Q1) Circle either T ---- if the statement is always true, or F ---- if the statement is false: **(20 Marks)**

T F I will read all questions in the exam carefully and focus on the question requirements. Only after doing that, I will attempt to answer the question.

T F An embedded application uses a lot of mathematical processing during running. In this case, it is better to use a RISC type processor rather than a CISC.

T F A Von Neumann processor is better than Harvard in real time applications.

T F In PIC, the programmer must configure all needed SFRs registers for proper operation.

T F In any design, we can replace a PIC 16F84 with a PIC 16CR84.

T F We can never use 32 bit integers in an application for the PIC 16F84.

T F In multitasking embedded applications (applications with different things to do), it is better to use interrupts to handle serial data reception.

T F Weak pull up resistors in I/O ports can be used when the I/O port is configured as input.

T F The ORG directive when executed by the CPU, tells the CPU where in program memory to put the instruction following the directive.

T F In any embedded system, there will always be critical (masked) regions of code.

T F The 16F84 is an 8 bit microcontroller with a 1k ×14 program memory, 68 × 8 RAM file registers, 8 level deep stack and can operate with a maximum frequency of 20 MHz.

T F Decoupling capacitors are used to provide extra needed voltage to the microcontroller when the power supply is not able to do that at certain times.

T F In the 16F84, the TMR0 register controls the TIMER0 module.

T F Using the prescaler, it is possible to increase the maximum count of a timer/counter module but the accuracy will be decreased.

T F In an ISR, the programmer has to make sure by writing instructions that the GIF flag is set before returning to the main program.

T F In a sample and hold circuit, droop depends on the value of the sampling capacitor.

T F Switch debouncing can be achieved using a buffer circuit.

T F A freewheeling diode is used with inductive loads to allow the current in the coil to decrease gradually when the switching circuit is switched off.

T F For an 8 bit timer with its input clock of 4 MHz, the maximum time that can be measured assuming no scaling is 64 micro seconds.

T F A signal conditioning circuit is used to prevent aliasing in a data acquisition system.

T F The resolution of an A/D converter depends on the reference voltage used.

for the 16F877 do?

```
swapf  Reg, W
andlw  0x0F
movf   Reg, W
```

SC) swap the higher and lower nibbles of Reg.
CS) perform a signed division of Reg by 8.
CC) logical right shift Reg 4 bit places.
SS) Rotate Reg 4 places.
S) None of the above.

b) Which of the following statement regarding the components of a CPU is **correct**?
CC) The ALU always contain a multiplier unit. CS) All CPUs contain internal stack.
SS) The PC contains the address of the last instruction fetched. SC) Registers are located in a special section of RAM outside the CPU. C) None of the above.

c) For a program on the PIC16F877, the following table is called with the value 5 in W

```
BatLkup   addwf  PCL,7
          retlw  A'B'
          retlw  A'a'
          retlw  A'Y'
          retlw  0x00
          retlw  0x04
          retlw  0x06
```

The value returned in the working register is:
CC) 0x04 SS) A'a' SC) 0x00 CS) A'Y' C) none of the above

d) Which of the following statements is **incorrect** in relation to the following code for a 16F877?

```
Lp    movlw  255
      btfss  In_lo, 7
      clrw
      xorwf  In_hi, w
      btfss  status, z
      retlw  255
      movf   In_lo, w
      movwf  Out
      retlw  0
```

C) This code can be started by the statement call Lp. CS) This code uses the values In_lo, In_hi and modifies Out S) This code tests the sign of the 16 bit number In (composed of In_hi and In_lo) , and returns 0 if positive and 255 if negative. SC) this code produces the 8-bit equivalent of the 16 bit number; if possible, otherwise it returns 255. SS) None of the above

e) Which of the following statements is **incorrect** with regard to the serial port module in the 16F877?

C) Overrun errors occur because the program is not reading the RCREG fast enough.
S) The baud rate generator takes its input frequency from Fosc.
CS) Framing errors are usually an indication of wrong baud rate settings.
SS) In the code written for data reception, it is essential for the user to read the RCSTA register before reading the RCREG.
SC) In the code written for data transmission, it is essential for the user to write to the TSR register before writing to the TXREG register.

Name:

Q5) A) Which exact part of an RS-232 type serial communications waveform allows us to always know exactly where the start of a new word is.

(1 Marks)

B) If the baud rate is 1000, how long is one bit time?

(1 Marks)

C) What voltage appears on the TX pin of the PIC's USART when we transmit logic 1? What voltage appears when we transmit logic 0?

(1 Marks)

D) In general, RS-232 supports data bits of 5, 6, 7, or 8 bits in each word. Which of these data payload sizes is supported by the PIC USART?

(1 Marks)

E) We wish to copy the value in register 0x02A into the W register and then mask off the middle four bits. The result, which should remain in the W register, will be of the form 0X00XX00X where the X positions contain the original bit values from register 0x02A. Write an instruction sequence that will accomplish this task on the PIC18F452.

(2 Marks)

F) Given the following program fragment:

```
        MOVLW 0x20
        MOVWF FSR
NEXT    MOVF INDF, W
        ANDLW 0x0F
        MOVWF INDF
        INCF FSR, F
        BTFSS FSR, 4
        GOTO NEXT
CONTINUE NOP
```

Count the execution time (in cycles) of this program, from the first MOVLW instruction to NOP. Include the execution of NOP instruction at CONTINUE. Show your work clearly.

(2 Marks)