School of Engineering and Applied Science, Ahmedabad University

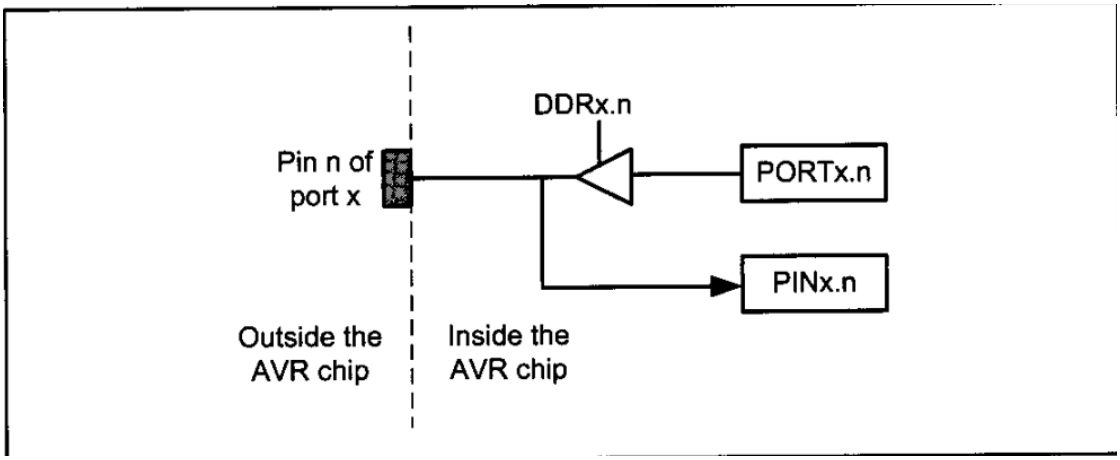
Name: _____ **Enrolment No.**_____

Student's Signature: _____ **Invigilator's Signature:** _____

B.Tech. ICT : Semester IV : Mid-Semester Examination (Maximum Marks : 100)
Subject: Embedded System Design (EVD220)
26/02/2020; 2:30 PM to 4:00 PM; (Exam Duration: 1 Hour, 30 Minutes)

Instructions: **(1) Attempt All Questions. (2) Answer all the question with reference to ESD Course taught in the class. (3) Figures to the right indicate full marks. (4) Assume any necessary data and mention them.**

Q.1 : Draw the symbolic circuit diagram of I/O Port Pin of AVR with three most essential port registers that are utilized in defining the function of the port pin. Draw their connection to outside and inside of AVR Chip. Put appropriate labels on the diagram to identify registers. [6]



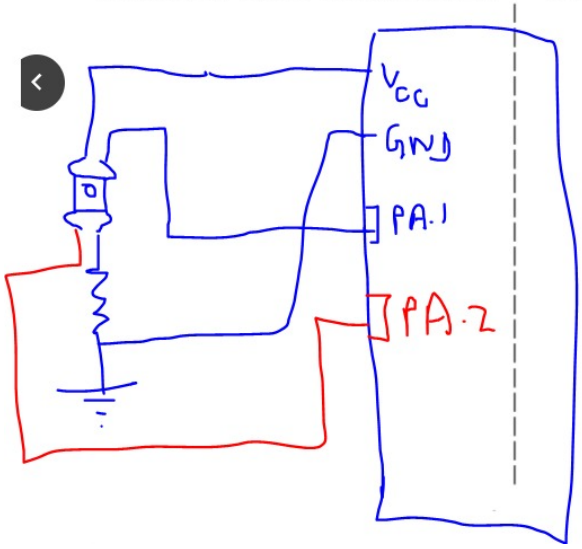
Q.2 : A push button switch, in series with a resistor, is connected with Power Supply and Ground. The junction point between the switch and resistor goes to the input Pin of ATmega32. Draw two separate circuits for following two scenarios. [8]

Scenario 1: When Switch is pressed, "Logic 1" goes to ATmega32. When switch is not pres

Q.2 A push button switch, in series with a resistor, is connected with Power Supply and Ground. The junction point between the switch and resistor goes to the input Pin of ATmega32. Draw two separate circuits for following two scenarios. [8]

Scenario 1: When Switch is pressed, "Logic 1" goes to ATmega32. When switch is not pressed, "Logic 0" gores to ATmega32

Scenario 2: When Switch is pressed, "Logic 0" goes to ATmega32. When switch is not pressed, "Logic 1" gores to ATmega32.



