

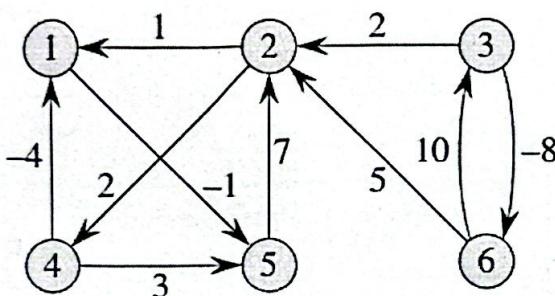
University of Dhaka
Department of Computer Science and Engineering
2nd Year 2nd Semester In-course Examination, 2024
CSE-2202: Design and Analysis of Algorithms-I (3 Credits)

Total Marks: 40**Time: 90 minutes**

- 1 Run Johnson's algorithm on the following directed graph:

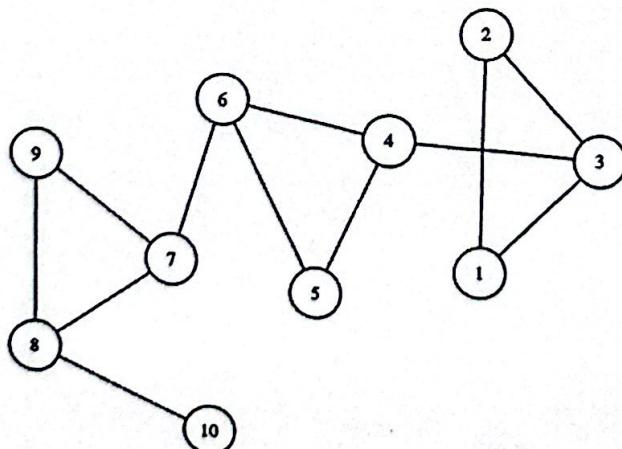
[15 marks]

- Calculate the $h[v]$ values for each node and draw the reweighted graph G' [0.5 marks x 6 nodes]
- Calculate all pair shortest paths on the reweighted graph and populate the table below [1.5 marks x 6 rows]
- Calculate all pair shortest paths on the original graph and populate the table below [0.5 marks x 6 rows]

**APSP Table Format:**

	1	2	3	4	5	6
1						
2						
3						
4						
5						
6						

- 2 Run DFS on the following undirected graph in **lexicographic order** and draw the DFS tree. Create a table like the example below [1 mark x 10 nodes]. Then find **articulation points** and **bridges** in this graph based on the low values of those nodes. [5 marks]

**DFS Result Table format:**

Node	d[v]	f[v]	low[v]

- 3 Simulate Kruskal's algorithm in the following graph and draw the MST. You should [5 marks] create a table to represent the order in which edges were added. (Sample given below) and find the total cost of that MST.

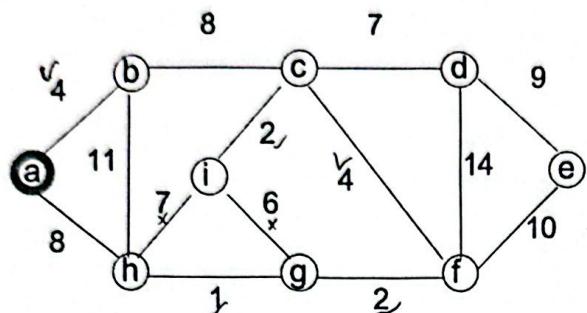


Table format:

Start Node	End Node	Edge Weight

- 4 A warehouse has seven items and a delivery truck that can carry at most 37 kg. [5 marks]

Based on the values given in the table below, populate the last two columns to denote how much of each item was packed, and also calculate the maximum total profit earned.

Item i	Weight w_i (kg)	Profit p_i (BDT)	Weight Taken	Profit Earned
A	6	42	?	
B	13	91	?	
C	7	49	?	
D	3	24	?	
E	15	105	?	
F	5	25	5	
G	9	45	5	

University of Dhaka
Department of Computer Science and Engineering
2nd Year 2nd Semester B. Sc. In-course Examination 2024
CSE 2201: Database Management Systems - I

Total Marks: 25

Time: 1.5 Hours

(Answer All the Questions)

1. a) Define a data model. Classify data models. 2
- b) Explain the concept of physical data independence and its importance in database systems. 2
- c) What is metadata? Why is it important? 2
- d) Explain the difference between two-tier and three-tier database application architectures. Which is better suited for web applications? Why? 3

2. We have studied 'university' database as an example in our classroom and the schemas of the database are as follows:

classroom(building, room_number, capacity)
department(dept_name, building, budget)
course(course_id, title, dept_name, credits)
instructor(ID, name, dept_name, salary)
section(course_id, sec_id, semester, year, building, room_number, time_slot_id)
teaches(ID, course_id, sec_id, semester, year)
student(ID, name, dept_name, tot_cred)
takes(ID, course_id, sec_id, semester, year, grade)
advisor(s_ID, i_ID)
time_slot(time_slot_id, day, start_time, end_time)
prereq(course_id, prereq_id)

Now write SQLs for the following queries:

1.5 x
8=12

- a) Find the IDs and names of all students who were taught by an instructor named Einstein; make sure there are no duplicates in the result and sort the data by names in reverse lexicographic order.
- b) Find all instructors earning the highest salary (there may be more than one with the same salary).
- c) Find the sections that had the maximum enrollment in Fall 2017.
- d) Increase the salary of each instructor in the Comp. Sci. department by 10%.

