[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1058 **I**

Unique Paper Code : 2512013501

Name of the Paper : Embedded Systems (CORE)

Name of the Course : **B.Sc. (H) Electronic Science**

Semester : V

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. **1** is Compulsory. Attempt **5** questions in all.
3. **All** questions carry equal marks.
4. Use of non-programmable scientific calculators is allowed.

1. (a) What is an embedded system? What does it mean when it is said that embedded systems are reactive and real time systems?

   (b) What is the purpose of Brown-out-Detector? Where is the BOD level set?

   (c) If the crystal frequency of three different AVR based systems is (i) 8 MHz (ii) 10 MHz and (iii) 16 MHz, what will be the period of instruction cycle in each case?

   (d) Solve and indicate the data on PORTB (in hex) for the following :

   PORTB = (0x2A | 93) ^ (0x63 & 0x7D);

   (e) Explain how a hardware interrupt request is generated in Atmega32 and what is the vector location for INT0, INT1 and INT2?

   (f) List 6 features of Atmega32 ADC. (3×6)

2. (a) Compare RISC Architecture and CISC Architectures. Is AVR microcontroller RISC or CISC based? (6)

P.T.O.

(b) List the major criteria for picking a microcontroller for an embedded system? (6)

(c) Explain Program memory map and data memory map (without extended I/O) AVR microcontroller in brief. (6)

3. (a) What do you understand by GPR and SFR. Give two features of each. What additional meaning do GPR R26 to R31 have in ATmega32 AVR microcontroller? (6)

(b) Write an assembly code snippet for each of the following to send $55 to PORT B using :

(i) Register names

(ii) I/O addresses

(iii) Data Memory Addresses

Given that DDRB data memory address is $37 and PORTB data memory address = $38. (6)

(c) Compare and contrast the instructions JMP, RJMP, IJMP. (6)

4. (a) Which addressing modes are used in the following AVR instructions :

(i) NEG R32

(ii) MOV R17, R23

(iii) STS 0x40, R19

(iv) IN R18, 0x16

(v) LD R23, X

(vi) STD Z+, R17 (6)

(b) (i) Explain the role of the Pull-up resistor.

(ii) Explain the directives: .EQU, .ORG, .INCLUDE with examples. (6)

(c) What are the two ways to transfer a byte by data serialization. Write an AVR C/assembly program to send out the value 44H serially one bit at a time via PORTC, pin 3. The LSB should go out first. (6)

5. (a) What is an Interrupt? Give its advantages over Polling. Explain with an example. (6)

(b) Assume that the INT0 pin is connected to a switch that is normally high. Write a C/Assembly program that toggles PORTC.3, whenever INT0 pin goes low. Use external interrupt in level -triggered mode.

What instruction(s) need to be used so that whenever INT0 goes low, the program toggles PORTC.3 only once? (6)

(c) Explain in detail with examples the significance of various bits in the Timer/ Counter Control Register (TCCR0). What will be the value for TCCR0 if we want to program Timer0 in CTC Mode, with clk/64 prescaler. (6)

6. (a) Explain Simplex, Half Duplex and Full Duplex mode of Communication with relevant diagrams. (6)

(b) Explain the Phase correct PWM mode in Timer0 of Atmega32 AVR Microcontroller with relevant diagrams. (6)

(c) A door sensor is connected to port B pin 1, and LED is connected to PORT C pin 7. Write an AVR C/Assembly program to monitor the door sensor and when the door opens, turn the LED 'ON' (consider when the door opens, state of PB1 is logic '1'). (6)

7. (a) Write a code snippet to initialize the USART to work in asynchronous mode at 9600 baud rate, 8 bit data, odd parity and 1 stop bit, Assume XTAL = 8 MHz. Show the framing of the letter 'Z'(0101 1010). (6)

(b) Compare and Contrast SPI protocol and TWI protocol. (6)

(c) For a 10-bit ADC, if Vref = 2.56V

(i) Determine D9-D0 digital output if the analog input voltage is 1.7 V

(ii) Find the Vin (equivalent analog voltage at its input) if the outputs from 10 bit ADC is 11 0110 0010. (6)

P.T.O.