Scenario 2: When Switch is pressed, "Logic 0" goes to ATmega32. When switch is not pressed, "Logic 1" gores to ATmega32.

Type

Q. 3: Write any one main selection criteria for microcontrollers. Mention any four points (sub-criteria) of this mentioned main criteria. **[5]**

One Main Criteria : PDF Page 59

Sub criteria (a)_____

Sub criteria (b)_____

Sub criteria (c)_____

Sub criteria (d)_____

1. The first and foremost criterion in choosing a microcontroller is that it must meet the task at hand efficiently and cost effectively. In analyzing the needs of a microcontroller-based project, we must first see whether an 8-bit, 16-bit, or 32-bit microcontroller can best handle the computing needs of the task most effectively. Among other considerations in this category are:
   (a) Speed. What is the highest speed that the microcontroller supports?
   (b) Packaging. Does it come in a DIP (dual inline package) or a QFP (quad flat package), or some other packaging format? This is important in terms of space, assembling, and prototyping the end product.
   (c) Power consumption. This is especially critical for battery-powered products.
   (d) The amount of RAM and ROM on the chip.
   (e) The number of I/O pins and the timer on the chip.
   (f) Ease of upgrade to higher-performance or lower-power-consumption versions.
   (g) Cost per unit. This is important in terms of the final cost of the product in which a microcontroller is used. For example, some microcontrollers cost 50 cents per unit when purchased 100,000 units at a time.
2. The second criterion in choosing a microcontroller is how easy it is to develop products around it. Key considerations include the availability of an assembler, a debugger, a code-efficient C language compiler, an emulator, technical support, and both in-house and outside expertise. In many cases, third-party vendor (i.e., a supplier other than the chip manufacturer) support for the chip is as good as, if not better than, support from the chip manufacturer.

Q. 4: Draw the circuit diagram showing minimum connections required for turning on the ATMega32 microcontroller for its 40 Pin version. Out of 40 Pins, only mention details of the pins used in the connections in the circuit. Put proper labels on the diagram. **[6]**

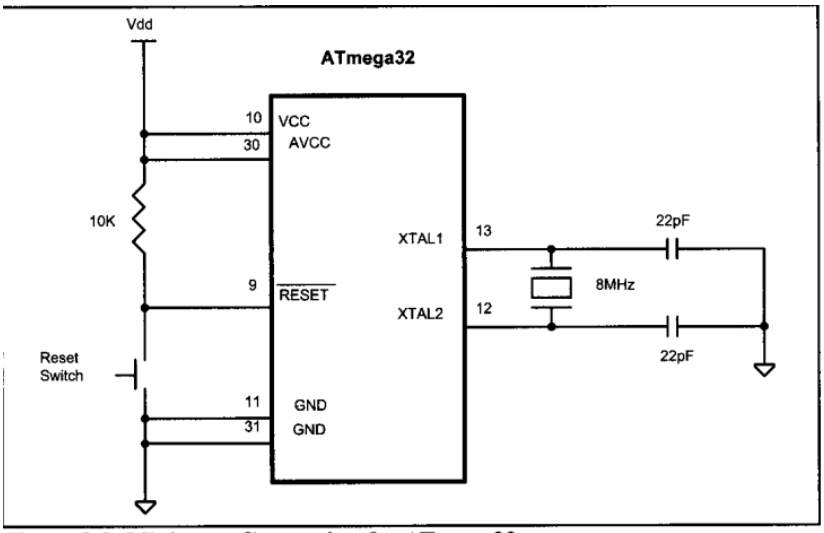


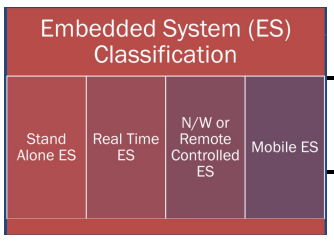
Figure 8-2. Minimum Connection for ATmega32

Q. 5 : Answer following questions very briefly. **[12]**

(a) Mention any two differences between Timer 1 and Timer 2.

