Selected Topics – Embedded Systems Model Answer
Midterm #1 - November 2011

Solve As Much As You Can – Maximum Grade:100 points

Part 1. Answer the following questions by marking the best answer among the choices given: [3 points each]

1. Using a 3.3V microcontroller, a GPIO pin can provide high current output using …
    a. A push-pull output mode
    b. An open-drain output mode with internal weak pull-ups
    c. An open-drain output mode with external pull-ups. (*)
2. Using a 3.3V microcontroller, one can make a GPIO work as an input pin using …
    a. An open-drain output mode and a pull-up resistor
    b. A push-pull output mode and an amplifier at the output of the pin
    c. A push-pull output mode and an internal weak pull-up (*)
3. For multiple microcontrollers to be synchronized, a clock source for C8051F020 based on … is used.
    a. RC oscillator
    b. CMOS clock (*)
    c. Internal clock
4. Accessing C8051F020 memory location 020H using indirect addressing mode refers to …
    a. Special function register
    b. General purpose data RAM memory address (*)
    c. Immediate value
5. Using a 3.3V microcontroller, a GPIO pin can provide TTL-compatible output levels using …
    a. A push-pull output mode (*)
    b. A push-pull output mode with internal weak pull-ups
    c. An open-drain output mode
6. We can toggle bit 3 of P1 by the following C instruction …
    a. P1= P1 ^ 008H
    b. P1= P1 & 0F7H
    c. P1.3= ~P1.3 (*)
7. GPIO pins can be used for bidirectional data transfer when they are configured as …
    a. Open-drain mode with internal weak pull-ups (*)
    b. Open-drain mode with external pull-ups
    c. Push-pull mode
8. When the external crystal oscillator is invalid for a long period of time, the microcontroller …
    a. Switches automatically to internal oscillator
    b. Can be configured to reset (*)
    c. Causes a flag to be raised for the program to repair the problem
9. The instruction to be used to transfer data from program memory is …
    a. MOV
    b. MOVX
    c. MOVC (*)
10. C8051F020 has a … architecture.
    a. Harvard
    b. Von Neumann
    c. Mixed

Part 2. Mark the following statement as either True (T) or False (F): [1 Point each]

11. C8051F020 is a mixed-signal microcontroller because it can handle analog and digital data. (F)
12. The C8051F020 instruction `MOV` can be used with indirect addressing. (T)
13. Microcontroller external clock configuration must perform a check on the external clock validity (T)
14. Division must work only in register addressing mode. (T)
15. Using `bit` to declare a bit variable is valid only for global variables (F)
16. 8-bit MCUs are well-suited for low-power applications that use batteries. (T)
17. One can declare a bit-addressable variable in C language programming for microcontrollers (F)
18. The operands of a logical operation must be Boolean. (F)
19. Some registers in8-bit microcontrollers are 16-bit wide. (T)
20. The size of the bit-addressable region of the data memory allows for 256 bit variables. (F)

Part 3. Denote the following C8051F020 microcontroller instructions as either being true (T) or false (F) assembly instructions: [1 point each]

21. `MOV #70H, 060H` (F)
22. `MOV @R0, A` (T)
23. `ADD A, #030H` (T)
24. `RLC 040H` (F)
25. `DJNZ R7, 70H` (T)
26. `CPL P2.4` (T)
27. `MAIN EQU 070H` (F)
28. `POP 070H` (T)
29. `XCH A, #05AH` (F)
30. `DA A` (F)
31. `CJNE R6, 70H` (F)
32. `CPL P1^3` (F)
33. `SETB C` (T)
34. `INC @R1` (T)
35. `MUL AB` (T)

Part 4. Determine the number of bytes required to represent the following instructions in assembly: [2 points each]

36. `CLR  A (1)`
37. `RR  A (1)`
38. `MOV  A,R4  (1)`
39. `LJMP  MAIN  (3)`
40. `ACALL ARRAY  (2)`
41. `JNZ  Loop  (2)`
42. `CLR  P1.1 (2)`
43. `XRL  P2,#40h (3)`
44. `CPL  A (1)`
45. `RLC  A (1)`

Part 5. Compute the output of the following operations in a C Language program for a C8051F020 device: [2 points each]

```
46.     00100100b > 10100001b       (ans: FALSE)
47.     !(00100100b | 00000001b)    (ans: FALSE)
48.     (0F0H & 080H) >= 0          (ans: TRUE)
49.     021H % 02H                  (ans: 1)
50.     1>>2                        (ans: 0)
51.     0F0H + 00AH                 (ans: 0FAH )
52.     !(00100100b & 00000001b)    (ans: TRUE)
53.     (0F0H - 080H) == 0          (ans: FALSE)
54.     0A3H % 08H                  (ans: 3)
55.     040H>>2                     (ans: 010H)
```

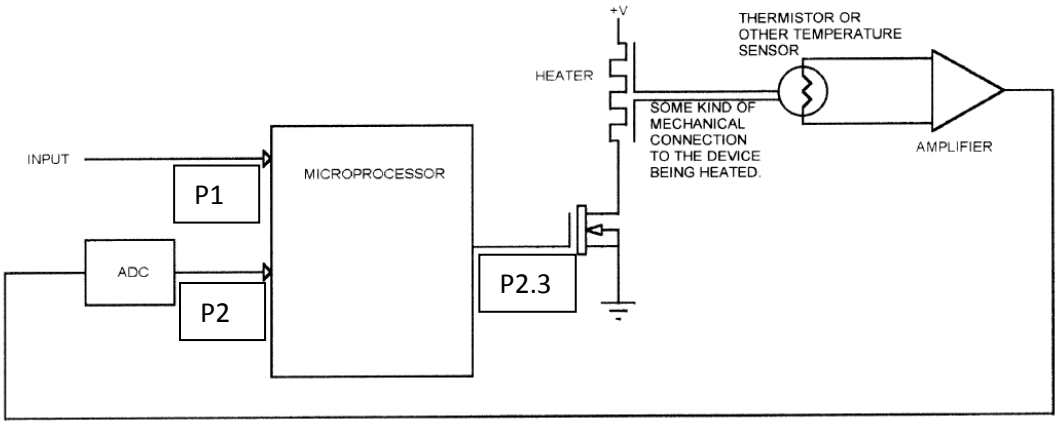
Q6. Write C8051F020 assembly code lines to do the following: [4 Points each]

c. Configuration of external crystal oscillator working at 1 MHz.
d. Generation of a periodic binary signal with duty cycle of 30% from pin P1.6.
e. Transfer the contents of memory location 050H to accumulator A using 2 different methods.

Answers: To Be Discussed in LAB

Part 7. [10 points] Consider the simple C8051F020 microcontroller-based temperature control shown below. The user selects the value of the temperature and puts it as an 8-bit INPUT that is connected to PORT 1 while the temperature measured is converted to an 8-bit digital value and connected to PORT 2. The microcontroller can turn the heater ON by setting pin P2.3 and OFF by resetting the same pin. Design a project that would enable the ON/OFF control of the heater to adjust the temperature to exactly the value read by INPUT. Control should work as follows:

1. Read INPUT
2. Read ADC
3. Compare INPUT to ADC
4. Turn Heater ON if INPUT > ADC and wait for 1 s
5. Turn Heater OFF if INPUT < ADC



Answer: To Be Discussed in LAB
