GUJARAT TECHNOLOGICAL UNIVERSITY

BE-4 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

Subject Name & Code:
Microprocessor and Microcontroller (3141008)

Unit 1: Fundamentals of Microprocessors

Topics: History, Microprocessor vs Microcontroller, Applications, 8085 architecture, memory interfacing, role in embedded systems, AVR overview.

Repeated Questions:

1. **List differences between microprocessor and microcontroller.**
   - Appeared in:
     - S25 (Q1b, 03 marks)
     - W25 (Q1a, 03 marks)
     - W24 (Q1a, 03 marks)
     - S22 (Q1a, 03 marks)
2. **Explain/draw architecture of 8085 microprocessor.**
   - Appeared in:
     - S25 (Q1c, 07 marks)
     - S24 (Q2c, 07 marks)
     - S22 (Q2c, 07 marks)
3. **Explain the role of microcontroller in embedded systems.**
   - Appeared in:
     - W25 (Q1b, 04 marks)
     - W24 (Q1b, 04 marks)
     - W23 (Q1b, 04 marks)

Other Important Questions:

1. **List features of AVR microcontroller.**
   - S25 (Q1a, 03 marks)
2. **Draw and explain status register of AVR microcontroller.**
   - S25 (Q2b, 04 marks)
3. **Explain memory space of AVR microcontroller.**
   - S24 (Q2c OR, 07 marks)
4. **What is address space partitioning? Draw interfacing diagram for 16KB RAM and 16KB PROM with given starting addresses.**
   - S22 (Q1c, 07 marks)
5. **Show how address bus and data bus are de-multiplexed in 8085-based system.**
   - S22 (Q2a, 03 marks)
6. **List differences between RISC and CISC architecture. Write advantages of RISC.**
   - S22 (Q2b, 04 marks)
7. **Explain Harvard vs von Neumann architecture.**
   - S25 (Q3a OR, 03 marks)
   - W25 (Q2a, 03 marks)
   - S22 (Q2b related)
8. **Explain the following 8085 pins:**
   - S23 (Q1c, 07 marks) – TRAP, SOD, HLDA, READY
   - W25 (Q2b, 04 marks) – HOLD, INTA, SID, RESET
9. **Explain importance of flags in 8085.**
   - W24 (Q1c, 07 marks)
10. **Size and function of stack pointer and program counter in 8085.**

- S23 (Q1b, 04 marks)

11. **Explain criteria for choosing a microcontroller.**
    - S23 (Q2c, 07 marks)
    - W25 (Q2c OR, 07 marks)
12. **Explain 8085 vs ATMega32 differences.**
    - S24 (Q2c OR, 07 marks)
13. **What is an embedded system? List applications of microcontrollers.**
    - W25 (Q1b, 04 marks)
14. **Draw internal block diagram of AVR microcontroller and explain each block.**
    - W25 (Q1c, 07 marks)
15. **Explain branch instructions in AVR.**
    - W25 (Q2c, 07 marks)

Unit 2: Architecture and Instruction Set of AVR

Topics: AVR architecture, registers, memory space, addressing modes, instruction set (data transfer, arithmetic, logic, branch, bit manipulation).

Repeated Questions:

1. **Explain addressing modes of AVR with examples.**
   - Appeared in:
     - S25 (Q3c, 07 marks)
     - S23 (Q4c, 07 marks – related to logical instructions)
2. **Explain status register (SREG) and its flags.**
   - Appeared in:
     - S24 (Q1c, 07 marks)
     - W24 (Q2a, 03 marks)
     - W25 (Q4b OR, 04 marks)
3. **Explain DDRx, PORTx, PINx registers.**
   - Appeared in:
     - S23 (Q3b, 04 marks)
     - W25 (Q4b, 04 marks)
     - W24 (Q2c, 07 marks)
     - W23 (Q1c, 07 marks)

Other Important Questions:

1. **Write instructions to configure PORT as input/output.**
   - S24 (Q1a, 03 marks) – PORTD
   - W24 (Q3a, 03 marks) – PORTC
2. **Purpose of GPRs in AVR. Which registers are used as 16-bit pointers?**
   - S24 (Q1b, 04 marks)
3. **Explain SBIS and SBIC instructions with examples.**
   - S24 (Q2a, 03 marks)
   - W24 (Q3b, 04 marks)
4. **Analyze given ALP and find register values and flags.**
   - S24 (Q2b, 04 marks)
5. **Explain LDS, STS instructions with examples.**
   - S23 (Q2a, 03 marks)
6. **Draw and explain data memory space of AVR.**
   - S23 (Q2b, 04 marks)
7. **Write conditions when N and V flags are set/reset in AVR.**
   - S23 (Q3a, 03 marks)
8. **Explain bit manipulation instructions (SBI, CBI, SBR, CBR, etc.) with examples.**
   - S22 (Q3b, 04 marks)
   - W24 (Q2b, 04 marks)
9. **Explain logical instructions in AVR with examples.**
   - S23 (Q3c OR, 07 marks)
10. **Explain X, Y, Z registers in AVR.**
    - S23 (Q4a OR, 03 marks)
11. **Explain SWAP, ASR, ROL, LSR instructions with examples.**
    - S23 (Q4c, 07 marks)
12. **What is branch penalty in AVR?**
    - S23 (Q3a OR, 03 marks)
13. **Compare JMP and RJMP instructions.**
    - S25 (Q5b, 04 marks)
    - W25 (Q4a OR, 03 marks)
    - W23 (Q3a, 03 marks)
14. **Compare RET and RETI instructions.**
    - S25 (Q5b, 04 marks)