External Clock , Bit difference

(b) Mention any two out of four of classifications of Embedded Systems.



Notes 1 Page 17

(e) Briefly compare "Software" and "Firmware" with reference to Embedded Systems.

YOu code a software and it becomes firmware after uploaded.

(f) Calculate Check Sum Byte for these four Hex Numbers: 0x23, 0x45, 0x99, and 0xAA

55

Q. 6: Assume that eight LEDs are connected to PORTA of ATmega32. (One LED is connected to one port pin of the 8-bit port. So, total eight LEDs are connected to entire PORTA). The connection is such that the Anodes of all LEDs are connected to +5 volt Power Supply through appropriate current limiting resistors and cathodes of all LEDs are connected to the corresponding PORTA pins individually. Write an AVR C program for ATmega32 that continuously generates the pattern mentioned in the following table. Do NOT use any kind of arrays or look-up table for the program to generate LED patterns. Do NOT use eight output statements such that each one represents port pin conditions of one time duration. Make your program efficient by using either "for" loop or any other such loop/functions.

Time	LED 0 on PORTA.0	LED 1 on PORTA.1	LED 2 on PORTA.2	LED 3 on PORTA.3	LED 4 on PORTA.4	LED 5 on PORTA.5	LED 6 on PORTA.6	LED 7 on PORTA.7
T1							ON	ON
T2					ON	ON		
T3			ON	ON				
T4	ON	ON						
T5							ON	ON
T6					ON	ON		
T7			ON	ON				
T8	ON	ON						

Notes:

(1) LEDs are on when "ON" is mentioned in the corresponding box for that time in above table. LEDs are off when nothing is mentioned in above boxes for the corresponding time in the above table.

(2) All time durations are equal to 75 micro-second. (That is, T1 = T2 = …. = T8 = 75 micro-second).

(3) To generate the time durations/intervals, use Timer 0 in CTC mode. Use Crystal Frequency equal to 10 MHz. [20]

```
1)for (int i=0 ; t<8; i++){
   PORTA=PORTA | (1<<(8-T));
   PORTA=PORTA | (1<<(7-T));
   PORTA=0x00;
}
```

Q. 7: Write one AVR C program for ATmega32 that performs following three tasks.

(a) Generate a square wave on Pin No. 7 of Port D, of time period of 200 micro seconds. Use Timer 0 in Normal mode. Use appropriate Timer Interrupt. Use Crystal Frequency of 1 MHz.

(b) A push button switch is connected to the Pin for External Hardware Interrupt 0 (INT0). Circuit is such that when the switch is pressed, Logic 1 will go to the microcontroller. Use INT0 on rising edge of the input signal. Use this switch to count the number of students entering a classroom. In other words, whenever a student enters the classroom, a volunteer pushes the switch and sends the signal to the microcontroller for counting. The class room capacity is 120. So, if the number of students inside the classroom is less than 120, a green LED connected to Pin 5 of Port D should turn ON. If the count of students entering the class room becomes equal to or eater than 120, a Red LED connected to Pin 6 of Port D should Turn ON. For both LEDs, Anodes of the LEDs are connected to the mentioned Pins of Microcontroller and Cathrods are connected to Ground through suitable resistors to limit the current.

(c) Continuously inputs a number from Port A. Assume that the entered number is always in Hex format and its value is always between 0x11 and 0x50. Write a program to convert this Hex number into Decimal number and send its decimal digits to Port B and Port C.

[33]

Additional Instructions for Question 8 to Question 17. (i) Select one or more correct options for every question. (ii) Each question is of one mark. (iii) The mark will be given only if you select all correct options, and only correct options.

