maximum variance.

Note: One of the Eigen values of the covariance matrix is 0, and corresponding Eigen vector is $[-0.7071 \ 0.7071]^T$.

- b) Is there any difference if we choose the number of principal components using either 'the maximum projection error allowed' or 'minimum variance retained'? Justify your answer.
2. a) Identify the strengths and weakness of elbow method in determining the number of clusters in a dataset?
- b) Does k -medoids clustering technique produce convex-shaped clusters? Explain your answer.
- c) Compare between k -means and k -medoids clustering techniques.
- d) Design a criterion function J for partitioning, where for each class a distance measure can be used between samples p , instead of using cluster center c_i .
3. a) Consider a Support Vector Machine and the following training data for a two-class problem given in Table 2:

Table 2

class	x_1	x_2
+	1	1
+	2	2
+	2	0
-	0	0
-	1	0
-	0	1

- i. After plotting these six training points (use graph paper), construct the weight vector for the optimal hyperplane, and the optimal margin width.

- ii. If you remove one of the support vectors does the size of the optimal margin decrease, stay the same, or increase?

[Note: You do not need to calculate the solutions by solving, rather find the answers from inspecting the graph.]

- b) Suppose the test data in a two-class problem is not linearly separable and noisy with outliers. Which concepts can you employ to make the SVM classifier work with better generalization? Explain in brief with changes in the objective function.

10
[CO3,
PO3]

4. a) Compare between Generative and Discriminative models.

5
[CO2,
PO2]

- b) Suppose you are training a robot in a lumber yard, and the robot must learn to discriminate Oak wood from Pine wood. You choose to learn a Naïve Bayes classifier with the following data in Table 3:

4+1
[CO1,
PO1]

Table 3

Density	Grain	Hardness	Class
Heavy	Small	Hard	Oak
Heavy	Large	Hard	Oak
Heavy	Small	Hard	Oak
Light	Large	Soft	Oak
Light	Large	Hard	Pine
Heavy	Small	Soft	Pine
Heavy	Large	Soft	Pine
Heavy	Small	Soft	Pine

Consider a new sample (Density=**Light**, Grain=**Small**, Hardness=**Soft**)^T. Calculate the posterior probability for each class and classify the sample

- c) For the Naïve Bayes classifier, the decision rule $f(x)$ can be written as follow, where the sample will be classified to the positive class (i.e., $y=1$) if $f(x) > 0$:

5
[CO3,
PO3]

$$f(x) = \log \frac{P(y=1|x)}{P(y=0|x)}$$

Can the decision rule be formulated similarly for multiclass Naive Bayes? Explain why.

- d) During decision tree generation for classification, instead of taking a binary split for the numeric attribute, can we use ternary split using two thresholds w_{ma} and w_{mb} ? In other words, three potential branches where samples can take j-th branch according to the following conditions:

7+3
[CO3,
PO3]

$$x_j < w_{ma}; w_{ma} \leq x_j \leq w_{mb}; x_j > w_{mb}$$

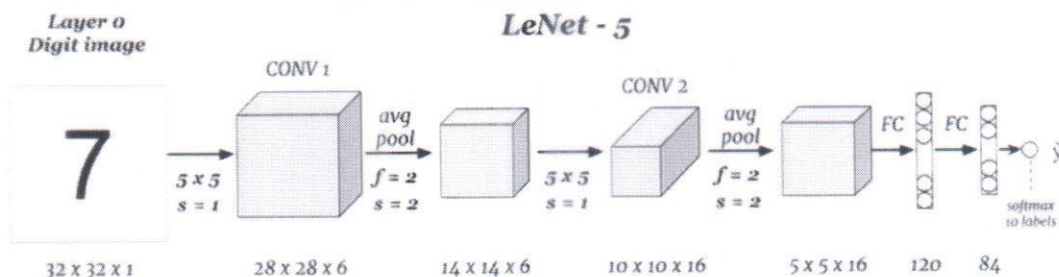
Propose a modification of the tree induction method along with impurity measure to learn those two thresholds. What are the advantages of performing ternary split over binary?

5. a) What is the motivation behind 1×1 convolution? How can it help in reducing the computation cost? Give an example scenario

5
[CO1,
PO1]

- b) Consider the following LeNet-5 model in Figure 1. If we replace the average-pool with max-pool layers, determine the changes you might see?

7
[CO2,
PO2]



- c) Examine the benefits of using skip connections in Convolution Neural Network (CNN). How do we incorporate such skip connections and in which cases?
- d) You come up with a CNN classifier as shown in Figure 2. For each layer, measure the number of weights, number of biases and the size of the associated feature maps.

6
[CO2,
PO2]
7
[CO1,
PO1]

The notation follows the convention:

- CONV-K-N denotes a convolutional layer with N filters, each them of size $K \times K$, Padding and stride parameters are always 0 and 1 respectively.
- POOL-K indicates a $K \times K$ pooling layer with stride K and padding 0.
- FC-N stands for a fully-connected layer with N neurons.

Layer	Activation map dimensions	Number of weights	Number of biases
INPUT	$128 \times 128 \times 3$	0	0
CONV-9-32			
POOL-2			
CONV-5-64			
POOL-2			
CONV-5-64			
POOL-2			
FC-3			

Figure 2.

6. a) For large batch sizes, the number of iterations does not change much as the batch size is increased. Explain this statement.
- b) Why do we need a Regularization term in the cost function? Compare between L1 and L2 Regularization.
- c) The standard form of L2-regularized loss function for linear regression is:

5
[CO1,
PO1]
2+5
[CO2,
PO2]

$$J(\theta) = \frac{1}{2m} \sum_{i=1}^m (h_{\theta}(x^i) - y^i)^2 + \frac{\lambda}{m} \theta^T \theta$$

- i. Suppose you have accidentally defined: $J(\theta) = \frac{1}{2m} \sum_{i=1}^m (h_{\theta}(x^i) - y^i)^2 + \frac{\lambda}{m} Y^T Y$. What kind of regularization effect will you have?
- ii. Suppose we use the correct expression but accidentally choose $\lambda < 0$. Will you either have overfitting or underfitting? Justify your answer.
- d) If the following first-order condition is true:
 $\forall x, y \in \text{dom } f, f(y) \geq f(x) + [\nabla f(x)]^T \cdot (y - x)$, then determine that the function f is convex.

4+4
[CO2,
PO2]
5
[CO3,
PO3]

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Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

SWE 4637: Web and Mobile Application Development

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

- | | |
|---|----------------------|
| 1. a) What are the advantages of building Single-Page Applications (SPA)? | 6
(CO1)
(PO1) |
| b) Explain the concept of Asynchronous JavaScript used in AJAX or AsyncStorage. | 5
(CO2)
(PO1) |
| c) What are transpilers? Give an example. | 4
(CO1)
(PO1) |
| d) Consider the webpage shown in Figure 1: | 10
(CO1)
(PO2) |

Figure 1: Sign up page for Question 1.d)

Write a script (JavaScript/TypeScript) to do form validation of the sign up page given in Figure 1 as per the following rules:

- None of the form element value should be empty.
- First Name and Last Name can only contain alphabetic characters.
- Password and Confirm Password values should be exactly the same and have a minimum length of 8.
- The Email should be in a standard format.

359

2. a) What are the differences between SQL and NoSQL databases? 6
(CO1)
(PO1)
- b) What are the differences between using *FlatList* and using *Map* function for rendering a list of items in React Native? 7
(CO1)
(PO1)
3x4
- c) Write short notes on the following: (CO1)
(PO1)
- useRef
 - React Routing
 - useState
 - Context API
3. Consider the Blog-Post application shown in Figure 2. This application consist of 3(three) screens: LoginScreen, SignUpScreen, and HomeScreen.

