Lab 1: Samuel Kosik

Link to your `Digital-electronics-2` GitHub repository:

GitHub Link

Blink example

1. What is the meaning of the following binary operators in C?
   - `|` = OR, sum
   - `&` = AND, product
   - `^` = XOR
   - `~` = NOT, flipping bits
   - `<<` = LEFT Shift
   - `>>` = RIGHT Shift

2. Complete truth table with operators: `|`, `&`, `^`, `~`

b	a	b or a	b and a	b xor a	not b
0	0	0	0	1	1
0	1	1	0	0	1
1	0	1	0	0	0

b	a	b or a	b and a	b xor a	not b
1	1	0	1	1	0

Morse code

1. Listing of C code with syntax highlighting which repeats one "dot" and one "comma" on a LED:

```c
#define LED_GREEN   PB5 // AVR pin where green LED is connected
#define LINE_DELAY  500 // LINE
#define SHORT_DELAY 150 // VERY SHORT DELAY (in ONE letter)
#define DOT_DELAY   250 // DOT
#define LONG_DELAY  800 // NEW Letter
#ifndef F_CPU           // Preprocessor directive allows for conditional
                        // compilation. The #ifndef means "if not defined".
# define F_CPU 16000000 // CPU frequency in Hz required for delay
#endif                  // The #ifndef directive must be closed by #endif

/* Includes ----------------------------------------------------------*/
/* Include another C language file into the current file at the location
 * of the #include statement prior to compiling the source code.
 */
#include <util/delay.h> // Functions for busy-wait delay loops
#include <avr/io.h>     // AVR device-specific IO definitions

/* Function definitions ----------------------------------------------*/
/**********************************************************************
 * Function: Main function where the program execution begins
 * Purpose:  Toggle one LED and use delay library.
 * Returns:  none
 **********************************************************************/
int main(void)      //funkcia
{
    // Set pin as output in Data Direction Register
    // DDRB = DDRB or 0010 0000
    DDRB = DDRB | (1<<LED_GREEN);

    // Set pin LOW in Data Register (LED off)
    // PORTB = PORTB and 1101 1111
    PORTB = PORTB & ~(1<<LED_GREEN);                // << je bit shift

    // Infinite loop
    while (1)
    {

         //WORD "MORSE CODE":

         _delay_ms(LONG_DELAY);
         _delay_ms(LONG_DELAY);

        //M --
```

```
PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
_delay_ms(LINE_DELAY);
PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
_delay_ms(SHORT_DELAY);
PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
_delay_ms(LINE_DELAY);
PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
_delay_ms(LONG_DELAY);

//O ---
PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
_delay_ms(LINE_DELAY);
PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
_delay_ms(SHORT_DELAY);
PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
_delay_ms(LINE_DELAY);
PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
_delay_ms(SHORT_DELAY);
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PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
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//R .-.
PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
_delay_ms(DOT_DELAY);
PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
_delay_ms(SHORT_DELAY);
PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
_delay_ms(LINE_DELAY);
PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
_delay_ms(SHORT_DELAY);
PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
_delay_ms(DOT_DELAY);
PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
_delay_ms(LONG_DELAY);

//S ---
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PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
_delay_ms(SHORT_DELAY);
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PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
_delay_ms(SHORT_DELAY);
PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
_delay_ms(DOT_DELAY);
PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
_delay_ms(LONG_DELAY);

//E .
PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
_delay_ms(DOT_DELAY);
PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
```

```
		_delay_ms(LONG_DELAY);

		//
		//C -.-.
		PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
		_delay_ms(LINE_DELAY);
		PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
		_delay_ms(SHORT_DELAY);
		PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
		_delay_ms(DOT_DELAY);
		PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
		_delay_ms(SHORT_DELAY);
		PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
		_delay_ms(LINE_DELAY);
		PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
		_delay_ms(SHORT_DELAY);
		PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
		_delay_ms(DOT_DELAY);
		PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
		_delay_ms(LONG_DELAY);

		//O ---
		PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
		_delay_ms(LINE_DELAY);
		PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
		_delay_ms(SHORT_DELAY);
		PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
		_delay_ms(LINE_DELAY);
		PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
		_delay_ms(SHORT_DELAY);
		PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
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		//D -..
		PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
		_delay_ms(LINE_DELAY);
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		_delay_ms(SHORT_DELAY);
		PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
		_delay_ms(DOT_DELAY);
		PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
		_delay_ms(SHORT_DELAY);
		PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
		_delay_ms(DOT_DELAY);
		PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
		_delay_ms(LONG_DELAY);

		//E .
		PORTB = PORTB ^ (1<<LED_GREEN);     //LED ON
		_delay_ms(DOT_DELAY);
		PORTB = PORTB & ~(1<<LED_GREEN);    //LED OFF
		_delay_ms(LONG_DELAY);
```
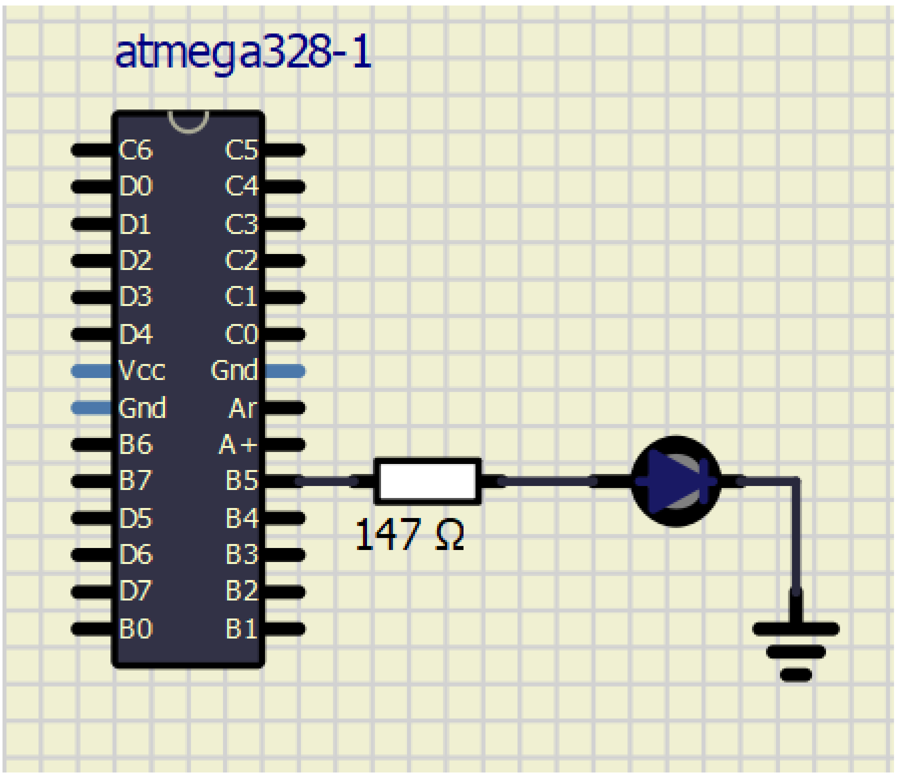

```
    }

    // Will never reach this
    return 0;
}
```

2. Scheme of Morse code application, i.e. connection of AVR device, LED, resistor, and supply voltage. The image can be drawn on a computer or by hand. Always name all components and their values!



atmega328-1
C6
D0
D1
D2
D3
D4
Vcc
Gnd
B6
B7
D5
D6
D7
B0
C5
C4
C3
C2
C1
C0
Gnd
Ar
A+
B5
B4
B3
B2
B1
147 Ω