Question 8: Von Neumann architecture is generally associated with which architecture?
(A) Harvard Architecture
(B) Princeton Architecture
(C) MIT Architecture
(D) Intel Architecture

Question 9: Which of the following statement(s) is (are) generally correct?
(A) C programs run faster than corresponding assembly programs.
(B) C programs run slower than corresponding assembly programs.
(C) C programs occupy more space than corresponding assembly programs.
(D) C programs occupy less space than corresponding assembly programs.

Question 10: Which of the following is (are) valid Packed BCD number(s)?
(A) 0011 0011
(B) 1010 1010
(C) 1001 0000
(D) 0000 1001

Question 11: For Normal mode operation of Timer2 of ATmega32, TCNT2 will roll over to zero after which of the following count?
(A) 0xFFFF
(B) 0xFFF
(C) 0xFF
(D) 0xF

Question 12: Assume that Timer 0 is running in CTC mode. The programmer has assigned decimal number value 200 to OCR0 Register. Which of the following initial value of TCNT0 will take longest time for Compare Flag to Set?
(A) 150 (Decimal value)
(B) 50 (Decimal value)
(C) 250 (Decimal value)
(D) 0 (Decimal Value)

Question 13: What does "BCD" stand for?
(A) Basic Code in Decimal
(B) Binary Coded Decimal
(C) Basic Code with Distinction
(D) Binary coded Distinction
(E) None of the above

Question 14: Which one of the following four interrupts will have highest priority?
(E) External Interrupt Request 2
(F) Timer/Counter2 Overflow
(G) External Interrupt Request 1
(H) Timer/Counter0 Overflow

Question 15: Which of the following interrupts can be activated on Rising Edge of the signal?
(A) External Hardware Interrupt 0
(B) External Hardware Interrupt 1
(C) External Hardware Interrupt 2
(D) None of the above

Question 16: What does "CISC" stand for ?
(A) Comprehensive Instruction Set Computing
(B) Compiled Instruction Set Computing
(C) Compact Instruction Set Computing
(D) Complex Instruction Set Computing
(E) None of the above

Question 17: Which of the following C language instructions is (are) generally used to turn of the Timer0 of ATmega32?
(A) TCCR0 = 0xFF;
(B) TCNT0 = 0xFF;
(C) TCCR0 = 0;
(D) TCNT0 = 0;
(E) None of the above

School of Engineering and Applied Science, Ahmedabad University

Student's Name: _____ Student's Roll no.: _____

Student's Signature: _____ Invigilator's Signature: _____

B. Tech. ICT: Semester IV
Subject: Embedded System Design (EVD220); Mid-Term Exam (Maximum Marks: 100)
20/02/2019, 2:30 PM to 4:00 PM (Duration: 1 Hour, 30 Minutes)

Instructions: (1) Attempt All Questions. (2) Answer all the question with reference to ESD Course taught in the class. (3) Figures to the right indicate full marks. (4) Assume any necessary data and mention them.

Q.1 Write down four major classifications of Embedded Systems. [4]

(1)_____

(2)_____

(3)_____

(4)_____

Q.2 A push button switch, in series with a resistor, is connected with Power Supply and Ground. The junction point between the switch and resistor goes to the input Pin of ATmega32. Draw two separate circuits for following two scenarios. [8]

Scenario 1: When Switch is pressed, "Logic 1" goes to ATmega32. When switch is not pressed, "Logic 0" gores to ATmega32

Scenario 2: When Switch is pressed, "Logic 0" goes to ATmega32. When switch is not pressed, "Logic 1" gores to ATmega32.

Q.3 Explanation why Line Driver is needed between ATmega32 and RS232. **[4]**

Q.4 Very briefly answer following questions. **[8]**

(a) Write one difference between software and firmware.