- W25 (Q3b, 04 marks)

15. **Explain LDI, BREQ, CP, STS, PUSH, ADIW, OUT instructions with examples.**
    - S25 (Q2c, 07 marks)
16. **Explain ROL, NEG, LDI, OUT, SBI, SBR, SWAP instructions.**
    - W25 (Q3c OR, 07 marks)

Unit 3: AVR Assembly and C Programming

Topics: Assembler directives, I/O programming, time delays, BCD/ASCII conversion, lookup tables, macros, C vs assembly, simple C programs.

Repeated Questions:

1. **Write a program to find number of 1s/0s in a byte.**
   - Appeared in:
     - S25 (Q3b, 04 marks)
     - W25 (Q3a, 03 marks)
     - S23 (Q3c, 07 marks)
2. **Write program to read from port, compare, set/reset another pin.**
   - Appeared in:
     - S24 (Q4a, 03 marks) – PORTC, compare 0x80
     - W24 (Q4a, 03 marks) – PORTA, compare 0x7F
3. **Write program to toggle port bits at regular intervals using Timer0 CTC mode.**
   - Appeared in:
     - S24 (Q4c, 07 marks) – 100 µs, XTAL=8MHz
     - W24 (Q3c, 07 marks) – 200 µs, XTAL=8MHz

Other Important Questions:

1. **Write AVR C program to send 00 to FF on Port B.**
   - S25 (Q3a, 03 marks)
2. **Write ALP to convert hex to decimal and store digits.**
   - S25 (Q2c OR, 07 marks)
3. **Write ALP to perform 15/2, store quotient and remainder.**
   - S25 (Q5b, 04 marks)
4. **Write program to load 0x55 in PORTB and complement 100 times.**
   - W25 (Q3c, 07 marks)
5. **Write program to generate square wave using Timer0/Timer2.**
   - W25 (Q4c, 07 marks) – Timer0, 3kHz
   - W25 (Q4c OR, 07 marks) – Timer2, 50% duty
6. **Write C program to toggle bit 4 of PORTC without disturbing others.**
   - S23 (Q4b OR, 04 marks)
7. **Write program to rotate stepper motor in half-step mode.**
   - S24 (Q4b, 04 marks)
8. **Write program to control servo motor using PWM.**
   - S24 (Q4b OR, 04 marks)
9. **Write program to read switch and send status to LED.**
   - S25 (Q4b, 04 marks)
10. **Write program for look-up table to send message to port.**
    - W24 (Q4c, 07 marks)
    - W23 (Q4c, 07 marks)
11. **Write program for ASCII conversion from packed BCD.**
    - S23 (Q2c OR, 07 marks)
12. **Explain pros and cons of C vs assembly.**
    - S23 (Q3b OR, 04 marks)
    - W25 (Q3b OR, 04 marks)
13. **Explain assembler directives with examples.**
    - W22 (Q3b, 04 marks)

Unit 4: AVR On-Chip Peripherals and Programming

Topics: GPIO, Timers, Interrupts, Serial Communication (SPI, I2C, UART), peripheral programming in Assembly/C.

Repeated Questions:

1. **Explain steps to enable/configure external interrupts in AVR.**
   - Appeared in:
     - S24 (Q3a, 03 marks)
     - S22 (Q4c, 07 marks)
     - W22 (Q4c, 07 marks)
2. **Explain Timer0 programming in normal/CTC mode.**
   - Appeared in:
     - S25 (Q4c, 07 marks) – Normal mode steps
     - S23 (Q4c OR, 07 marks) – Normal mode steps
     - W24 (Q3c, 07 marks) – CTC mode
3. **Explain UART configuration steps for TX/RX.**
   - Appeared in:
     - S25 (Q4c OR, 07 marks)
     - S24 (Q4c OR, 07 marks)

Other Important Questions:

