Important Notes:

- This paper contains **FOUR** questions in **THREE** pages plus **ONE** answer sheet.
- Attempt **ALL** questions. Total Marks: **60**
- Enhance your answers with proper sketches whenever applicable.

Q.1 [15 Marks, 3 each] Underline the false statement, explain why it is wrong and correct it:

1.

- An 8-bit ALU can process only 1 byte of data at a time.
- Every AVR microcontroller has an interrupt controller.
- Arduino Uno has up to 20 MIPS Throughput.

Correction:

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2.

- To access a 1KB memory, data and address lines must be 8 data lines and 8 address lines.
- Storage bits in SRAM are made of Flip-flop.
- MOV instruction is used in register addressing mode.

Correction:

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3.

- ATmega328p has 23 digital I/O lines distributed in three ports B, C and D.
- Port C pins PC0 and PC1 can be used as analog outputs.
- Clearing all bits of DDRB makes all bits of port B as inputs.

Correction:

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4.

- In TTL logic level, logic LOW is represented by 0V and logic HIGH is represented by 5V.
- Light emitting diodes are considered TTL compatible devices.
- PC serial port is considered as TTL compatible device.

Correction:

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5.

- UART is the only ATmega328p serial interface that have an error checking technique.
- I2C technique uses only 2 lines to have full duplex data transmission hence called TWI.
- SPI is a single master multi slave protocol that uses hardware to select slaves.

Correction:

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Q.2 [15 Marks] Explain the purpose of the following:

a) Arduino function **Serial.begin( )**.
b) ADMUX register.
c) T bit of status register.

Q.3 [15 Marks] Write ATmega328 assembly instruction(s) for the following tasks:

a) Generating 25% duty PWM signal on pin PD3.
b) Configure ADC0 as analog input with internal reference voltage.
c) Add contents of R2 & R3 registers and store the result directly in forth register of SRAM.

Q.4 [15 Marks] For **I2C** serial communication protocol shown in figure (1), answer the following:

a) In figure (1.a), what is the value of **N** of last slave? Elaborate your answer.
b) Which slave the master is communicating with according to timing diagram in figure (1.b)?
c) Redraw the timing diagram to represent the master reading from EEPROM?

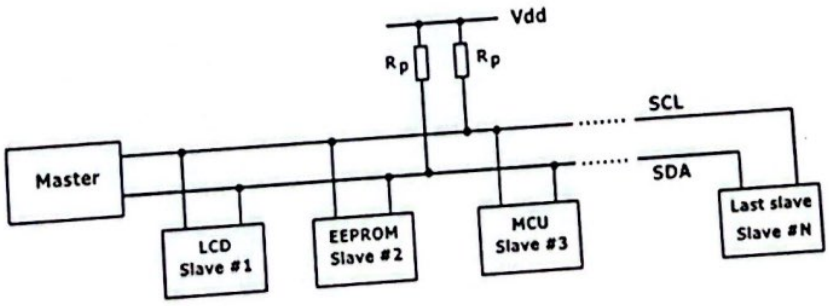

Fig. (1-a)

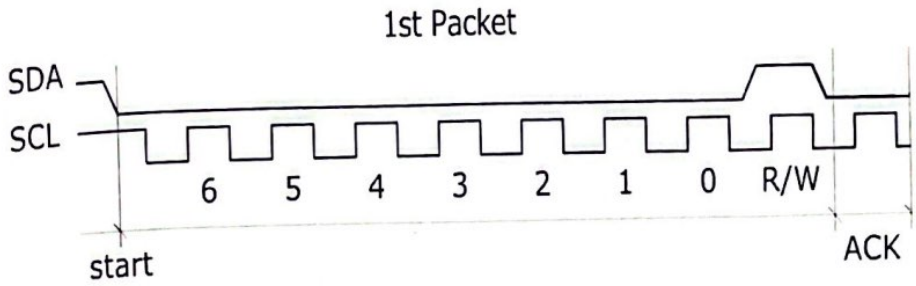

Fig. (1-b)

END OF QUESTIONS
Good luck to all of you!