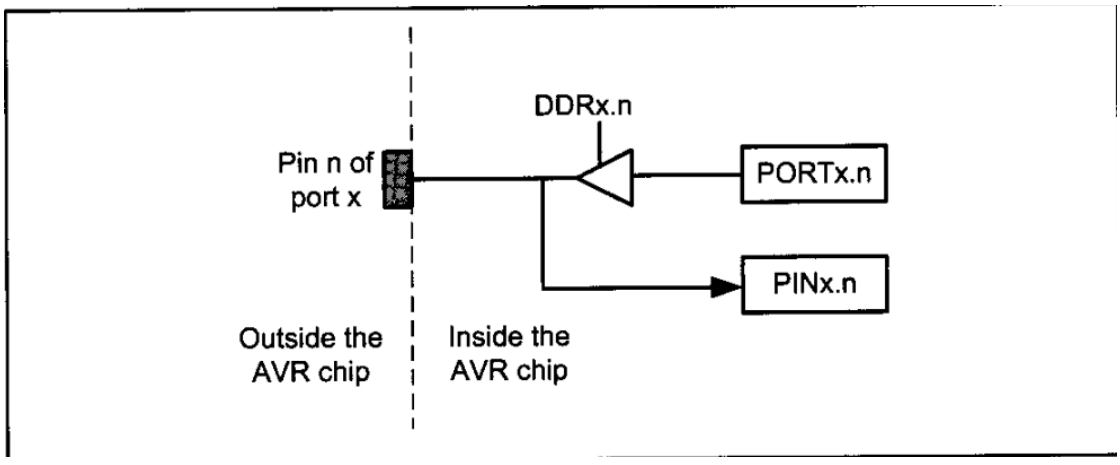
(b)Write one advantage of assembly language programing over c language programing.

Smaller HEx file but tedious to write

(c) Compare Normal and CTC modes for Timer 0 and complete following table for ATmega32.

	Timer 0 Normal Mode	Timer 0 CTC Mode
When will TCNT0 roll-over to 0?	FF	OCR0
Which flag will be set on roll-over of the TCNT0 ?	TOV0	OCF0

(d) Draw the symbolic circuit diagram of I/O Port Pin of AVR with three most essential port registers that are utilized in defining the function of the port pin. Draw their connection to outside and inside of AVR Chip. Put appropriate labels on the diagram to identify registers.



Q.5 **Assume that user can input one number, between 0 and 9, in ASCII format, from Port A as well as from Port B of ATmega32. Write an AVR C program for ATmega32 to combine these numbers from Port A and Port B, in packed BCD format, and display the final number on Port C. While converting the numbers into packed BCD, implement following condition – if the number from Port A is odd number, put this number as first four bits of the packed BCD number, otherwise put this number as last four bits of the packed BCD number.** **[16]**

Q.6 **Assume that eight LEDs are connected to PORTA of ATmega32. (One LED is connected to one port pin of the 8-bit port. So, total eight LEDs are connected to entire PORTA). The connection is such that the cathodes of all LEDs are connected to Ground and anodes of all LEDs are connected to the corresponding PORTA pins individually, through a series resistor. Write an AVR C program for ATmega32 that continuously generates the pattern mentioned in the following table. Do NOT use any kind of arrays or look-up table for the program to generate LED patterns. Do NOT use eight output statements such that each one represents port pin conditions of one time duration. Make your program efficient by using either "for" loop or any other such loop/functions. Explain your program and write appropriate comments after each instruction.**

Time	LED 0 on PORTA.0	LED 1 on PORTA.1	LED 2 on PORTA.2	LED 3 on PORTA.3	LED 4 on PORTA.4	LED 5 on PORTA.5	LED 6 on PORTA.6	LED 7 on PORTA.7
T1	ON							
T2		ON						
T3			ON					
T4				ON				
T5					ON			
T6						ON		
T7							ON	
T8								ON

Notes:

(1) LEDs are on when "ON" is mentioned in the corresponding box for that time in above table. LEDs are off when nothing is mentioned in above boxes for the corresponding time in the above table. (2) All time durations are equal to 750 micro seconds. (That is, T1 = T2 = …. = T8 = 750 micro-seconds). Use Timer 0 in normal mode to generate these time intervals. Use Crystal Frequency equal to 1 MHz. **[20]**

Q.7 Write one AVR C program for ATmega32 that performs all of the following tasks.

