This question paper contains 4 printed pages + 1 Table]

Roll No. | 1 | 5 | 0 | 8 | 5 | 5 | 5 | 8 | 0 | 1 | 1 |

S. No. of Question Paper : 9436A

Unique Paper Code : 32517916   HC

Name of the Paper : Embedded Systems

Name of the Course : B.Sc. (Hons.) Electronics : DSE-4

Semester : VI

Duration : 3 Hours   Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. **1** is compulsory.

Attempt *five* questions in all.

All questions carry equal marks.

Use of non-programmable scientific calculator is allowed.

1. (a) Differentiate between Harvard architecture and Von Neumann Architecture.

   (b) Explain the function of DDR, PIN and PORT registers.

   (c) What is the function of Watchdog Timer ?

   (d) Explain the difference between RET and RETI instructions.

(e) If reference voltage in ADC is 5V, then what will be

the step size for :

(i) 8-bit ADC

(ii) 10-bit ADC.   5×3

2. (a) Explain the difference between CISC and RISC

processors. Give an example of each processor.

(b) Briefly explain *five* criteria for selecting a microcontroller

for an embedded system.

(c) What is an embedded system ? What are its

essential features ? How do they affect the design

decision.   5+5+5

3. (a) Draw and explain the Program Memory map of a

ATmega32 processor.

(b) What do you understand by GPR and SFR. Give *two*

features of each.

(c) Explain the following instructions with an example :

(i) CBI

(ii) LSL

(iii) BREQ

(iv) SBIC

(v) ADIW.   5+5+5

4. (a) Write a program to clear bit 3, 4 and 5 and set bit 6 and 7 of PORTA. Remaining bits should be unchanged.

(b) Write a program to identify if a given number is prime or not. If the number is prime, then show 0×02 else show 0×04 at Port D.

(c) Solve and indicate the data on the ports for each of the following

(i) PORTB = (0×F0 & 0×45) | (0×C5 ^ 0×12);

(ii) PORTA = (0×65 >> 2) & (0×39 << 3). 5+5+5

5. (a) What is the default configuration of a Port on Power-on reset ? Write a program to configure pin 0, 2, 4 & 6 of Port C as input port with pull-up resistor enabled. Remaining pins should be configured as output pins.

(b) LEDs are connected to each pin of Port B. One switch is connected to pin 0 of Port C. Initially all LEDs are off. Write program such that whenever the switch is pressed, the count displayed on LEDs is incremented by one.

(c) Assume that the INT0 pin is connected to a switch that is normally high. Write a program to initialize the interrupt and Interrupt Service Routine that toggles PC3 whenever INT0 goes low. 5+5+5

6. (a) Briefly explain with the help of a diagram how Timer 0 can be configured as :

(i) Delay Timer

(ii) Event Counter.

(b) Write a program to toggle all LEDs connected to Port A whenever Timer 0 counter overflows.

(c) What is the priority of INT0, INT1 and INT2 interrupts ? Give their vector address. Also specify the triggering options for all the three interrupts. 5+5+5

7. (a) An analog signal which varies between 0 to 5V is connected to channel 2 of ADC. Write a program to read the input voltage using ADC and convert the digital value read from ADC to its equivalent analog value. Assume that the reference voltage is 5V.

(b) With the help of a diagram explain how data is transferred between 2 devices using SPI protocol.

(c) Explain UART communication protocol. Calculate the value of UBRR register to generate baud rate of 9600 bps if clock frequency is 8 MHz. 5+5+5

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	–	–	–	IVSEL	IVCE
$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							