National University of Computer and Emerging Sciences

# Programming Fundamentals Lab (CL1002)

Date: 10/10/2025

**Course Instructor(s)**

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# Lab Mid Exam (B)

**Total Time: 90 minutes**
**Total Marks: 20**
**Total Questions**: **03**

**Semester:** FL-2025
**Campus:** Karachi
**Dept:** Computer Science)

**Submission Instructions:**

- You must comment your student ID on top of each file. (Line#1 of your code).
- Name the file for each question according to Roll_No e.g. **k24-xxxx_Q1.c, k24- xxxx _Q2.c** etc.
- Submission is via a client software so open the application present on the Desktop.
- Enter your username as **24K-xxxx** and its assigned password (**Default is Fast1234**).
- Submission is timed so after the time no submission will be accepted.

| Student Name | Roll No | Section | Student Signature |
|---|---|---|---|

***CLO # 1: Understand and Analyze flowcharts, PAC (Process-Activity-Control) charts, and IPO (Input-Process-Output) models to represent system workflows and these diagrams into algorithm and pseudocode implementation.***

**Q1**. **[5 marks]** "Café Karachi" requires a program to automatically generate customer bills that factor in dining time, group size, and membership status to ensure precise and fair pricing. The program should first compute a base amount by multiplying the cost per person by the number of diners. If the dining occurs during peak hours, an additional 15% is added to this base amount; otherwise, no extra charge applies. Next, the program should apply a discount based on membership status: 15% off for gold members, 10% for silver, 5% for regular members, and no discount for non-members. After adjusting for membership, a service charge is added—10% if the group size exceeds five people, or 5% if five or fewer. The program must validate all inputs, ensuring the number of people is at least one, the meal cost is positive, the peak hour indicator is either 0 or 1, and the membership code falls within the expected range of 0 to 3. Upon receiving valid inputs for meal cost per person, number of diners, peak hour status, and membership category, the program should calculate and display the base amount, any peak hour addition, the total before discount, the membership discount applied, the amount after discount, the service charge, and the final bill amount.

***CLO # 2: Gain hands on experience in writing code that provides the use of logical and bitwise operators to perform efficient data manipulation and apply decision and nested decision structures in control flow to create dynamic, condition-based logic within C-code.***

**Q2**. **[7 marks]** A modern office building uses an 8-bit security monitoring system where each floor's status is represented by a single byte. The bits of this byte correspond to different sensors and systems on each floor. Specifically, bit 0 represents the main door sensor, bit 1 represents the emergency exit sensor, bit 2 corresponds to the window sensor, bit 3 tracks the HVAC system status, bit 4 indicates motion detection, bit 5 signals the fire alarm, bit 6 monitors the water leak sensor, and bit 7 indicates whether the power backup is active.

The security team needs to generate alerts for each floor based on these bit values, following a set of priority rules. The first rule states that a CRITICAL alert is triggered if either the fire alarm is activated (bit 5) or both the water leak and power backup failure are detected (bits 6 and 7 set). The second rule triggers a SECURITY BREACH if any of the door/window sensors (bits 0, 1, or 2) are active while motion detection (bit 4) is also triggered. A MAINTENANCE alert is raised if either the HVAC system (bit 3) or the water leak sensor (bit 6) is active on its own. A MONITORING alert is given if only motion is detected (bit 4). If no sensors are activated, the floor's status is marked as NORMAL.
The task is to write a C program that monitors several floors, takes inputs for each floor's number and status code (ranging from 0 to 255), and uses bitwise operators to check the conditions and generate the appropriate alert. The program should display the alert for each floor and, after processing all the floors, provide a summary of the total number of CRITICAL, SECURITY BREACH, and NORMAL alerts. To check these conditions, bitwise AND (&) and OR (|) operators must be used.

***CLO # 3: Understand and implement code utilize loops for iteration and arrays for data storage and manipulation, demonstrating efficient traversal and management of elements in C-code, while optimizing control flow and enhancing program efficiency.***

**Q3**. **[8 marks]** Hina is managing a loan and making annual repayments based on her salary and additional income over the years. The loan repayment structure differs between odd and even years.

In **odd years** (such as 1, 3, 5, etc.), Hina's annual salary remains fixed at Rs. S. She can repay 30% of her salary, but she has to pay Rs. 3,000 for professional courses, so the net repayment for odd years is calculated as 30% of her salary minus Rs. 3,000.

In **even years** (such as 2, 4, 6, etc.), Hina earns additional freelance income along with her salary. The freelance income increases over time: Rs. 12,000 in Year 2, Rs. 18,000 in Year 4, Rs. 24,000 in Year 6, and so on, with an increase of Rs. 6,000 each year. She can repay 35% of her total income (salary plus freelance income) in these years, but she also has to pay Rs. 5,000 in taxes, so the net repayment for even years is calculated as 35% of her total income minus Rs. 5,000.

In addition to this, Hina receives a bonus every **B** years, which she uses entirely for loan repayment. Moreover, her base salary increases annually by a growth rate of **G%** (compound growth).

The task is to write a C program that simulates Hina's loan repayment process over a period of time. The program will take the following inputs:

- The total loan amount (L)
- The repayment period in years (N), where N ranges from 5 to 20
- The initial annual salary (S)
- The annual salary growth rate percentage (G), which is between 5% and 12%
- The bonus frequency in years (B), where B ranges from 2 to 4
- The bonus amount (M)

The program will simulate the loan repayment year by year:

- For each year, determine if it is an odd or even year.
- Calculate the current salary after applying the growth rate.
- Calculate the repayment for the year based on whether it is an odd or even year.
- Apply any bonus if applicable.
- Deduct the repayment amount from the remaining loan.

After all years have been simulated, the program should display:

- The total amount repaid
- The remaining loan balance
- The loan status: fully repaid or not
- If fully repaid, the year in which it was completed
- If not repaid, the shortfall amount