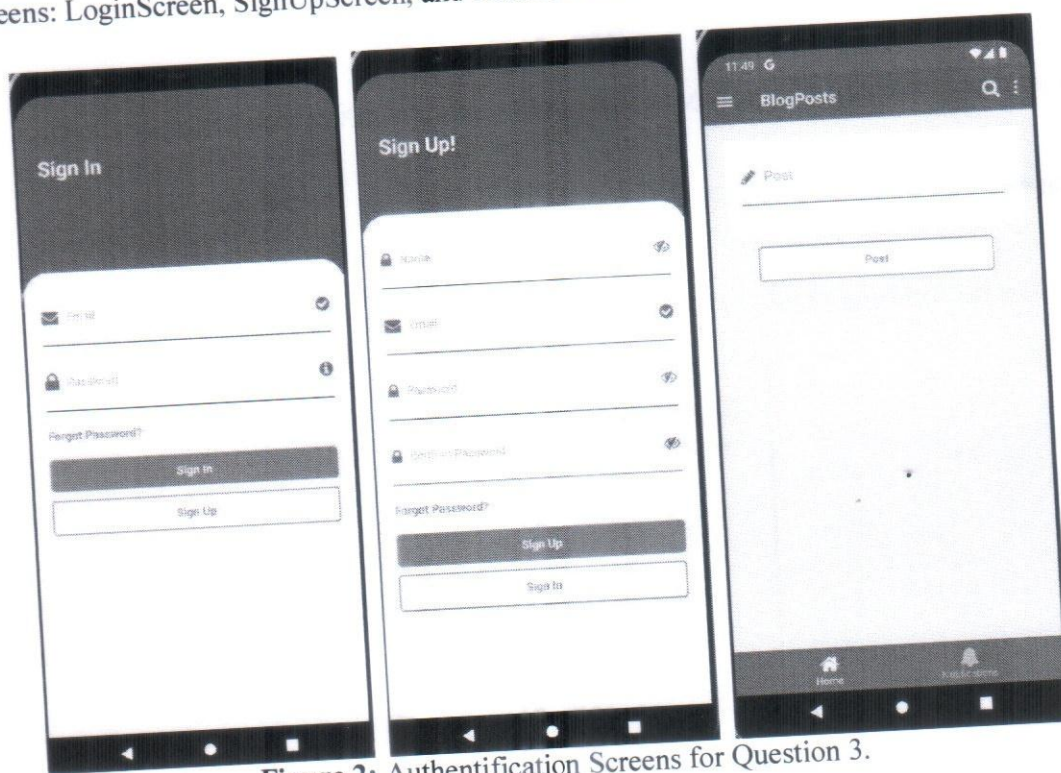


Figure 2: Authentication Screens for Question 3.

Based on the Blog-Post application, answer the following questions:

- a) What type of navigation should be used to achieve the best performance for this application? Explain your reasoning. 4
(CO2)
(PO1)
- b) Write the implementation code of the app navigation using *stack navigation*. 5
(CO3)
(PO2)
- c) Write the implementation code for the LoginScreen and SignUpScreen using AsyncStorage for authentication and authorization. 16
(CO1,
CO4)
(PO2,
PO3)

4. Assume that you are asked to develop a mobile app for IUT programming contest competition. The mobile app will show the list of teams participating in the contest along with the points that they have. You are given the IUT CONTEST API, <https://www.iut-programming.edu/contest/2022/>, which will return the updated information about teams participating in the contest. An example of the JSON response from the API is shown in Figure 3.

```

1  {
2    "results": [
3      {
4        "teamName": "NewTeam",
5        "teamID": "101",
6        "members": [
7          { "name": "Member 1", "Dept": "CSE", "Student_ID": 180042101 }
8          ...
9        ],
10       "solved": "7",
11       "totalPoints": "1542",
12       "teamLogo": "https://images-contest/teams/team101/team101.png"
13     },
14     {
15       "teamName": "IUT_CG",
16       "teamID": "102",
17       "teamMembers": [
18         { "name": "Member 3", "Dept": "CSE", "Student_ID": 180041101 }
19         ...
20       ],
21       "solved": "6",
22       "totalPoints": "1208",
23       "teamLogo": "https://images-contest/teams/team102/team102.png"
24     }
25   ]
26 }

```

Figure 3: Example of JSON response from IUT CONTEST API.

- a) Write the necessary code to fetch the teams' information from the API provided. 6
(CO2)
(PO2)
- b) Using *FlatList* component, write the code to display the teams' logo, names and total points they currently have in descending order of total points. 15
(CO3)
(PO1)
- c) Add a pull to refresh functionality to the *FlatList* component where the information displayed will be updated if the *FlatList* is pulled down. 4
(CO4)
(PO1)
5. a) What is SEO? What is the difference between Page Rank (PR) and Search Engine Result Page (SERP)? 2+4
(CO2)
(PO1)
- b) Consider the Blog-Post application given in question 3. Write the code for the HomeScreen functional or class component with the following requirements: 15
(CO3)
(PO2)
- The Blog-Post application is for people interested in literature to share their thoughts on various topics related to literature.
 - The app will use Firebase as Backend as a service.
 - In the dashboard, users will be able to see posts from other users.
 - Users will be able to create a post.
 - When the user clicks on the post button, his message should be posted, so that other users can see it.
- You do not need to write the code for authentication. You can assume the structure of the different collections and documents in firebase.
- c) Differentiate between class-based components and functional components. 4
(CO3)
(PO1)

356

6. a) Write the output that will be shown if the *Index.html* in Figure 4 below is run in a browser. 10
 Replace "YOUR_STUDENT_ID" in test.js with your IUT student ID. You do not need to (CO2)
 show the step-by-step procedure. The final output is sufficient. (PO2)

Index.html	test.js
<pre><!DOCTYPE html> <head> <meta charset="UTF-8"> <title>Test</title> </head> <body> <div id="para"></div> <script src="test.js"/> </body> </html></pre>	<pre>const sid = YOUR_STUDENT_ID % 5; const Display = (number) => { let c; let val = 1; let output = ""; for(c=0; c < number; c++){ val += val; output += "<p>" + val + "</p>"; } (1=="1")? (c=val+20+"\$px") : (c=val+7+"\$qx") output += "<h1>" + c + "</h1>"; return output; } let value = Display(sid); para.innerHTML = value;</pre>

Figure 4: Code snippet for Question 6.a)

- b) Use the flexbox CSS property to create the layout given in Figure 5 below.

10
(CO5)
(PO2)

1	2	3
4		
5		
6	7	

Figure 5: Flex box layout for Question 6.b)

- c) Describe the different types of navigation used in cross-platform mobile application development.

5
(CO3)
(PO1)

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Department of Computer Science and Engineering (CSE)

SEMESTER: FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

Math 4643: Probability and Statistics II

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer any **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin.