1. **What is the need of RTC?**
   - S25 (Q4a, 03 marks)
2. **Explain fast PWM mode with diagram.**
   - S25 (Q4a OR, 03 marks)
3. **Find content of register after given instructions (LDI, SWAP, EOR, etc.).**
   - S25 (Q4b OR, 04 marks)
4. **Explain ADC control register ADCSRA.**
   - S24 (Q4a OR, 03 marks)
   - W24 (Q5a, 03 marks)
5. **Explain SPSR register in SPI.**
   - S25 (Q5a OR, 03 marks)
6. **Explain TCCR0 register for Timer0.**
   - W25 (Q4a, 03 marks)
   - W24 (Q5b, 07 marks)
7. **Explain TIMSK register for timer interrupts.**
   - S22 (Q4b OR, 04 marks)
   - W23 (Q5b OR, 04 marks)
8. **Explain UBRR register for baud rate setting.**
   - W22 (Q5a, 03 marks)
9. **Write program to toggle pin on external interrupt.**
   - S22 (Q4c, 07 marks)
   - W22 (Q4c, 07 marks)
10. **Write program to generate square wave of given frequency using Timer0.**
    - S22 (Q4c OR, 07 marks) – 16kHz, 50% duty
    - W22 (Q4c OR, 07 marks) – 16kHz, 50% duty
11. **Explain SPI signals and interfacing.**
    - S22 (Q5b, 04 marks)
    - W22 (Q5a, 03 marks)
12. **Compare SPI and I2C protocols.**
    - S22 (Q5a, 03 marks)
    - W24 (Q4b, 04 marks)
    - W22 (Q5b, 04 marks)
13. **Explain I2C addressing modes.**
    - S24 (Q5a, 03 marks)

14. **Explain brown-out detector and fuse bits.**
    - W22 (Q4a, 03 marks)
    - W22 (Q4b, 04 marks)
15. **Explain interrupt vs polling method.**
    - W24 (Q5a, 03 marks)
    - W23 (Q5a, 03 marks)
16. **Explain steps for ADC programming using polling.**
    - S25 (Q5c OR, 07 marks)
    - S23 (Q5c, 07 marks)
17. **List serial interrupts in AVR and write program to receive and display data.**
    - W25 (Q5c, 07 marks)
18. **Explain steps for SPI multi-byte burst mode.**
    - W25 (Q5b OR, 04 marks)

Unit 5: Device Interfacing and Programming

Topics: LCD, GLCD, keyboard, ADC/DAC, sensors, relays, stepper/servo motors, PWM, DC motor control, RTC, etc.

Repeated Questions:

1. **Draw and explain interfacing of LCD with AVR (8-bit/16x2).**
   - Appeared in:
     - S25 (Q5a, 03 marks) – 8-bit data
     - S22 (Q5c, 07 marks) – 16x2 LCD
     - W25 (Q5c OR, 07 marks)
     - W24 (Q4c, 07 marks)
     - W22 (Q5c, 07 marks)
2. **Explain stepper motor interfacing and program for rotation.**
   - Appeared in:
     - S23 (Q5a OR, 03 marks)
     - W25 (Q5a, 03 marks)
     - W23 (Q5c, 07 marks)
3. **Explain PWM and DC motor control with AVR.**
   - Appeared in:
     - W24 (Q5c, 07 marks)
     - S22 (Q5b OR, 04 marks) – DC motor control

Other Important Questions:

1. **Write program to display message on LCD ("HEALTH IS WEALTH", etc.).**
   - S24 (Q5c, 07 marks)
   - W23 (Q4c OR, 07 marks)
   - W22 (Q5c, 07 marks) – "Azadi Ka Amrit Mahotsav"
2. **Interface common anode 7-segment display and display digit.**
   - S24 (Q4c OR, 07 marks) – with interrupts
   - S22 (Q5a, 03 marks) – display number 6
3. **Write program to control servo motor for 0°, 90°, 180°.**
   - W24 (Q5c, 07 marks)
4. **Write program for temperature monitoring using LM35.**
   - S24 (Q5c OR, 07 marks)
5. **Draw interfacing for push-button and relay; write toggle program.**
   - W24 (Q5b, 04 marks)
6. **Write program for proximity sensor and solenoid control.**
   - S24 (Q5b, 04 marks)
   - S22 (Q3c OR, 07 marks)
7. **Write program to read ADC and calculate digital output for given analog input.**
   - W22 (Q5b, 04 marks)
8. **Write program to transmit message serially at 9600 baud.**
   - W22 (Q5c, 07 marks)
9. **Write program to rotate stepper motor in unipolar mode with interrupt toggling direction.**
   - S22 (Q5c OR, 07 marks)
   - W23 (Q5c, 07 marks)
10. **Explain features of I2C protocol.**
    - S23 (Q5c OR, 07 marks)
11. **Explain ADC characteristics of ATmega32.**
    - W25 (Q5b, 04 marks)
12. **Write program to display count on 7-segment using external interrupts.**
    - S24 (Q4c OR, 07 marks)
13. **Explain RS and E pins in LCD interfacing.**
    - S24 (Q5c OR, 07 marks)

14. **Write program for speed control of DC motor using push-buttons.**
    - W24 (Q5c, 07 marks)
15. **Explain PWM in servo motor control.**
    - S24 (Q4b OR, 04 marks)
16. **Explain data transmission in SPI.**
    - S24 (Q5a, 03 marks)
17. **Explain UART baud rate calculation for 8MHz crystal.**
    - S24 (Q5b, 04 marks)
    - W24 (Q5b, 04 marks)
18. **Write program to rotate DC motor at full speed using L293D.**
    - S22 (Q5b, 04 marks)

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