

Name Theodore Yin Start Time _____ End Time _____

ME430 - Mechatronics

Examination III

Summer 2022

Problem	Score
1	/ 14
2	/ 12
3	/ 6
4	/ 14
Tinkercad	/ 54
Total	/100

For the written portion of the exam, you may use only:

- Three sheets of paper notes. Front and back of three 8.5" by 11" papers (6 sides total), typed or handwritten (any font size is fine). The notes page must be made by you not someone else.
- A calculator. Maple, Excel, or Chrome **may** be used as a calculator.
- The ATmega328P and ATmega2560 datasheets as PDFs on your computer. Note: other computer usage is NOT allowed.

In addition to those materials, for the computer part of the exam, you may also use:

- Your computer.
- Any paper notes (such as notes on the videos), so long as those notes were written by you or provided as course materials.
- Any electronic notes or code residing on your local (C:) hard drive, so long as those notes/code were written by you or your lab partner.
- The course website, Moodle, and Tinkercad. These are the only approved websites allowed during the exam.

Anything not specifically allowed is prohibited. In particular, you may not use notes or code written by someone outside your lab group.

Problem 1 – Coding mistakes

Below you will find a few coding snippets. Some of these code snippets have syntax errors, some of them have semantic errors (they don't do what the comment says), and some are correct. For each snippet either write what the correct code should be or mark that it is correct. Note, you ARE allowed to use the datasheets from your computer.

Code	Fixed Solution
// Enable INT5 interrupt on Mega EIMSK = _BV(INT5);	EIMSK = _BV(INT5);
// INT1 FALLING edge on the Mega EICRB &= ~_BV(ISC11); EICRB = _BV(ISC10);	EICRB = _BV(ISC11); EICRB &= ~_BV(ISC10);
// Enable Timer4 Compare A interrupts TIMSK4 = OCIE4A;	TIMSK4 = _BV(OCIE4A);
// Setup <u>Uno</u> pin 11 pushbutton #define DDR_PUSH DDRD #define PORT_PUSH PORTD #define BIT_PUSH 11 #define BIT_PUSH 4 void setup() { DDR_PUSH &= ~_BV(BIT_PUSH); PORT_PUSH = _BV(BIT_PUSH); }	#define DDR_PUSH DDRD #define PORT_PUSH PORTD #define BIT_PUSH 11 void setup() { DDR_PUSH &= ~_BV(BIT_PUSH); PORT_PUSH = _BV(BIT_PUSH); }
// Timer 2 Output Compare A ISR ISR(TIMER2_COMPA) {}	ISR(TIMER2_COMPA_vect) {}
// Set Timer 2 prescaler to 256 TCCR2B = _BV(CS22); TCCR2B &= ~_BV(CS21); TCCR2B = _BV(CS20);	TCCR2B = _BV(CS22); TCCR2B &= ~_BV(CS21); TCCR2B &= ~_BV(CS20);
// Set <u>Uno</u> pins 6 and 7 as outputs, pins 0-5 as inputs w/o using bits. DDRD = 0xC0;	This is correct

Problem 2 – SFR purpose

Name the register and the bits that are involved in each task. The first one has been done as an example.

	Register	Bit names involved
Selecting the ADC reference voltage	ADMUX	REFS1 REFS0
Specifically enabling Timer 2 Compare A Match interrupt	TIMSK2	OCIE2A
Setting INT3 as rising edge on a Mega	EICRA	ISC31 ISC30
Setting Port D as outputs	DDRD	NA (we just use numbers not special bit name)
Enabling pull up resistors on Port C	PORTC	NA (we just use numbers not special bit name)
Reading digital input states on Port B	PINB	NA (we just use numbers not special bit name)
Setting the Timer 3 prescaler on a Mega	TCCR3B	CS32 CS31 CS30
Starting the ADC conversion	ADCSRA	ADSC
Setting the Timer1 Compare B Match value	TIMSK1	NA (writes to the entire register)

Problem 3 – Timer prescaler

Write the lines of code necessary to set the ATmega328's Timer 2 prescaler to 32.

```
// Prescaler : 32   Timer2   011

TCCR2B |= ~_BV(CS22);
TCCR2B |= _BV(CS21);
TCCR2B |= _BV(CS20);
```

Use a `_BV` syntax style that only sets / clears 1 bit at a time using bit names.

Problem 4 – External Interrupt setup

Write the lines of code necessary to set up ATmega2560's INT3 for falling edge interrupts. Add all the code needed to configure and enable the External Interrupt (including enabling global interrupts) AND setup the Digital I/O to make that pin into an input with a pull-up resistor. Use the style of Digital I/O setup that does NOT use `#defines`. Just do things like.. `DDRB = _BV(6)`; Also don't show the ISR, just write the External Interrupt **setup** code as requested above.

```
DDRD |= _BV(3);
PORT |= _BV(3);

// setup interrupt)
EIMSK |= _BV(INT3);
EICRB |= _BV(ISC31);
EICRB |= _BV(ISC30);
sei();
```

Use a `_BV` syntax style that only sets / clears 1 bit at a time using bit names.

When you finish this problem you have finished the paper part of this exam. You can look over your work, but once you decide to start the computer part of the exam, you must turn these pages over and not alter them. It is as if you are **handing them in** before you are allowed to start the computer part (but you'll actually do the "handing in" later since it takes a while to generate the PDF and upload it to Gradescope).