-
- | | | |
|-------|---|---------------------|
| 1. a) | Define normal distribution and standard normal distribution in terms of their respective probability density functions. | 4
(CO1)
(PO1) |
| b) i. | Show that the area under the normal curve having a probability density function is unity. | 9
(CO2) |
| ii. | Find the mean and variance of the standard normal distribution. | (PO2) |
| c) i. | The normal random variable Y having a mean 25 and unknown variance is distributed in such a way that $P(Y < 30) = 0.6915$. Find the variance of Y . | 12
(CO3) |
| ii. | The line width while manufacturing semiconductor is assumed to be normally distributed with a mean of 0.5 micrometer and variance of 0.0025 micrometer. Now, what is the probability that the line width is greater than 0.64 micrometer? Also, find the probability that the line width is between 0.48 and 0.65 micrometer. | (PO3) |
| 2. a) | Define Poisson distribution. Prove that the Poisson distribution function is a probability mass function. | 6
(CO1)
(PO1) |
| b) | Find the mean and variance of Poisson distribution. | 7
(CO2)
(PO2) |
| c) | If the average number of claims handled daily by an insurance company is 6, then what is the probability that the company will receive | 12
(CO3) |
| i. | no claim? | (PO3) |
| ii. | exactly two claims? | |
| iii. | at least three claims on Friday? | |
| 3. a) | Define statistical hypothesis with two examples. Classify the types of statistical hypothesis. | 6
(CO1)
(PO1) |
| b) | What do you mean by power of a test? Define the level of significance and comment on what level of significance is statistically accepted in hypothesis testing. | 6
(CO2)
(PO2) |

358

- c) The daily production of milk in a dairy firm has an average of 880 tons for the last couple of months. The authority would like to know whether this average has changed or not in recent time. For investigating the fact they selected 50 days randomly from their database and found that the average and standard deviation of the 50 days' production were 870 tons and 22 tons, respectively. If 5% level of significance is considered, then compute the power of the test and hence sketch the power curve. 13 (CO3) (PO3)
4. a) i. Define type-I and type-II error using their mathematical expression. Define critical region, and hence mention their role in statistical hypothesis testing. 7 (CO1)
- ii. What do you mean by confidence interval? Write down the mathematical formulation for finding out the confidence interval for a two-tailed test. (PO1)
- b) What do you mean by power of a test? Define the level of significance and comment on what level of significance is statistically accepted in hypothesis testing? 6 (CO2) (PO2)
- c) i. The mean and variance of CGPA scores obtained from a random sample of 50 students of IUT were found to be 2.8 and 0.1225, respectively. Would it be logical to conclude that the sample has come from the entire group of students which has a mean score of 2.4? Use 5% level of significance and compute 95% confidence interval for the mean score in the population. 12 (CO3) (PO3)
- ii. The sample data show that 120 adults males born in rural areas have a mean height of 62.7 inches with a standard deviation of 2.50 inches, and that of 150 males who born in urban areas have 61.8 inches and 2.62 inches, respectively. Using 1% level of significance, test the hypothesis that the mean heights in the two different areas from where the samples have been taken do not differ.
5. a) i. What do you mean by correlation in statistical science? Write down the classification of correlation between two random variables. 12 (CO1)
- ii. Define covariance and correlation coefficient of two random variables with their mathematical representations. (PO1)
- b) Consider the joint probability density function of two random variables X and Y as follows: 7 (CO3) (PO3)
- $$f(x, y) = \begin{cases} \frac{6}{5} (x^2 + 2xy); & \text{if } 0 \leq x \leq 1, 0 \leq y \leq 1 \\ 0; & \text{otherwise} \end{cases}$$
- Find the covariance between the two random variables. Compute the correlation by means of correlation coefficient.
- c) Three girls A, B, and C share the household works. Since A is the oldest, she does the job 40% of the time, while B and C share the other 60% equally. The probability that at least one dish will be broken when A is working is 0.02; for B and C, the probabilities are 0.03 and 0.04, respectively. The parents do not know who is washing the dishes, but one morning they hear one dish has been broken. What is the probability that B was working on that morning? 6 (CO3) (PO3)
6. a) i. Define probability density function for a random variable and write down its properties. 10 (CO1)

- ii. Define cumulative distribution function for a discrete random variable with its mathematical representation. (PO1)

- b) A continuous random variable X has the following density function: 8

$$f(x) = \begin{cases} \frac{1}{30}(x^2 - 2x + 4); & 2 \leq x \leq 5 \\ 0; & \text{otherwise} \end{cases}$$

(CO2)
(PO2)

- i. Verify that it satisfies the condition $\int_{-\infty}^{\infty} f(x)dx = 1$

- ii. Evaluate $P(X < 3)$.

- iii. Find the value of $P(3 < X < 4)$.

- c) A fair coin is tossed three times. If X is the random variable representing the number of tails obtained, then find the probability distribution function of X and hence find its cumulative distribution function (CDF). Also, sketch the CDF of X and comment on the nature of this distribution. 7
(CO3)
(PO3)

7. a) What do you mean by nonparametric hypothesis testing? Under what condition, a nonparametric hypothesis testing could be applied? 6
(CO1)
(PO1)

- b) If a sample of size 200 contains 120 values that are less than m_0 and 80 values that are greater, what is the p-value of the test of the hypothesis that the median is equal to m_0 ? 7
(CO2)
(PO2)

- c) In a study of bilingual coding, 12 bilingual (French and English) college students are divided into two groups. Each group reads an article written in French, and each answers a series of 25 multiple-choice questions covering the content of the article. For one group the questions are written in French, the other takes the examination in English. The score (total correct) for the two group is: 6
(CO3)
(PO3)

Exam in French	11	12	16	22	25	25
Exam in English	10	13	17	19	21	24

Is this evidence at the 5% level of significance that there is difficulty in transforming information from one language to another?

- d) In a certain region, insurance data indicate that 82% of the drivers have no accidents in a year, 15% have exactly 1 accident, and 3% have 2 or more accidents. In a random sample of 440 engineers, 366 had no accidents, 68 had exactly 1 accident, and 6 had 2 or more. Can you conclude that engineers follow an accident profile that is different from the rest of the drivers in the region? 6
(CO3)
(PO3)

- 360
8. a) The life of a particular type of generator is thought to be influenced by the material used in its construction and also by the temperature at the location where it is utilized. The following table represents lifetime data on 24 generators made from three different types of materials and used in two different temperatures. Do the data indicate that the material and temperature do indeed affect the lifetime of a generator? Is there evidence of an interaction effect?

8
(CO2)
(PO2)

Material	Temperature	
	10° C	18° C
1	135, 150	50, 55
	176, 85	64, 38
2	150, 162	76, 88
	171, 120	91, 57
3	138, 111	68, 60
	140, 106	74, 51

- b) The following data refer to the number of deaths per 10,000 adults in a large Eastern city in the different seasons for the year 1982 to 1986.

9
(CO3)
(PO3)

Year	Winter	Spring	Summer	Fall
1982	33.6	31.4	29.8	32.1
1983	32.5	30.1	28.5	29.9
1984	35.3	33.2	29.5	28.7
1985	34.4	28.6	33.9	30.1
1986	37.3	34.1	28.5	29.4

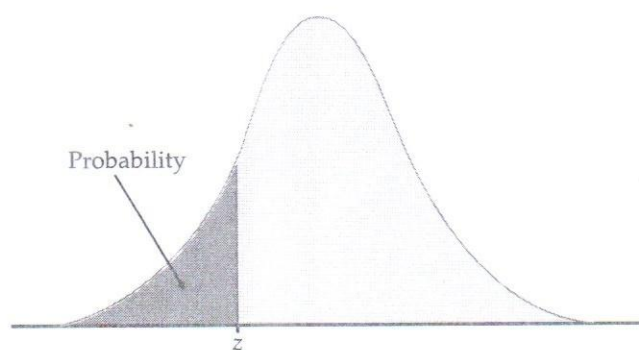
- Assuming a two-factor model, estimate the parameters.
 - Test the hypothesis that death rates do not depend on the season, using 5% level of significance.
- c) A purification process for a chemical involves passing it, in solution, through a resin on which impurities are adsorbed. A chemical engineer wishing to test the efficiency of 3 different resins took a chemical solution and broke it into 15 batches. She tested each resin 5 times and then measured the concentration of impurities after passing through the resins. Her data were as follows:

8
(CO3)
(PO3)

Concentration of Impurities		
Resin I	Resin II	Resin III
0.046	0.038	0.031
0.025	0.035	0.042
0.014	0.031	0.020
0.017	0.022	0.018
0.043	0.012	0.039

Test the hypothesis that there is no difference in the efficiency of the resins.