Register Summary

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
$3F ($5F)	SREG	I	T	H	S	V	N	Z	C
$3E ($5E)	SPH	–	–	–	–	SP11	SP10	SP9	SP8
$3D ($5D)	SPL	SP7	SP6	SP5	SP4	SP3	SP2	SP1	SP0
$3C ($5C)	OCR0	Timer/Counter0 Output Compare Register							
$3B ($5B)	GICR	INT1	INT0	INT2	–	–	–	IVSEL	IVCE
$3A ($5A)	GIFR	INTF1	INTF0	INTF2	–	–	–	–	–
$39 ($59)	TIMSK	OCIE2	TOIE2	TICIE1	OCIE1A	OCIE1B	TOIE1	OCIE0	TOIE0
$38 ($58)	TIFR	OCF2	TOV2	ICF1	OCF1A	OCF1B	TOV1	OCF0	TOV0
$37 ($57)	SPMCR	SPMIE	RWWSB	–	RWWSRE	BLBSET	PGWRT	PGERS	SPMEN
$36 ($56)	TWCR	TWINT	TWEA	TWSTA	TWSTO	TWWC	TWEN	–	TWIE
$35 ($55)	MCUCR	SE	SM2	SM1	SM0	ISC11	ISC10	ISC01	ISC00
$34 ($54)	MCUCSR	JTD	ISC2	–	JTRF	WDRF	BORF	EXTRF	PORF
$33 ($53)	TCCR0	FOC0	WGM00	COM01	COM00	WGM01	CS02	CS01	CS00
$32 ($52)	TCNT0	Timer/Counter0 (8 Bits)							
$31[1] ($51)[1]	OSCCAL	Oscillator Calibration Register							
	OCDR	On-Chip Debug Register							
$30 ($50)	SFIOR	ADTS2	ADTS1	ADTS0	–	ACME	PUD	PSR2	PSR10
$2F ($4F)	TCCR1A	COM1A1	COM1A0	COM1B1	COM1B0	FOC1A	FOC1B	WGM11	WGM10
$2E ($4E)	TCCR1B	ICNC1	ICES1	–	WGM13	WGM12	CS12	CS11	CS10
$2D ($4D)	TCNT1H	Timer/Counter1 – Counter Register High Byte							
$2C ($4C)	TCNT1L	Timer/Counter1 – Counter Register Low Byte							
$2B ($4B)	OCR1AH	Timer/Counter1 – Output Compare Register A High Byte							
$2A ($4A)	OCR1AL	Timer/Counter1 – Output Compare Register A Low Byte							
$29 ($49)	OCR1BH	Timer/Counter1 – Output Compare Register B High Byte							
$28 ($48)	OCR1BL	Timer/Counter1 – Output Compare Register B Low Byte							
$27 ($47)	ICR1H	Timer/Counter1 – Input Capture Register High Byte							
$26 ($46)	ICR1L	Timer/Counter1 – Input Capture Register Low Byte							
$25 ($45)	TCCR2	FOC2	WGM20	COM21	COM20	WGM21	CS22	CS21	CS20
$24 ($44)	TCNT2	Timer/Counter2 (8 Bits)							
$23 ($43)	OCR2	Timer/Counter2 Output Compare Register							
$22 ($42)	ASSR	–	–	–	–	AS2	TCN2UB	OCR2UB	TCR2UB
$21 ($41)	WDTCR	–	–	–	WDTOE	WDE	WDP2	WDP1	WDP0
$20[2] ($40)[2]	UBRRH	URSEL	–	–	–	UBRR[11:8]			
	UCSRC	URSEL	UMSEL	UPM1	UPM0	USBS	UCSZ1	UCSZ0	UCPOL
$1F ($3F)	EEARH	–	–	–	–	–	–	EEAR9	EEAR8
$1E ($3E)	EEARL	EEPROM Address Register Low Byte							
$1D ($3D)	EEDR	EEPROM Data Register							
$1C ($3C)	EECR	–	–	–	–	EERIE	EEMWE	EEWE	EERE
$1B ($3B)	PORTA	PORTA7	PORTA6	PORTA5	PORTA4	PORTA3	PORTA2	PORTA1	PORTA0
$1A ($3A)	DDRA	DDA7	DDA6	DDA5	DDA4	DDA3	DDA2	DDA1	DDA0
$19 ($39)	PINA	PINA7	PINA6	PINA5	PINA4	PINA3	PINA2	PINA1	PINA0
$18 ($38)	PORTB	PORTB7	PORTB6	PORTB5	PORTB4	PORTB3	PORTB2	PORTB1	PORTB0
$17 ($37)	DDRB	DDB7	DDB6	DDB5	DDB4	DDB3	DDB2	DDB1	DDB0
$16 ($36)	PINB	PINB7	PINB6	PINB5	PINB4	PINB3	PINB2	PINB1	PINB0
$15 ($35)	PORTC	PORTC7	PORTC6	PORTC5	PORTC4	PORTC3	PORTC2	PORTC1	PORTC0
$14 ($34)	DDRC	DDC7	DDC6	DDC5	DDC4	DDC3	DDC2	DDC1	DDC0
$13 ($33)	PINC	PINC7	PINC6	PINC5	PINC4	PINC3	PINC2	PINC1	PINC0
$12 ($32)	PORTD	PORTD7	PORTD6	PORTD5	PORTD4	PORTD3	PORTD2	PORTD1	PORTD0
$11 ($31)	DDRD	DDD7	DDD6	DDD5	DDD4	DDD3	DDD2	DDD1	DDD0
$10 ($30)	PIND	PIND7	PIND6	PIND5	PIND4	PIND3	PIND2	PIND1	PIND0
$0F ($2F)	SPDR	SPI Data Register							
$0E ($2E)	SPSR	SPIF	WCOL	–	–	–	–	–	SPI2X
$0D ($2D)	SPCR	SPIE	SPE	DORD	MSTR	CPOL	CPHA	SPR1	SPR0
$0C ($2C)	UDR	USART I/O Data Register							
$0B ($2B)	UCSRA	RXC	TXC	UDRE	FE	DOR	PE	U2X	MPCM
$0A ($2A)	UCSRB	RXCIE	TXCIE	UDRIE	RXEN	TXEN	UCSZ2	RXB8	TXB8
$09 ($29)	UBRRL	USART Baud Rate Register Low Byte							
$08 ($28)	ACSR	ACD	ACBG	ACO	ACI	ACIE	ACIC	ACIS1	ACIS0
$07 ($27)	ADMUX	REFS1	REFS0	ADLAR	MUX4	MUX3	MUX2	MUX1	MUX0
$06 ($26)	ADCSRA	ADEN	ADSC	ADATE	ADIF	ADIE	ADPS2	ADPS1	ADPS0
$05 ($25)	ADCH	ADC Data Register High Byte							
$04 ($24)	ADCL	ADC Data Register Low Byte							
$03 ($23)	TWDR	Two-wire Serial Interface Data Register							
$02 ($22)	TWAR	TWA6	TWA5	TWA4	TWA3	TWA2	TWA1	TWA0	TWGCE
$01 ($21)	TWSR	TWS7	TWS6	TWS5	TWS4	TWS3	–	TWPS1	TWPS0
$00 ($20)	TWBR	Two-wire Serial Interface Bit Rate Register							