- e) Delete all courses that have never been offered (i.e., do not occur in the *section* relation).
f) Insert every student whose *tot_cred* attribute is greater than 100 as an instructor in the same department, with a salary of 30,000.
g) Find the ID and name of each student who has taken at least one ‘Comp. Sci.’ course; make sure there are no duplicate names in the result.
h) Find the lowest, across all departments, of the per-department maximum salary.
3. a) What are the conditions for set operations between two relations? 1
b) The SQL **like** operator is case sensitive (in most systems), but the **lower()** function on strings can be used to perform case-insensitive matching. To show how, write a query that finds departments whose names contain the string “sci” as a substring, regardless of the case. 1
c) Rewrite the **where** clause:
where unique (select title from course)
without using the **unique** construct.
d) Consider the following SQL query on the university schema: 1
select avg(salary) - (sum(salary) / count(*))
from instructor
We might expect that the result of this query is zero. Explain why the result might not be zero.

University of Dhaka
Department of Computer Science and Engineering
2nd Year 2nd Semester Incourse Examination, 2024
CSE-2205: Introduction to Mechatronics
Total Marks: 25 Duration: 1 Hour

Answer any **five (5)** of the following questions. Each question carries 5 marks.

1. A solar cell is tested under standard conditions (light intensity, $E = 1000 \text{ W/m}^2$) with the following parameters: Short-circuit current $I_{sc} = 5 \text{ A}$; Open-circuit voltage $V_{oc} = 0.6 \text{ V}$; At maximum power point, the voltage and current are $V_m = 0.5 \text{ V}$ and $I_m = 4.5 \text{ A}$ respectively; The surface area of the solar cell $A = 0.01 \text{ m}^2$. Calculate the (a) maximum power, (b) Fill factor and (c) Efficiency
2. Describe the working principle of a Linear Variable Differential Transformer (LVDT). Sketch and label its circuit diagram and characteristic curve. Explain how displacement is converted into an electrical signal.
3. Describe how inductive proximity sensor detects the presence of metallic objects without physical contact by utilizing changes in inductance when a metal object enters its electromagnetic field.
4. Compare the characteristics and applications of NTC (Negative Temperature Coefficient) and PTC (Positive Temperature Coefficient) thermistors. How does the resistance of each type vary with temperature, and what are common uses for both types?
5. How does an LDR (Light Dependent Resistor) control an automatic street lighting system? Explain how the change in light intensity affects the operation of the circuit and switching of the street lights.
6. Why are dissimilar metals used in a thermocouple? Explain how the Seebeck effect enables temperature measurement using these materials. A thermocouple is made from Copper and Constantan. If the Seebeck coefficient for Copper-Constantan is approximately $41 \mu\text{V}/^\circ\text{C}$, calculate the thermoelectric voltage generated when the junction temperature is 150°C and the reference (cold) junction is at 25°C .
7. Draw the basic circuit diagrams of a condenser microphone and a dynamic microphone. How does each type convert sound waves into electrical signals, and what are the key differences in their circuitry and working principles?

Department of Computer Science and Engineering
 University of Dhaka
 2nd Year 1st Semester Mid-term Examination 2025

Course # 2203, Title- Data and Telecommunications

Answer all questions.

Full Marks: 30

1. a) Differentiate between "bit-rate" and "baud". Are these two parameters related to each other? Explain with example. 2+2

- b) Suppose, you need to transmit a digital data '00000111' using Manchester and differential Manchester schemes. Draw the signal diagrams. 3

- c) In terms of baseline wandering and synchronization, compare between NRZ-I and Manchester digital transmission schemes. 3

2. a) The input stream to a 4B/5B block encoder is 0110 0000 0000 0000 0000 0000 0101.