Table entry for z is the area under the standard normal curve to the left of z .

**TABLE A**

Standard normal probabilities

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
-3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
-3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
-3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
-3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
-2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
-2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
-2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
-2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
-2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
-2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
-2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
-2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
-2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
-2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
-1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
-1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
-1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
-1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
-1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
-1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
-1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
-1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
-1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
-1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
-0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
-0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
-0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
-0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
-0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
-0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
-0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
-0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
-0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

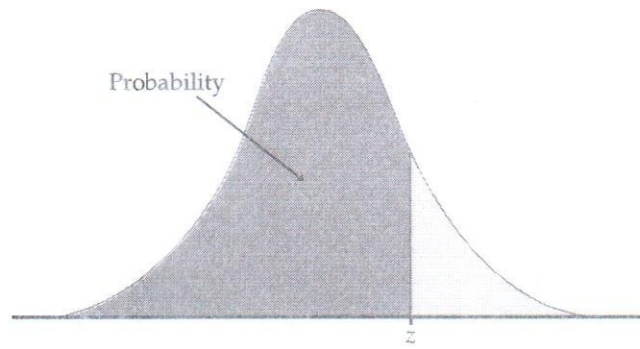


Table entry for z is the area under the standard normal curve to the left of z .

TABLE A

Standard normal probabilities (continued)

[illegible]

B.Sc. in SWE 8th Semester4th April 2022

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

SWE 4801: Software Maintenance**Programmable calculators are not allowed. Do not write anything on the question paper.**Answer all 6 (Six) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. A pharmaceutical company wants to analyze their current legacy software. They have given this task to "ABC" software company. "ABC" software company analyzed the maintainability of the legacy software using software metrics.
 - a) According to ISO 9126, what is maintainable software? Write all the characteristics of a maintainable software with their metrics (at least 3). 5
(CO1)
(PO1)
 - b) What do you understand about software measurement? What are the objectives to measure a software? 5
(CO1)
(PO1)
 - c) Explain, as a maintainer of "ABC" software company, how and what you will use to measure the **code-based artifacts** of the software system. 15
(CO2)
(PO2)
2. From Question 1, "ABC" software company suggested that existing software can be used for another 10 years. In regards to that, the Pharmaceutical company requested some new features and modifying existing ones. Before and during the implementation, "ABC" software wants to analyze the areas that will be affected by change.
 - a) Elaborate how you will conduct impact analysis on the legacy software with a figure. 4+6
Explain with an example how you will evaluate adequacy and effectiveness of any change made on the legacy software. (CO4)
(PO2)
 - b) L1 : int i = 0;
L2 : do{
L3 : assert (i <= 15);
L4 : i = i + 5;
L5 : }while(i <= 11);
Draw a Program Dependency Graph of the above code fragment.. 5
(CO3)
(PO1)
 - c) For a given execution trace: ABCrDrrEFGHrrDrrrrx 5
In the trace, r and x represent function returns and program exits, respectively. If procedure E is modified, find the potentially impacted procedures. (CO4)
(PO3)
 - d) For analyzing impact in a given source code it was found that. 1+2+2
SIS={A,B} (CO3)
CIS={A,B,D,E} (PO1)
DIS={F,G,P,Q}
AIS={A,B,F,G,P,Q}
 - i. Find the false positive impact set.
 - ii. Find error in impact estimation
 - iii. Find the precision and recall

- 3 From Question 2, After implementing changes, the software maintainer wants to restructure the code so that it becomes maintainable. So, developers refactored the existing code so that it is maintainable.
- a) What activities will you conduct as a developer to refactor the code? 10
(CO1)
(PO1)
3+3+3
+6
- b) Calculate Crv, Cpp and Csv and Cy for the following Scenario. 3+3+3
For a function A, +6
Functions Q, R and Y are in the same class and others are in different class. (CO2)
For methods m outside the class Krv(m) is 3, Kpp(m)=5, Ksv(m)=7 (PO2)
- i. Set of functions provided return values to and used by function
A={P(2),Q(4),R(1),S(2)}
- ii. set of methods where return value of A is used and methods that called
A={X(3),Y(3)}
- iii. Set of methods that shared instance variables with A={P(3),Q(2),Y(4)}
- Given Wrv=.2 and Wpp=.15 and Wsv=.65
4. From Question 3, After implementing changes, the software of the pharmaceutical company is sent to Software Quality Assurance team. The Quality assurance team found a requested feature was not modified by the development team. While investigating the cause, developer could not handle the complex code and its relationship with other features as it may break down the core services provided by the program.
- a) What type of testing "ABC" software company will conduct? Write the different types of this testing and how these are conducted. 5
(CO1)
(PO1)
- b) Elaborate how you will conduct this testing as a member of Software Quality Assurance team member of "ABC" software Company. 10
(CO4)
(PO2)
- c) Since, the mentioned feature **could not be modified due complexity** of the source code in the **legacy software system**. So, as a developer of "ABC" software, what solution will you adopt to get service the feature? How will you construct the solution and adapt legacy software with it? 2+4+4
(CO3)
(PO3)
5. After several years, the software of the pharmaceutical company could no longer be supported either by wrapping or redevelopment as there is a major technological change. So, "ABC" software company was given the responsibility to handle this case.
- a) What is the best possible solution that "ABC" software can give regarding this case? Explain step by step about how they will carry it out. 5
(CO2)
(PO2)
- b) How will you plan the solution to handle this case? 15
(CO2)
(PO3)
- c) If "ABC" software company has adopted the "Composite Database" method, then how will they implement the solution? Explain with figures. 5
(CO3)
(PO1)
6. "ABC" software company wants to make clear guidelines for its software maintenance process. In this regard, they are talking with the senior developers about how they conduct the maintenance.
- a) Elaborate on how the maintenance framework of the company can effectively play role in Maintenance process. 15
(CO1)
(PO1)
- b) Senior developers mentioned about following phase model while they re-engineer software systems. Explain how they carry out reengineering activities following this model. 10
(CO1)
(PO2)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**ORGANISATION OF ISLAMIC COOPERATION (OIC)****Department of Computer Science and Engineering (CSE)****SEMESTER FINAL EXAMINATION****SUMMER SEMESTER, 2020-2021****DURATION: 3 HOURS****FULL MARKS: 150****SWE 4803: Software Project Management**

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Identify and explain the important characteristics of software development projects which make them harder to manage compared to other types of projects. 8
(CO1)
(PO2)
- b) Why software development houses prefer to use project organization over functional organization? How the project manager differs from functional or operational manager? 5+4
(CO1)
(PO1)
- c) General Electric (GE) has the opportunity to invest in 2 projects. Project A requires an investment of \$1000000 which will give a return of \$300000 each year for 5 years. Project B requires an investment of \$750000 which will give a return of \$100000, \$150000, \$200000, \$250000, and \$ 250000 for the next 5 years. In which project GE should invest if the discount rate is 7%? 8
(CO1)
(PO11)