(a) Assume that an external clock is connected to T0 (PB0) pin of ATmega32. Count these pulses on rising edge and display the count on Port A continuously. If the count value exceeds 100, then reset the count value and restart the count from 0, and continuously display on Port A.

(b) Toggle one LED connected to Pin 0 of Port D (PD0) , whenever a switch connected to external interrupt pin of INT0 goes high. Use external interrupt INT0. Activate interrupt on rising edge of the signal.

(c) A switch is connected to external interrupt pin of INT1. Program to activates this interrupt on the falling edge of the signal from this switch. Starting from 0, count the number of time this interrupt is received and display the count on Port C. Assume that the count will roll-over after counting from 0x00 to 0xFF.

Write appropriate comments at the end of each instruction of the program. [20]

Table 1-3: Some Members of the ATmega Family

Part Num.	Code ROM	Data RAM	Data EEPROM	I/O pins	ADC	Timers	Pin numbers & Package
ATmega8	8K	1K	0.5K	23	8	3	TQFP32, PDIP28
ATmega16	16K	1K	0.5K	32	8	3	TQFP44, PDIP40
ATmega32	32K	2K	1K	32	8	3	TQFP44, PDIP40
ATmega64	64K	4K	2K	54	8	4	TQFP64, MLF64
ATmega1280	128K	8K	4K	86	16	6	TQFP100, CBGA

Notes:
1. All ROM, RAM, and EEPROM memories are in bytes.
2. Data RAM (general-purpose RAM) is the amount of RAM available for data manipulation (scratch pad) in addition to the register space.
3. All the above chips have USART for serial data transfer.

tions 8 to 17: (i) Select one or more correct options for every question.
s. (iii) The marks will be given only if you select all correct options,

Question 8: Which of the following statement(s) is (are) correct about ATmega32?
(A) It has 32K of Data ROM
(B) It has 32K of Code RAM
(C) It has 32K of EEPROM
(D) None of the above

Question 9: Which of the following is the "Check Sum Byte" for 0x11, 0xAA and 0x66?
(A) 0x21
(B) 0xDE
(C) 0x22
(D) 0xDF
(E) None of the above

Question 10: Which of the following is (are) valid Packed BCD number(s)?
(A) 0001 0001
(B) 1100 1100
(C) 0011 0011
(D) 0000 1001

Doubt

Question 11: Regarding the selection criteria for microcontrollers, which of the following will fall under the criteria titled "Availability of Software Development Tools"?
(A) Availability of Assemblers
(B) Number of Timers
(C) Availability of Debugger
(D) Number of companies that supply this microcontroller.

Question 12: Generally, which of the following can be considered as the component(s)/building block(s) of the Embedded Systems?
(A) Software
(B) Hardware
(C) Firmware
(D) None of the above

Question 13: What will be the content of PORTD after the execution of the following instructions?
PORTD = 0x82 << 3;
PORTD = PORTD ^ 0xC5
(A) 0xC5
(B) 0xD5
(C) 0xC4
(D) 0xD4
(E) None of the above

Question 14: For Normal mode operation of Timer1 of ATmega32, TCNT1 will roll over to zero after which of the following count?
(A) 0xFFFF
(B) 0xFFF
(C) 0xFF
(D) 0xF

Question 15: Which of the following statements is (are) correct?
(A) Polling method ties down the microcontroller.
(B) Use of interrupts may increase the utilization of microcontroller.
(C) There are two External Hardware Interrupts facility available in 40 pin ATmega32 microcontroller
(D) The interrupt vector table directs the microcontroller to the address of interrupt service routine.

