İ.T.Ü. Faculty of Computer and Informatics –
BLG222E Microprocessor Systems Final
Asst. Prof. Dr. Erdem Matoglu

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Time:90 mins

Student #	Name	Signature

Q1 40%	Q2 60%	Total

Do not use any reference other than the approved printouts.
Write your name on all answer sheets. Good Luck

A digital combinational lock is designed as shown in the concept design of Figure 1. The keypad module, buzzer (alarm), and the door lock relay modules and their connections to the EDU-PIA are shown in Figure 2.

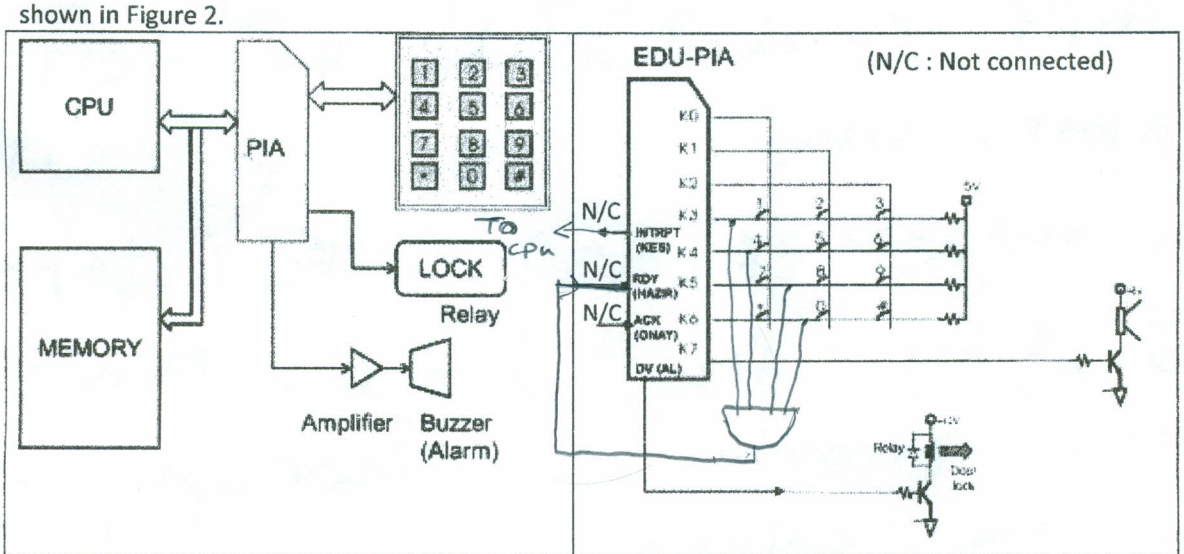

Figure 1: Digital Combinational Lock Concept | Figure 2: Keypad, Buzzer, Relay modules

During the system tests, it was observed that the buzzer (alarm) is continuously ON, while no key is pressed. The problem is narrowed down to the READKEY subroutine as shown below.

```
READKEY   KUR E 0111 1110   ; set carry bit
          YUK B %1111 1110  ;apply low to K0
          YAZ B PIAPORT
          YUK A <PIAPORT>
          VE  A,$78
          KAR A,$78         ; if all rows 1, no key is pressed
          DEE SCAN
          YAZ A, ROW        ; contains row info
          YAZ B, COL        ; contains column info
          ALT KEY           ; branches to KEY subroutine to process ROW and COL info.
          DÖN
SCAN      SOLD B            ; scan K1 and K2
          KAR B,$F7
          DEE READKEY
          DAL REW
```

Note that after SOLD B is not applied to the port.

③ E=1 → SOLD B : 0111 1110 → 1111 1101

④ VE B, $7F ⇒ B = 01111101

⑤ 0111 0111 KAR B, $77

Q1) The problem is K7 is always 1 in this code. Modified as above to fix. Also REW is in the wrong line.

Note: There are multiple solutions. This is what I thought of.

Q1[40pts] Examine the design and the code, and identify the reason of the continuously running alarm. Propose and implement a solution for this problem. Explain your solution. Modify or re-write the READKEY subroutine to fix the problem without changing the hardware.

Q2[60pts] During further tests of the system, it was observed that the keypad erroneously accepts the same key entry multiple times. For example, if user presses Key 5 once, the computer reads multiple 5,5,5,5... mistakenly.
Propose and implement a solution for this problem. Explain your solution. Modify the hardware and software to fix this problem. Write the necessary codes (subroutines etc...) to fix the problem. Indicate the changes in the status/control register, if any. Indicate the changes in hardware connections, if any.

Q2) See the AND Gate in Figure 2
It is connected to the RDY input. When a key is pressed, the output of AND (RDY input) transitions from 1 → 0. This should generate an interrupt to scan the columns.

PIA conditioning = 00000010

Set the interrupt vector address to the READKEY.

NOTE: There are other ways to solve this. Such as software to detect if the key is released. It is OK, but risky.
Setting a time delay between keystrokes is not user friendly. Checking if the consequtive keys are the same does not work. The code can actually be 5,5,5,5