2. a) **Table 1: Table for Question 2. (a)**

10+ 2+5
(CO3)
(PO2)

Project Activity	Precedence Activity	Duration (Weeks)		
		Optimistic	Most likely	Pessimistic
Start		0	0	0
C	Start	2	3	4
D	C	2	7	9
A	C	5	7	12
E	D	1	3	8
B	A, E	4	5	6
F	E	2	3	4
End	B, F	0	0	0

- i. Estimate the duration and standard deviation of each task provided in Table 1 using PERT (beta distribution).
- ii. What is the estimated total duration of the project according to PERT?
- iii. What should be the safe statement to the sponsors about the estimation of project duration?
- b) "Lag provides mandatory delay to the Successor Activity and Lead provides acceleration to the Successor Activity" – justify with proper example. 8
(CO3)
(PO2)
3. a) While creating the agenda of a common status meeting for two different projects, one of the team member mentions a very specific item that should be added in the meeting agenda. One of the project managers says that "We cannot deal with this item now!" Few other team members say that the team is not ready to resolve the item during the meeting. But after having a discussion with both the project teams, another project manager decides to put the item on the agenda as an initial discussion item. What sort of conflict resolution techniques are the project managers utilizing in the given scenario? 5
(CO3)
(PO2)

- b) CSE Department of IUT is planning to organize an App development contest on the last Friday of July 2022. You are selected as a project manager for this big event. You are allowed to start working on this project from 1st week of May 2022. Develop a project charter for your project. 15
(CO3)
(PO3)
- c) A company is making an effort to improve its project performance and create historical records of past projects. What is the best way to accomplish this? 5
(CO3)
(PO2)
4. a) You want to let your team know that the weekly project status report is now officially due by 4:00 PM on each Thursday. Which type of communication would you use? 5
(CO3)
(PO2)
- b) A project manager for a large bank is in-charge of developing a new certificate of deposit product, which needs IT system development. His internal IT staff does not have expertise in the technology needed for this project. So, he must contract out the work. Unfortunately, he does not have the time to develop a detailed procurement statement of work, but this effort is likely to be large. In this situation, what is the best contract type the project manager should select? 8
(CO3)
(PO4)
- c) Formulate with your own example how the earned value chart depicts scheduled progress, actual cost, and actual progress (earned value) to allow the determination of cost, schedule, and time variances. 12
(CO3)
(PO3)
5. a) For your upcoming project, you decided to develop 80 functionalities of your product within 5 days by some third-party Software development firm. The plan for 5 days and the actual development till day 3 is given in Table 2. Also, it is estimated that development cost for each functionality will be 1000\$. And as a project manager you are performing monitoring and control activities on day 3. 6+4
(CO3)
(PO2)

Table 2: Table for Question 5. (a)

	Day 1	Day 2	Day 3	Day 4	Day 5
Functionalities planned to be built	10	13	17	20	20
Functionalities actually built	8	12	16	.	
Actual cost for the day	8000	12000	16000		

- i. Based on the given information analyze the impact of SV, CV, SPI, and CPI on your project.
- ii. As the third-party organization failed to deliver the expected outcome, you decided to revise the budget of this project as 78000\$. Calculate the TCPI for this change.
- b) In one of the outsourced software development contractual agreements, the buyer and seller agreed to a cost of \$300,000 and a profit/fee of \$30,000. The buyer has informed that the ceiling price will be \$360,000. Beyond the target cost, the sharing ratio between the buyer and seller will be 60:40. What is the PTA? 8
(CO3)
(PO2)
- c) Does profit/fee become zero at PTA? Justify your answer with proper example. 7
(CO3)
(PO2)
6. a) As a project manager you need to decide whether to invest \$120M to build a new data center, or to invest only \$50M to upgrade the existing data center. If you decide to build a new one, then there is 60% chance that the new data center will help to generate revenue of \$200M and 40% chance of generating revenue of \$90M. Also, if you decide to upgrade the existing data center then there is 60% chance that it will help to generate revenue of \$120M and 40% chance of generating revenue of \$60M. Using proper data analysis method make your decision for the given scenario. 12
(CO4)
(PO4)
- b) "Designing redundancy into a system may reduce the impact from a failure of the original component." – What kind of strategy is this for dealing with risk? 5
(CO4)
(PO2)
- c) If the team cannot identify a suitable response to an identified risk, which risk response strategy would they apply? Justify your answer. 8
(CO4)
(PO2)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (CSE)

SEMESTER FINAL EXAMINATION
DURATION: 3 HOURS

SUMMER SEMESTER: 2020-2021
Full Marks: 150

SWE 4805: SOFTWARE VERIFICATION AND VALIDATION

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Marks of each question and corresponding CO and PO are written in the brackets of the right margin.

-
1. a) Define Software Verification and Validation. Describe the activities of verification and validation of the V-model. 10
(CO1, PO1)
 - b) It is difficult to generate test cases for integration testing. On the other hand, mutation testing is a technique to evaluate the effectiveness of test cases. How can we use mutation testing to perform integration testing effectively? 5
(CO1, PO1)
 - c) Analyze the following myths of formal method and propose corresponding facts: 5+5
(CO1, PO2)
 - i. Formal methods are all about program proving.
 - ii. Formal methods delay the development process.
 2. Consider the code snippet and answer the following questions:


```
int greatestNumber(int a, int b, int c) {
    int result = a;
    if(a > b && a > c) result = a;
    else if(b > c) result = b;
    else result = c;
    return result;
}
```

 - a) Write a test plan having five (5) test cases considering boundary value analysis? In your test plan, only consider the input and its corresponding expected output. 5
(CO1, PO3)
 - b) Create three types of mutants considering the above code snippet and calculate the mutation score using your test plan. 10
(CO2, PO3)
 - c) Mutation testing takes a lot of time to execute. How can we speed up mutation testing? Give your opinion and explain with examples that can be explored in the future. 10
(CO2, PO2)
 3. a) What is model-based testing? How do we perform it? 5
(CO1, PO1)
 - b) Describe the differences between *smoke* and *sanity testing*, with their strengths and weaknesses? Explain with examples, when do you prefer one over another? 10
(CO1, PO1)
 - c) Explain different types of performance testing. How to make the performance testing 10

more effective? Give your opinion.

(CO3, PO2)

4. Consider the code snippet and answer the following questions:

```
int inDegree(int graph[][[]], int vertex, int node) {
    int cnt = 0;
    for(int i=0; i<vertex; i++) {
        if(graph[i][node] == 1) cnt++;
    }
    return cnt;
}

int outDegree(int graph[][[]], int vertex, int node) {
    int cnt = 0;
    for(int i=0; i<vertex; i++) {
        if(graph[node][i] == 1) cnt++;
    }
    return cnt;
}

bool isDirected(int graph[][[]], int vertex) {
    for (int i = 0; i < vertex; i++) {
        if(inDegree(graph, vertex, i) != outDegree(graph,
            vertex, i)) return true;
    }
    return false;
}

int main() {
    //Assume, number of vertices, edges and adjacency matrix
    //of a graph are provided by the readInput() function
    int vertex, edge, graph[][[]] = readInput();
    if(isDirected(graph, vertex) == true)
        cout<<"Directed graph."<<endl;
    else
        cout<<"Undirected graph"<<endl;
    return 0;
}
```

- | | | |
|----|--|------------------|
| a) | What is integration testing? Write different approaches of integration testing, and what approach do you prefer and why? | 8
(CO2, PO1) |
| b) | What will be the structure of stubs and drivers considering isDirected function? | 7
(CO1, PO1) |
| c) | If the four functions (components) are spread across multiple computers (or other computing devices) on a network, how will you perform integration testing? | 10
(CO2, PO2) |