Question 16: Which of the following is (are) the value(s) of the single clock period for the crystal frequency of 1 MHz and no pre-scaling is used?
(A) 10×10^{-9} Seconds
(B) 100×10^{-9} Seconds
(C) 1000×10^{-9} Seconds
(D) 10000×10^{-9} Seconds
(E) None of the above

Question 17: What might be the content of a register of a microcontroller if you the store value -5 (negative five) in it?
(A) 0xFA
(B) 0xFB
(C) 0xFC
(D) 0xFD
(E) None of the above

School of Engineering and Applied Science, Ahmedabad University

Student's Name: _____ Student's Roll no.: _____

Student's Signature: _____ Invigilator's Signature: _____

B. Tech. ICT: Semester IV
Subject: Embedded System Design (EVD220); Mid-Term Exam (Maximum Marks: 100)
14/02/2018, 9:30 AM to 11:00 AM (Duration: 1 Hour, 30 Minutes)

Instructions: (1) Attempt All Questions. (2) Answer all the question with reference to ESD Course taught in the class. (3) Figures to the right indicate full marks. (4) Assume any necessary data and mention them.

Q.1 Write two main selection criteria for microcontrollers. Mention any four points (sub-criteria) of the two mentioned criteria. [10]

Main Criteria 1: _____

Sub criteria 1(a)_____

Sub criteria 1(b)_____

Sub criteria 1(c)_____

Sub criteria 1(d)_____

Main Criteria 2: _____

Sub criteria 2(a)_____

Sub criteria 2(b)_____

Sub criteria 2(c)_____

Sub criteria 2(d)_____

Q.2 Write down four major classifications of Embedded Systems. [4]

(1)_____

(2)_____

(3)_____

(4)_____

Q.3 Draw the diagram showing the connection of 40 pin ATmega32 to RS232. Explain why MAX232 or MAX233 is needed in above diagram. [10]

Draw Diagram Here:

Explanation why MAX 2332 or MAX 233 is needed between ATmegga32 and RS232.

Q.4 Write an AVR C program for ATmega32 to input a hex number from PORTA, then convert it into decimal number and display the digits on PORTB, PORTC and PORTD. Write appropriate comments at the end of each instruction of the program. Briefly explain how will you convert the hex number into three possible decimal digits. [15]

Q.5 **Assume that eight LEDs are connected to PORTB of ATmega32. (One LED is connected to one port pin of the 8-bit port. So, total eight LEDs are connected to entire PORTB). The connection is such that the anodes of all LEDs are connected to +5 Volts and cathodes of all LEDs are connected to the corresponding PORTB pins individually. Write an AVR C program for ATmega32 that continuously generates the pattern mentioned in the following table.**
Do NOT use any kind of arrays or look-up table for the program to generate LED patterns. Make your program efficient by using either "for" loop or any other such loop/functions. Explain your program and write appropriate comments after each instruction.

Time	LED 0 on PORTB.0	LED 1 on PORTB.1	LED 2 on PORTB.2	LED 3 on PORTB.3	LED 4 on PORTB.4	LED 5 on PORTB.5	LED 6 on PORTB.6	LED 7 on PORTB.7
T1	ON							ON
T2		ON					ON	
T3			ON			ON		
T4				ON	ON			
T5				ON	ON			
T6			ON			ON		
T7		ON					ON	
T8	ON							ON

Notes:
(1) LEDs are on when "ON" is mentioned in the corresponding box for that time in above table. LEDs are off when nothing is mentioned in above boxes for the corresponding time in the above table. (2) All time durations are equal to 50 micro seconds. (That is, T1 = T2 = …. = T8 = 50 micro-seconds). Use Timer 0 in normal mode to generate these time intervals. Use Crystal Frequency equal to 1 MHz. **[15]**

Q.6 Write one AVR C program for ATmega32 that performs following tasks.

(a) Generate a square wave on Pin No. 4 of Port D, of time period of 100 micro seconds. Use Timer 0 in CTC mode for this purpose. Use Crystal Frequency of 1 MHz.

(b) Toggles one LED connected to Pin No. 5 of Port D, whenever a switch connected to external interrupt pin of INT0 goes low. Use external interrupt INT0. Activate interrupt on falling edge of the signal.

(c) Continuously inputs a number from Port A, (assume it even number), divides it by two, and displays the result on Port C. Do NOT use division or modulus operation for this purpose.

Write appropriate comments at the end of each instruction of the program. [16]

Additional Instructions for Questions 7 to 21: (i) Select one or more correct answers for every question. (ii) Each question is of two marks. (iii) The marks will be given only if you select all correct answers.