Answer the following questions: 01110 11110 1011

a. What is the output stream?

b. What is the length of the longest consecutive sequence of 0s in the input? 2+1

c. What is the length of the longest consecutive sequence of 0s in the output? +1

- b) Mention at least two benefits of using block coding. 2

- c) Often, we use a combination of both block and line coding instead of using line coding only. Which option is seems better to you? Explain. 4

3. a)

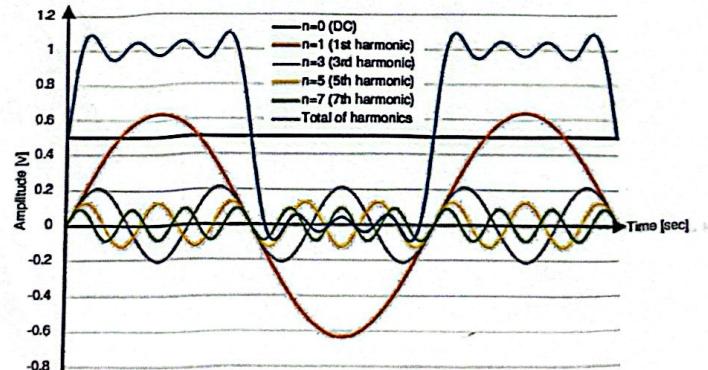


Figure 1: Square wave formation with five sine waves

Consider Figure 1 where five simple sine waves have been used to produce a composite square wave. Draw the frequency domain diagram for the signal. Here, the time period of the first harmonic ($n=1$) is 5ms. 4

- b) A channel has a signal-to-noise ratio of 700 and a bandwidth of 5MHz. What is the maximum data rate supported by this channel? 3

- c) We have a channel with 4 KHz bandwidth. If we want to send data at 100 Kbps, what is the minimum SNR_{dB} ? 3

**Department of Computer Science & Engineering
University of Dhaka
2nd Year 2nd Semester 2024, In-course Exam
CSE 2204: Computer Architecture and Organization**

Marks - 25

Time: 1hr 20 mins

Answer all the questions.

1. Write the basic steps for the Processing of all instructions by a CPU. 2
2. What is the floating point representation of 6.25 using an 8-bit hypothetical format, if possible? 4
[1 bit for sign, 3 bits for Exponent, and 4 bits for Mantissa]
3. Write the equivalent zero-address based machine code of $(A+B*C)/(A/B+C)$. 4
4. What is the difference between an Accumulator-based CPU and a Zero address based machine? Which one would you choose if you had to design your own CPU? 3
5. Multiply the two unsigned binary numbers: X = 10110, Y = 11010 using:
(a) Combinational array multiplier method. 2
(b) Sequential multiplication algorithm. 5

Show the detailed steps if required.

6. Write the ARM instruction based assembly code for the following statement- 5

```
for (int k = 1; k <= arr[4]; k++) {  
    fact *= k;  
}
```

You can assume that-
arr is stored in register R7
fact is stored in R1
k is in R2

Department of Computer Science and Engineering
University of Dhaka
2nd Year 2nd Semester 2024, Lab Examination
Course Code: CSE-2211, Database Management Systems – I Lab

Total Marks: 30

Time: 1.5 Hours

Consider the following training database below:

participant (par_id, par_name, cell_no, blood_group, gender, status)
course (course_id, course_name, contact_hours, fees)
training (par_id, batch, course_id, chief_inst, co_inst, room_no)
instructor (inst_id, inst_name, designation)

Notes:

- i) Underlined attributes are the **primary keys** for the respective tables. Find the **foreign keys** and referencing relations.
- ii) Consider appropriate **datatypes** and **lengths** of the attributes according to given data.

- | | |
|---|----|
| 1. Draw the Schema Diagram for the above table. | 2 |
| 2. Create the above tables using DDL commands. | 4 |
| 3. Implement the following constraints with appropriate naming convention: | 4 |
| a) Create a check constraint to ensure that ‘blood_group’ can hold only the valid blood groups. | |
| b) ‘cell_no’ must be unique attribute. | |
| c) Ensure that chief instructor must not be ‘Lecturer’s. | |
| d) Course fees in the range of 4000 to 10000 Tk. | |
| 4. Create a view ‘ training_session ’ to show the instructor name, participant name and the courses (name) for the 2 nd batch. | 2 |
| 5. Write query statements using SQLs for the following queries: | 18 |
| a) Find the names of the participant along with cell number and gender who have Grameen phone numbers and do not belong to blood group ‘A-’ or ‘O’. | |
| b) Find the number of participants taught by each group (by designation) of instructors who acted as chief instructor. | |
| c) Change the room number to null where ‘Associate Professor’ conducted ‘IPv6 Deployment’ course as chief instructor. | |
| d) Find the participant details who have taken training of the same course twice. | |
| e) Find the participants who enrolled for the training but did not take part in the training. | |
| f) Find the name and designation of the instructors who served as either chief or co-instructor. | |
| g) Delete courses for which average no of students per batch in any course is less than the average no of students per batch for all the courses. | |
| h) Write a query using ‘exist clause’ and scalar subquery format. Write the query statement also. | |
| i) Update the status of the participant to ‘Weak’ if they have participated in a course more than once. | |