6. Consider the SRS and answer the following questions in Alloy.
 We are building a permission management system. There are three kinds of things in it:
Accounts, Resources, and Users.
 -*resources* and *users* belong to **Accounts**.
 -**Users** can have direct access to *resources*.
 -A **Resource** can have a parent *resource*.
- a) Define **signatures** and *fields*. 5
(CO1, PO1)
- b) Write the following constraints in Alloy as fact: 2×5
(CO2, PO1)
- i. For every user, there is exactly one account.
 - ii. For every resource, if there is a parent resource, both resources belong to one same account.
 - iii. Every resource has an account.
 - iv. A resource cannot be found from its ancestor.
 - v. User should not have access to another account's resources.
- c) Verify and validate every statement in Alloy as an assertion: 2×5
(CO2, PO2)
- i. No two users have the same set of resources.
 - ii. Every resource belongs to exactly one account.
 - iii. There is no common resource for two different accounts.
 - iv. If a User can access a parent Resource, then s/he gets access to any child Resource.
 - v. What does Alloy Analyzer do when we run the command `run {} for 5 but exactly 3 Account?`

5. Consider the following Alloy code and answer the subsequent questions.

```

abstract sig Program {
    required: some Course
}
one sig CSE extends Program {}
one sig SWE extends Program {}
sig Course {
    enrolled: some Student,
    prerequisite: set Course
}
sig Student {
    id: one ID,
    batch: one Batch,
    program: one Program,
    transcript: set Course
}
sig RecordBook {
    students: set Student
}
sig ID, Batch {}

```

- a) Describe the above code snippet in natural language.

5
(CO1, PO1)

- b) Explain the following facts in natural language:

- i. $\text{fact } \{ \text{all } s: \text{Student} \mid \text{let } p: s.\text{program} \mid (p \text{ in CSE} \Rightarrow p \text{ not in SWE}) \text{ and } (p \text{ in SWE} \Rightarrow p \text{ not in CSE}) \}$
- ii. $\text{fact } \{ \text{CSE.required} \neq \text{SWE.required} \}$
- iii. $\text{fact } \{ \text{all } s: \text{Student} \mid s.\text{transcript} \wedge \text{prerequisite in } s.\text{transcript} \}$
- iv. $\text{fact } \{ \text{all disj } s1, s2: \text{Student} \mid s1.\text{program} \neq s2.\text{program} \Rightarrow s1.\text{transcript} \neq s2.\text{transcript} \}$
- v. $\text{fact } \{ \text{all } s: \text{Student}, r: \text{RecordBook} \mid s \text{ in } r.\text{students} \Rightarrow s.\text{program.required in } s.\text{transcript} \}$

2×5
(CO2, PO1)

- c) Analyze the following assertions:

- i. $\text{assert } \{ \text{no disj } s1, s2: \text{Student} \mid s1.\text{id} \neq s2.\text{id} \}$
- ii. $\text{assert } \{ \text{some } c: \text{Course} \mid \#c.\text{enrolled.program} = 2 \}$
- iii. $\text{assert } \{ \text{some } c: \text{Course} \mid c \text{ in CSE.required and } c \text{ in SWE.required} \}$
- iv. $\text{assert } \{ \text{some } c: \text{Course}, \text{disj } s1, s2: c.\text{enrolled} \mid s1.\text{batch} = s2.\text{batch and } s1.\text{program} \neq s2.\text{program} \}$
- v. What does Alloy Analyzer do when we check an assertion with a specific scope?

2×5
(CO2, PO2)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 Hours

FULL MARKS: 100

CSE 4809: Algorithm Engineering

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **6 (six)** questions. Answer **all** of them. Figures in the right margin indicate marks.

1. a) Prove that the expected running time of a randomized select algorithm is $O(n)$. 5
(CO5)
(PO2)
- b) Prove that the expected number of comparisons in a randomized quicksort is $n \lg n$. 5
(CO5)
(PO2)
- c) Prove that randomized MAX-3-CNF algorithm is an $8/7$ -approximation algorithm. 6
(CO5)
(PO2)
2. a) i. Knowing Hamiltonian Circuit problem is NPC, confirm TSP problem is also NPC. 3x2
 ii. Name two decision problems and two optimization problems that are NPC. (CO3)
 iii. Why are we interested in approximation algorithms? (PO1)
- b) Proof that 2-CNF SAT is in P. 5
(CO3)
(PO1)
- c) Write the approximation algorithm for TSP problem using Triangle inequality. 5
(CO3)
(PO1)
3. a) i. What is a balanced tree? Write two applications of balanced tree. 4x2
 ii. Why memory based balanced tree could not be used in disk based searching/indexing? (CO4)
(PO1)
 iii. How does Red-Black Tree maintain the balance in the tree? PO2)
 iv. How does B-Tree maintain the balance in the tree?
- b) Prove that the maximum height of a B-Tree is $\log_t (n + 1)/2$, where t is the minimum degree and n is the total number of keys. 4
(CO4)
(PO2)
- c) Insert the following keys in a B-tree (assume t is 3): 8
 G M P X A C D E J K N O R S T U V Y Z B Q L F (CO4)
(PO1)

4. a) i. Greedy and Dynamic Programming are applied to problems with similar properties; what are those properties? 3x2
(CO2)
(PO1, PO2)
- ii. How does Johnson's algorithm use Dijkstra Algorithm to solve all pair shortest path? PO2)
- iii. Can Johnson's Algorithm solve shortest path problem with negative loops in the graph? Explain your answer.
- b) Write an algorithm to solve the fractional knapsack problem in $O(n)$ time. 5
(CO2)
(PO2)
- c) Write the optimal substructure property of Optimal Prefix Coding problem. What is the greedy heuristic applied by Huffman Coding Algorithm to find the optimal prefix coding? 5
(CO2)
(PO2)
5. a) i. What is the greedy heuristic for Dijkstra Algorithm? Why does the heuristic work? 3x2
(CO2)
- ii. What is the greedy heuristic for Activity Selection problem? Why does the heuristic work? (PO1, PO2)
- iii. What is the graph property that Bellman Algorithm exploit? Is it a greedy or a dynamic programming algorithm?
- b) What do you understand by topological sorting? What is the role of topological sorting in finding shortest paths in DAG? 5
(CO2)
(PO1)
- c) Suppose there are cells in a rectangular mining field. Each cell may contain gold as reward, or may have bug that reduces the reward earned. We want to find the minimum number of squares in the mining field that will provide the maximum possible reward. Devise an algorithm or pseudo code for the purpose using greedy or dynamic programming technique. 5
(CO2)
(PO3)
6. a) i. Write two possible applications of Block Chain other than its use in crypto-currency. 3x2
ii. What are the applications of Merkle Tree? (CO4)
iii. How can block chain be hacked? (PO1, PO2)
- b) How is double spending restricted in a Block Chain-based crypto-currency? 5
(CO4)
(PO1)
- c) Explain the role of mining in Block Chain-based crypto-currency. How is the Proof of Work (PoW) ensured? 5
(CO4)
(PO2)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

SWE 4833: UI/UX Interface Design

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) What are design systems? Why do design teams need them? 5
(CO1) (PO1)
- b) Material is a design system by Google for user interface design. Taking Material and the other widespread design systems as reference, discuss the major components of a design system. 10
(CO1) (PO1)
- c) When Uber added more features resulting in a more complex product, users were often selecting the wrong feature. Then the company underwent their most recent redesign and focused on minimizing complexity in their interface. A before-and-after look at their primary screen is given in Figure 1. 10
(CO3) (PO2)



Figure 1

What may have been the rationale behind this change? How has the redesign made the app more intuitive and user-friendly?