Question 7: Which of the following statement(s) is (are) correct about ATmega32?
(A) It has 32K of Code ROM
(B) It has 32K of Data RAM
(C) It has 32K of EEPROM
(D) None of the above

Question 8: Which of the following is the "Check Sum Byte" for 0x41, 0x82 and 0x18?
(A) 0xA1
(B) 0x1A
(C) 0x52
(D) 0x25
(E) None of the above

Question 9: Which of the following statement(s) is (are) correct?
(A) Harvard Architecture has separate interfacing facility for Program Memory and Data Memory.
(B) Harvard Architecture has common (single) interfacing facility for Program Memory and Data Memory.
(C) Princeton Architecture has separate interfacing facility for Program Memory and Data Memory.
(D) Princeton Architecture has common (single) interfacing facility for Program Memory and Data Memory.
(E) None of the above.

Question 10: Which of the following is (are) valid Unpacked BCD number(s)?
(A) 0000 0101
(B) 0000 1010
(C) 0000 1001
(D) 0001 1000
(E) None of the above

Question 11: When DDRA = 0x20; which of the following statement(s) is (are) correct?
(A) PORTA.5 is programmed as output
(B) PORTA.5 is programmed as input
(C) PORTA.4 is programmed as output
(D) PORTA.4 is programmed as input
(E) None of the above

Question 12: What might be the content of a register of a microcontroller if you the store value -6 (negative six) in it?
(A) 0xFA
(B) 0xFB
(C) 0xFC
(D) 0xFD
(E) None of the above

Question 13: Which of the following statements is (are) generally true?
(A) In RISC Architecture, we can have 1, 2, 3 or 4 byte instructions.
(B) In CISC Architecture, we can have 1, 2, 3 or 4 byte instructions.
(C) In CISC Architecture, instructions are normally executed in one or two machine cycles.
(D) In RISC Architecture, instructions are normally executed in one or two machine cycles.
(E) None of the above.

Question 14: When DDRx.n is at logic zero, what is the function of PORTx.n?
(A) To act as input
(B) To act as output
(C) To connect/disconnect internal Pull-up register
(D) No function
(E) None of the above

Question 15: Von Neumann architecture is generally associated with which architecture?
(A) Harvard Architecture
(B) Princeton Architecture
(C) MIT Architecture
(D) Intel Architecture
(E) None of the above

Question 16: What will be the content of PORTD after the execution of the following instructions?
PORTD = 0xE2 << 3;
PORTD = PORTD ^ 0xD4
(A) 0xC5
(B) 0xD5
(C) 0xC4
(D) 0xD4
(E) None of the above

Question 17: What will be the content of PORTA after the execution of the following instructions?
PORTA = 0;
PORTA = PORTA | 0x62;
PORTA = PORTA & 0x43
PORTA= ~PORTA

(A) 0xB3
(B) 0x43
(C) 0x4D
(D) 0xBD
(E) None of the above

Question 18: Which of the following Timers of ATmega32 is (are) designed to be used as a "real time counter"?
(A) Timer0
(B) Timer1
(C) Timer2
(D) Timer3
(E) None of the above

Question 19: Which of the following statements is (are) correct?
(A) Use of interrupts may increase CPU efficiency
(B) Polling method ties down the CPU
(C) Using interrupts, multiple tasks can be performed by CPU
(D) The interrupt vector table directs the microcontroller to the address of interrupt service routine.
(E) None of the above

Question 20: Which of the following statement(s) is (are) generally correct?
(A) C programs run faster than corresponding assembly programs.
(B) C programs run slower than corresponding assembly programs.
(C) C programs occupy more space than corresponding assembly programs.
(D) C programs occupy less space than corresponding assembly programs.
(E) None of the above

Question 21: Which of the following C language operation(s) will convert unpacked BCD number "0x09" into ASCII?
(A) number = 0x09 + 0x30;
(B) number = 0x09 % 0x30;
(C) number = 0x09 | 0x30;
(D) number = 0x09 & 0x30;
(E) None of the above.