



### Section A

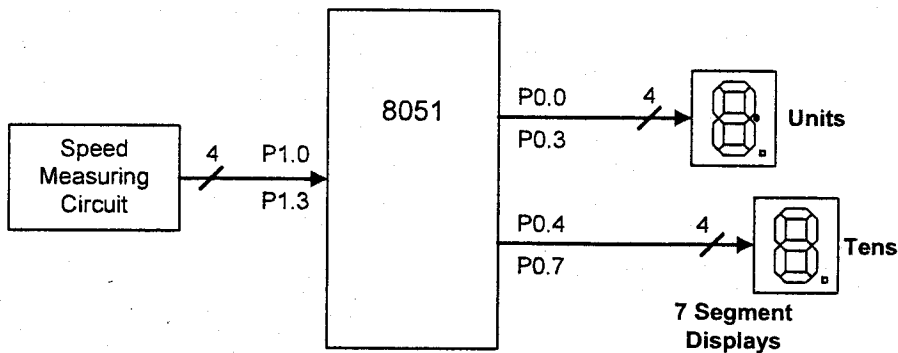
1. (a) What are the advantages of using arrays in computer systems? Why might a record or structure be more useful in certain situations? Illustrate your answers with examples where suitable. [4 marks]  
(b) List two problems associated with the use of the STACK in microprocessor systems. Explain how stack overflow can occur and explain the possible effects stack overflow might cause. [6 marks]  
(c) Write a short description of any *two* of the following systems found in modern computer:
  - i. RAID Hard Disk Array
  - ii. Sound Card
  - iii. AGP
  - iv. Graphics card[10 marks]
2. (a) Describe the operation of the Parallel Port Interface. Your answer should include a timing diagram and a short description of the handshaking between the two devices. [5 marks]  
(b) Explain with the aid of diagrams the *Von Neumann Architecture* (i.e. the *Fetch, Decode, Execute* principle). Why do some instructions in the 8051 Microcontroller require two bytes of program memory and others only one byte? Refer to the *Von Neumann Architecture* to illustrate your answer. [11 marks]  
(c) Explain how the use of cache memory helps to speed up the operation of a modern computer system. Illustrate your answer with a diagram if possible. [4 marks]
3. (a) You have been given the task of designing a digital camera which is required to interface to a modern computer to store captured images. Choose a suitable interface between the camera and computer. State three reasons for your choice. [4 marks]  
(b) With reference to a typical computer system explain what you understand by the terms:
  - i. OCR
  - ii. CRT
  - iii. ROM[6 marks]  
(c) Draw the functional diagram of a typical computer system. Label all buses and subsystems. [7 marks]  
(d) List any three differences between DVD and CDROM. [3 marks]

### Section B

4. (a) Write a short 8051 assembly program to implement the following system: [15 marks]

The circuit diagram overleaf shows an 8051 microcontroller-based motor speed monitoring system. The speed sensor (tachometer) can measure speeds ranging from 0 Revolutions Per Minute (RPM) to 15RPM. This speed is converted to digital (4-bit binary) and is applied to the microcontroller (Port 1, pins 0 –3). The microcontroller must convert the incoming data to 8 bit (packed) BCD, and send the correct speed (decimal) to the 7 segment displays).

[You can assume that  $0000_2 = 0RPM$ ,  $0001_2 = 1RPM$ ,  $0010_2 = 2RPM$ ..... etc.]



- (b) How long does your program take to run on an ADuC812? Express your answer in both microseconds and clock cycles – you may assume a 12MHz system clock speed. You may need to refer to the ADuC812 Quick Reference Guide supplied at the end of this question paper. **[5 marks]**
5. With reference to the 8051 Microcontroller, and using assembly language examples where appropriate, answer the following questions:
- (a) What is an ISR (Interrupt Service Routine)? **[4 marks]**
  - (b) Explain the sequence of events that occur when an interrupt request is received. **[4 marks]**
  - (c) What are the problems associated with interrupts? **[4 marks]**
  - (d) Explain how you would program the 8051 such that registers R0 - R7 refer to Bank 3? (Hint: PSW) **[4 marks]**
  - (e) Explain the difference between the RET and RETI instructions. Your answer should include reference to STACK and interrupt status **[4 marks]**
6. With reference to the program listing (next page), answer the following questions
- (a) Why is there no code associated with the \$mod52, org, and end instructions? **[2 marks]**
  - (b) What are the contents of program memory location 0101h? **[2 marks]**
  - (c) Explain the instruction on line 18 (setb PSW. 3). What bank is selected? **[2 marks]**
  - (d) At the end of the program, what are the contents of R0, R1, and R2 in bank 0? **[6 marks]**
  - (e) By referring to the program listing, or by referring to the quick-reference guide at the end of the paper, give the address of the PSW. **[2 marks]**
  - (f) Modify the code so that before the end of the program, the contents of the Accumulator are placed on port 0 for one second. After the one-second interval has elapsed, port 0 should then output 00h. **[6 marks]**

Program Listing

```

                                Line #
                                1      ;Exam program MSE 2003 (Summer)
                                2
                                3      $mod52
                                4
0100                            5      ORG 100h
                                6
0100 787B                      7      mov R0,#123
                                8
0102 740C                      9      mov A,#12
0104 F9                        10     mov R1,A
                                11
0105 E8                        12     mov A,R0
0106 FA                        13     mov R2,A
                                14
0107 E9                        15     mov A,R1
0108 CA                        16     xch A,R2
                                17
0109 D2D3                      18     setb PSW.3
                                19
010B E590                      20     mov A,P1
010D F8                        21     mov R0,A
                                22
010E C2D3                      23     clr PSW.3
                                24
                                25     end

VERSION 1.2h ASSEMBLY COMPLETE, 0 ERRORS FOUND

P1 . . . . . D ADDR 0090H PREDEFINED
PSW. . . . . D ADDR 00D0H PREDEFINED
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