2. a) Iconography has become one of the most visually appealing elements of graphic design. Describe how the Gestalt's Principle of continuity is used in some digital and non-digital icon designs. 10
(CO2) (PO1)
- b) How do components, modules and templates differ from each other? Explain with an example. 10
(CO1) (PO1)
- c) Construct the user flow of a task management software. 5
(CO2) (PO3)

3. a) Explain the 60-30-10 rule with an example. 10
(CO2) (PO1)
 - b) Ideate on how typography can shape UI design. 5
(CO2) (PO1)
 - c) Discuss the effects of leading space and tracking space on readability of the interface. 6
(CO2) (PO1)
 - d) How is font different from typeface? 4
(CO1) (PO1)
 4. a) What are the benefits of sketching a user journey? 5
(CO1) (PO1)
 - b) Design a closeup storyboard of a user visiting an ecommerce website for the first time. 10
(CO2) (PO3)
 - c) Describe some ways to resolve edge cases in a user journey. 10
(CO1) (PO1)
 5. a) Define information architecture. 2
(CO1) (PO1)
 - b) Outline the core benefit of wireframing before designing a prototype. 3
(CO1) (PO1)
 - c) What are the differences between wireframes and mockups? 5
(CO1) (PO1)
 - d) Through wireframing, the design team and stakeholders can see which entities, pages, and components the application is going to have and how these elements will interact with each other. 15
(CO3) (PO3)
- Sketch a wireframe design for a news portal targeted towards graduating university students. The goal of the design is to keep user retention high and increase engagement.
6. a) List the common types of pain points faced by users. 2
(CO1) (PO1)
 - b) When the Amazon team tested their interface in India, it turned out that people in India associated the magnifying glass icon (search icon) with a ping-pong paddle and not with the 'Search' functionality.
Suggest design changes in the interface that can solve this issue. 5
(CO2) (PO2)
 - c) Figure 2 shows the homepage of a website for "Khan's Kitchen" restaurant. It has been observed from a usability study that the conversion rate of users is very low. Describe how the homepage may be redesigned to boost conversion and keep users interested in the product. 10
(CO2) (PO3)

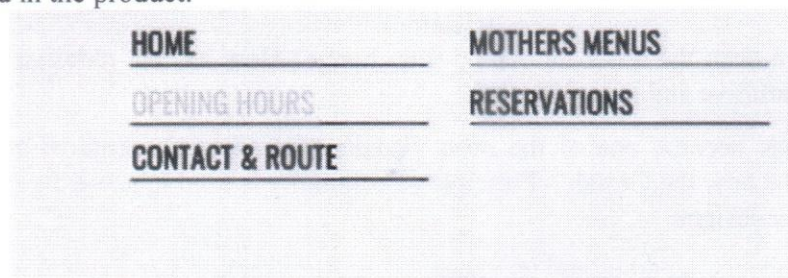


Figure 2

- d) Create two personas for the restaurant homepage given in question 6(c). (Images are not required for the creation of these personas). 8
(CO2) (PO3)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER: FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

SWE 4839: Big Data Analysis**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. We want to create a video-sharing website where registered users can upload, search, watch and share videos. They can also rate a video and post comments. However, despite watching lots of videos from the site, most of the users barely rate any videos or post any comments.

Our goal is to design a recommender system based on collaborative filtering for the users of the site.

- a) First, we need to create a Utility Matrix. Recommend three possible solutions for gathering the “known ratings” for the matrix and discuss their pros and cons. 6 × 3
(CO3)
(PO2)
- b) There are two options to incorporate the local effects. We can take the average of rating deviations weighted by either the similarity of items/users or a set of weights learned from the data. Which option would you choose? Justify your choice by providing three reasons. 1 + 2 × 3
(CO3)
(PO2)

2. In the web graph shown in Figure 1, each node corresponds to one web page. A directed edge from a node is considered as out-link, and to a node is considered as in-link.



Figure 1: Web graph for Question 2.

Suppose a search engine returns these three web pages for the search query “cricket”. Assume that the search engine uses the Flow Model to calculate the PageRank.

- a) Using Power Iteration, determine the order in which the web pages will be shown. You have to show at least 4 iterations. 21
(CO1)
(PO1)
- b) Asses the consequence to the Flow Model if the out-link from m to a is removed. Propose a solution to alleviate the problem. 2 + 2
(CO3)
(PO2)
3. a) In order to perform dimensionality reduction, we need to determine the axes of data that reduce dimensions. Recommend policies that can be followed to choose the axes. 6
(CO1)
(PO1)
- b) In Singular Value Decomposition, we decompose the data matrix A into UEV^T . Show that U can be determined by calculating the eigenvector of $A^T A$. 19
(CO1)
(PO1)

4. Table 1 shows a Utility Matrix, R for 6 movies (M_1, M_2, \dots, M_6) rated by 12 users (U_1, U_2, \dots, U_{12}). Here, the value in cell R_{ij} denotes the rating for movie M_i provided by user U_j ($1 \leq i \leq 6; 1 \leq j \leq 12$). An empty cell denotes that the movie has not been rated by the user yet.

Table 1. Utility Matrix, R for Question 1.

	1	2	3	4	5	6	7	8	9	10	11	12
M_1	1		3		?	5			5		4	
M_2			5	4			4			2	1	3
M_3	2	4		1	2		3		4	3	5	
M_4		2	4		5			4			2	
M_5			4	3	4	2					2	5
M_6	1		3		3			2			4	

We want to predict the rating of movie M_1 by user U_5 (denoted by '?' symbol).

- a) Calculate the rating using vanilla Item-Item Collaborative Filtering. Assume that we will work with at most 2 neighbors and use Pearson's Correlation Coefficient as the similarity metric. 13
(CO1)
(PO1)
 - b) Calculate the rating again, but this time incorporate the baseline estimate with Item-Item Collaborative Filtering. If required, you can re-use any values and/or assumptions from Question 4.(a). 12
(CO1)
(PO1)
5. A company owns a search engine called "BackRub" and a video-sharing website called "MePipe". To process a search query, first, they enlist the web pages containing the query words. Then they order the web pages based on the number of times the query words appear on the web page.
- a) Criticize the company's policy in handling the search queries by discussing two possible exploits that can be used by web spammers to make target web pages appear on top of the search results. 3 × 2
(CO3)
(PO2)
 - b) Recommend a solution that can be adopted by the company to counter these exploits. 9
(CO3)
(PO2)
 - c) Suppose that the company has adopted your solution. However, when people search for video-sharing sites, the company wants MePipe to be shown among the top results. Modify your recommended solution to achieve that. 10
(CO3)
(PO2)
6. a) Suppose we have information about the supermarket purchases of 100 million people. Each person goes to the supermarket 100 times a year and buys 10 of the 1000 items that the supermarket sells. We believe that a pair of "evil-doers" will buy exactly the same set of 10 items (perhaps the ingredients for a bomb?) at some time during the year. Is it worthwhile to search for people who are truly "evil-doers"? Justify your answer. 10
(CO3)
(PO2)
- b) Consider the following schema for an SQL database:
Employee(ID, Name, Designation, Salary)
 We want to determine the maximum salary for each designation.
 Design a MapReduce system to execute the query. 15
(CO2)
(PO3)

Formulae that you might find useful:

