

**B. E. ELECTRICAL ENGINEERING 3<sup>RD</sup> YR 1<sup>ST</sup> SEMESTER EXAMINATION, 2019****SUBJECT: - PROGRAMMABLE LOGIC & MICROCONTROLLER**

Time: Three hours

Full Marks 100  
(50 marks for each part)**Use a separate Answer-Script for each part****PART I***Answer any FIVE:*

1. a) Why are diodes or transistors not used for MOS device? 2+8  
b) Describe any one switching technology used for fabrication of MOS memory devices.
2. a) Discuss the use of multiplexers to implement AND gate and OR gate in configurable hardware. 4+6  
b) Discuss the advantages of using FPGA over CPLDs.
3. a) Develop a circuit by using PLA to implement the following logic equation: 7+3  

$$F = \overline{A.(B+C)}.(\overline{A} + \overline{B} + \overline{C}).(\overline{A}.\overline{B}.\overline{C})$$
  
b) What do you mean by registered PAL and configurable PAL?
4. Discuss the features of a MAX 7000 CPLD chip. 10
5. a) How does a transistorized switch driven by SRAM Cell work to interconnect row and column wires? 5+5  
b) Why has *In-System Programming* become popular over *out-of-board programming*?
6. Write a program in VHDL to implement a D Flip flop. Write a test bench program to test it. Draw the timing diagrams for input and output signals. 10
7. a) What are the various bit-shift operations and commands available in VHDL? What is the data-format for using the commands? 5+5  
b) Write a program in VHDL to develop an AND gate. Write a test bench program to test it. Draw the timing diagrams for input and output signals.
8. Write short notes on (any two): 5 x 2
  - a) AND plane of a PAL device;
  - b) JTAG cable;
  - c) Antifuse;
  - d) Different Logic States in VHDL.

[ Turn over

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| No. of Questions | <b><u>PART II</u></b>   | Marks                  |
|------------------|---|------------------------|
|                  | <i>Answer according to the instructions associated with each group.</i>   |                        |
|                  | <b>GROUP-A</b> [ <i>Answer any one from the group</i> ]   |                        |
| 1.               | (a) State in brief the organization of the on-chip memories within the architecture of microcontroller?<br>(b) Write down the basic action of the 'DAW' or 'DAA' instruction.<br>(c) Write a program to toggle the bit-0 & bit-1 of a port of your choice in every 125 msec.  | 2<br>1<br>7            |
| 2.               | (a) Write short notes on<br>i) Stack & Stack Pointer in microcontroller<br>ii) CALL instruction<br><br>(b) What is the usefulness of the "EQU" instruction?<br><br>(c) State two differences between a general purpose microprocessor and microcontroller?<br><br>(d) What do you know about the term 'Pipelining' or 'polling sequence'?   | 3+2<br><br>1<br>2<br>2 |
|                  | <b>GROUP-B</b> [ <i>Answer any one from the group</i> ]   |                        |
| 3.               | (a) Write a program to generate a rectangular wave of 75% duty cycle at one pin of the ports of a microcontroller at every 200ms. Assume that the crystal frequency is at 10MHz. Use in-built timer of the microcontroller.<br><br>(b) What is "Branch Penalty" of the PIC micro-controller?<br><br>OR<br><br>(b) Write the names of two SFRs that are used in context with timer.<br><br>(c) How many bytes are required to write RCALL or CJNE instruction? | 7<br><br><br>2<br>1    |
| 4.               | (a) Find the duration of the smallest instruction cycle of a micro-controller   |                        |

|                      | <p>working on a crystal frequency of 12 MHz?</p> <p>(b) What is the basic difference between (<i>any one of what mentioned below</i>)</p> <p>(i) CALL and RCALL instruction of a PIC micro-controller?</p> <p>(ii) JNZ and DJNZ of 8051?</p> <p>(c) What is the status of the TRIS register of PORTB upon “Reset” in PIC or the status of port-pins upon ‘Reset’ in 8051?</p> <p>(d) In which of the registers is the result of multiplication instruction placed?</p> <p>(e) Explain in short the functionality of four different bits of the status register of the microcontroller.</p> <p style="text-align: center;"><b>GROUP-C</b> [<i>Answer any two from the group</i>]</p> <p>5.</p> <p>(a) Assume that the file register of the RAM location xx52H-xx55H contain the following hex values. Write a simple program to find the sum of all the values such that location xx06H and xx07H should contain the lower and higher byte respectively. Find the content of the ‘status register’ after the execution of the program.</p> <table border="1"> <thead> <tr> <th>RAM location Address</th> <th>BCD Data</th> </tr> </thead> <tbody> <tr> <td>xx52H</td> <td>5BH</td> </tr> <tr> <td>Xx53H</td> <td>C5H</td> </tr> <tr> <td>xx54H</td> <td>7DH</td> </tr> <tr> <td>xx55H</td> <td>EBH</td> </tr> </tbody> </table> <p>(b) What is the meaning of “Data Dependency” in CPU design?</p> <p style="text-align: center;">OR</p> <p>(b) Write a program segment to enable external interrupt-0 and timer-1 interrupt.</p> | RAM location Address | BCD Data | xx52H | 5BH | Xx53H | C5H | xx54H | 7DH | xx55H | EBH | <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>6</p> <p>8</p> <p>2</p> |
|----------------------|---|----------------------|----------|-------|-----|-------|-----|-------|-----|-------|-----|--|
| RAM location Address | BCD Data  |                      |          |       |     |       |     |       |     |       |     |  |
| xx52H                | 5BH   |                      |          |       |     |       |     |       |     |       |     |  |
| Xx53H                | C5H   |                      |          |       |     |       |     |       |     |       |     |  |
| xx54H                | 7DH   |                      |          |       |     |       |     |       |     |       |     |  |
| xx55H                | EBH   |                      |          |       |     |       |     |       |     |       |     |  |
| 6.                   | <p>(a) Write a program in 8051 to read a numeric data <math>x</math> from port-1 and send <math>y</math></p>  |                      |          |       |     |       |     |       |     |       |     |  |