- Pearson Correlation Coefficient, $\text{sim}(x, y) = \frac{\sum_{s \in S_{xy}} (r_{xs} - \bar{r}_x)(r_{ys} - \bar{r}_y)}{\sqrt{\sum_{s \in S_{xy}} (r_{xs} - \bar{r}_x)^2} \sqrt{\sum_{s \in S_{xy}} (r_{ys} - \bar{r}_y)^2}}$
- Predicted rating for item i of user x , $r_{xi} = \frac{1}{k} \sum_{y \in N} \text{sim}(x, y) \cdot r_{yj}$
- Predicted rating for item i of user x incorporating baseline estimate,

$$r_{xi} = b_{xi} + \frac{1}{k} \sum_{y \in N} \text{sim}(x, y) \cdot (r_{yj} - b_{yj})$$
- Baseline estimate: $b_{xi} = \mu + b_x + b_i$
- Flow equation: $r_j = \sum_{i \rightarrow j} \frac{r_i}{d_i}$
- PageRank equation (The Google Formulation): $r_j = \sum_{i \rightarrow j} \beta \frac{r_i}{d_i} + (1 - \beta) \frac{1}{N}$
- Topic-Specific PageRank: $r_j = \begin{cases} \beta \frac{r_i}{d_i} + (1 - \beta) \frac{1}{|S|}, & \text{if } i \in S \\ \beta \frac{r_i}{d_i}, & \text{otherwise} \end{cases}$

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION

SUMMER SEMESTER, 2020-2021

DURATION: 3 HOURS

FULL MARKS: 150

CSE 4849: Human Computer Interaction

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **6 (six)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

Based on the following scenario and story, answer question number 1, 2, 3 and 4.

Restaurant 'Seasonal Platter' is a special kind of restaurant. During different seasons, like summer, winter or fall, they offer different types of specialty dishes. A special software is used to offer the dishes to the *customers for their choice*. At the end of the season, the customers who have an account with the restaurant can upvote or downvote the dishes, which would then affect the dishes of the later seasons. Dishes are actually *offered by the chefs themselves*, since they are responsible for offering their own specialty. A *manager oversees the whole process* and can modify, update or remove a dish offered by any chef.

Upon interviewing a famous chef, Mr. Rordon Gamsey from 'Seasonal Platter', a description of the overall process of offering a new dish was found and is attached below.

"Yeah, I remember the whole process. It is a bit tedious, but nothing too complex. First you need to log in with your chef account. Once there, you can offer new dishes. But before you offer, first you got to check whether your dish already exists or not. Like my Pineapple Smoothie is an all season favorite and it is there, always. So I do not need to re-offer it every time. However they did not like my Chicken Pot Pie last season, so it got removed from the display automatically by the system. I am offering it this season again though, since I believe it deserves a second chance. Since it was already offered once before, I just need to put it in the display using a single click, nothing an old chef cannot handle. I am also offering Chocolate Naga Cake this season, a completely new recipe. For this one though, I first need to create a new dish, put the name and the list of all the ingredients etc. Like you know, people have personal preferences, right? Once the dish is created, I can offer it to the whole world by a single click."

The owner of 'Season Platter' has decided to integrate an interactive display in each of the tables of the restaurant so that the customers can easily browse the dishes, order and register themselves and give their feedback. He has also decided to put the systems in the kitchen so that the chefs can fully utilize their eureka moments while inventing new dishes and register them right away.

1. a) With respect to the scenario, extract 3 requirements for each of the following cases that could have been used to build the system. Give a 1 or 2 line justification for each of them.
 - i. Functional Requirements
 - ii. Data Requirements
 - iii. Environmental Requirements
 - iv. User Requirements
 - v. Usability Requirements

5□3=15
 (CO4)
 (PO2)

- b) Based on the user story written above, create a Hierarchical Task Analysis with Plans and Graphs for *offering a new/existing dish by a chef*. 10
(CO4)
(PO2)
2. a) Briefly elaborate on two data gathering methods that you would find suitable in the above context if you were asked to implement the system from scratch. For each of the methods, explain how the specific method's advantage is going to fit the system and how the disadvantage needs to be overcome. $2 \times 4 = 8$
(CO4)
(PO2)
- b) What are the different personas that can be taken into consideration while designing the aforementioned system based on the three roles, customers, chef and manager? Mention 6 personas with just their abilities or shortcomings with respect to the system in 2-3 sentences. You can choose your own distribution of persona under each role, for instance, 3 personas under customers, 2 under chefs and 1 under manager etc. $6 \times 2 = 12$
(CO4)
(PO2)
- c) Can the process of affinization help the development of the aforementioned system? Give proper reasoning behind your answer within 10 simple sentences. 5
(CO4)
(PO2)
3. a) Different prototyping techniques are suitable for different tasks. For instance, the above story can be represented using storyboarding or a series of sketches. Now, for the following tasks, mention a suitable prototyping method with 3 sentences explaining each why they are suitable. $3 \times 3 = 9$
(CO5)
(PO2)
- i. Creating UI for the chefs for offering recipe
ii. Describing the interaction sequence of voting to the users
iii. Taking feedback from the users on the system
- b) Represent a chef offering a new dish using storyboarding. The drawings need not be very good, but clear and understandable drawings are required. 10
(CO5)
(PO2)
- c) Explain the sentence, "Though prototyping might prove to be costly in the initial phase, it may save valuable time and resources in the long run". 6
(CO1)
(PO1)
4. a) With respect to the scenario and aforementioned questions, illustrate how the Star Model can facilitate a user centric design process. 5
(CO3)
(PO2)
- b) Suppose the owner of the restaurant wants to find an answer to the research question, "Does the color of the customer's UI influence the purchase decision and amount of a specific type of food (appetizer, main course and/or dessert)?" With respect to the research question, $5 + 10 + 5 = 20$
(CO5)
(PO2)
- i. Describe an experiment with steps that may facilitate the answer to the question.
ii. Formally construct the independent, dependent, control, random and confounding variables of the experiment.
iii. Choose and justify a proper evaluation approach for the experiment.
5. Suppose you want to design a command line application for a certain task. The application has upto 30 configurable parameters. In your current design, the user may pass the value of each of the arguments or parameters while calling it from the terminal. Though 'help' can be called to list down all the possible parameters, novice users still find it difficult to properly use the application. And in many cases, for a certain user or environment, a lot of the parameters remain the same. For the simplicity of understanding, invocation of a command line tool, gcc for compiling a single C file is given below.

```
$ gcc Filename.c -o Application
```

The program takes 3 arguments, first one being the file name to compile, then '-o' to indicate that the next argument would be output file name/path and then accordingly, the output file name. Now based on this scenario, answer the following questions.

- | | | |
|-------|--|----------------------|
| a) | Point out how human memory, both short term and long term, can affect the usability of the aforementioned application. | 8
(CO2)
(PO2) |
| b) | Propose an ideal solution (a single one based on your decision) to the problem of having 30 parameters in the aforementioned program. You cannot decrease the number of parameters | 9
(CO2)
(PO2) |
| c) | Exemplify how the characteristics of reading text of human beings should influence the design of terminals and the output of command line programs. | 8
(CO2)
(PO2) |
| 6. a) | Based on your understanding from the classes, define what HCI is and where it is used under 15 simple sentences. | 10
(CO1)
(PO1) |
| b) | Note down and describe at least 3 domains that you think contributed in making this question paper. It was written in Google Docs. Each domain description should not exceed more than 5 simple sentences. | 8
(CO1)
(PO1) |
| c) | Define interface metaphors and how they influence the design of user interface in computer science under 7 sentences. | 7
(CO1)
(PO1) |