|                      | <p>to port-3 until the input data is more than seven. Given that,</p> $y = f(x) = 2x^2 + 8x + 10$ <p>Use the method of LOOK-UP for computation of the function <math>y = f(x)</math>.</p> <p>OR</p> <p>(a) Assume that four BCD data items are stored in the RAM location starting from xx40H. Write a simple program to find the sum of all the numbers. The result must in BCD. Find the content of the WREG after the execution of the program.</p> <table border="1"> <thead> <tr> <th>RAM location Address</th> <th>BCD Data</th> </tr> </thead> <tbody> <tr> <td>xx40H</td> <td>97H</td> </tr> <tr> <td>xx41H</td> <td>69H</td> </tr> <tr> <td>xx42H</td> <td>88H</td> </tr> <tr> <td>xx43H</td> <td>71H</td> </tr> </tbody> </table> <p>(b) When has the Overflow flag been set? Explain with an example.</p> | RAM location Address | BCD Data | xx40H | 97H | xx41H | 69H | xx42H | 88H | xx43H | 71H | 8 |
|----------------------|--|----------------------|----------|-------|-----|-------|-----|-------|-----|-------|-----|---|
| RAM location Address | BCD Data   |                      |          |       |     |       |     |       |     |       |     |   |
| xx40H                | 97H  |                      |          |       |     |       |     |       |     |       |     |   |
| xx41H                | 69H  |                      |          |       |     |       |     |       |     |       |     |   |
| xx42H                | 88H  |                      |          |       |     |       |     |       |     |       |     |   |
| xx43H                | 71H  |                      |          |       |     |       |     |       |     |       |     |   |
| 7.                   | <p>(a) Write a program to find the numbers of 1s in a given byte. (For the coding, assume any hex number of your choice). Explain your solution.</p> <p>(b) Which instruction is used to copy a data from location xx08 to PORTC without using WREG?</p> <p>OR</p> <p>(b) What happens if a particular port-pin of 8051 is used as source as well as destination in a single instruction?</p> <p>(c) Write the complete format of one instruction that implements conditional branching?</p>   | 2<br>8<br>1          |          |       |     |       |     |       |     |       |     |   |
| 8.                   | <p><b>GROUP-D</b> [Answer any one from the group]</p> <p>Write a program to generate a scrolling display of 4-LEDs. The LEDs are connected to 4-pins of a port of microcontroller. A switch is connected to another pin that controls the direction of scrolling. A HIGH or LOW generated by the switch alters the direction of scrolling. Draw necessary hardware diagram to implement the task. Explain your solution.</p>   | 10                   |          |       |     |       |     |       |     |       |     |   |

| 9.                     | <p>Two switches are connected to two pins of one port of a microcontroller. If the switches generate bit patterns as mentioned in the following table, another pin of the microcontroller will deliver output as a result of the action taken by the microcontroller:</p> <table border="1"><thead><tr><th>Switching bits (input)</th><th>Output as a result of the action</th></tr></thead><tbody><tr><td>00</td><td>AND</td></tr><tr><td>01</td><td>OR</td></tr><tr><td>10</td><td>XOR</td></tr><tr><td>11</td><td>NAND</td></tr></tbody></table> <p>Write an appropriate program. Explain your solution.</p> | Switching bits (input) | Output as a result of the action | 00 | AND | 01 | OR | 10 | XOR | 11 | NAND | 10 |
|------------------------|--|------------------------|----------------------------------|----|-----|----|----|----|-----|----|------|----|
| Switching bits (input) | Output as a result of the action   |                        |                                  |    |     |    |    |    |     |    |      |    |
| 00                     | AND  |                        |                                  |    |     |    |    |    |     |    |      |    |
| 01                     | OR   |                        |                                  |    |     |    |    |    |     |    |      |    |
| 10                     | XOR  |                        |                                  |    |     |    |    |    |     |    |      |    |
| 11                     | NAND   |                        |                                  |    |     |    |    |    |     |    |      |    |