

XMUT202 Digital Electronics

Tutorial 7: Interrupts

A. Interrupts in 8051

1. Why interrupt is important in the 8051 microcontrollers? [2 marks]
2. Describe differences between polling vs. interrupt programming in the 8051 microcontrollers by completing the blanks given in the following table. [6 marks]

	Polling	Interrupt
Program execution		
Processing requirement		
Applications		

3. Name the five interrupt sources of 8051? [5 marks]
4. Using flowchart diagram, describe the mechanism of interrupt in the 8051 microcontrollers. [4 marks]
5. What is the name of a piece of program used to handle the interrupt in the 8051 microcontrollers? [2 marks]
6. How an 8051 microcontrollers timer Interrupt request can be cleared? [2 marks]
7. When an 8051 microcontrollers timer interrupt service request will be set? [2 marks]
8. Describe the step-by-step procedure on how the 8051 microcontrollers can be configured to service a timer interrupt request. [6 marks]
9. List the order of the interrupts in the 8051 microcontrollers based on their priorities. [4.5 marks]

B. Interrupts Programming

1. Write an assembly language program in the 8051 microcontroller that will toggle LED when new interrupt arrives. You are advised to use Interrupt 1 and connect the LED in port 1, pin 3. Configure the interrupt so it is falling edge triggered and let the rest of the program as an infinite idle loop. [12 marks]

Appendix -Timer, Counter, and Interrupt Instruction Sets

TMOD (Timer Mode):

TMOD.7	TMOD.6	TMOD.5	TMOD.4	TMOD.3	TMOD.2	TMOD.1	TMOD.0
GATE	C/T	M1	M0	GATE	C/T	M1	M0

Descriptions:

GATE:

- 1: Timer only counts when TR1 bit is high and there is an external interrupt at INT0.

C/T: Counter or Timer.

- 0: Timer 1 serves as XTAL-driven delay generator (timer).
- 1: Timer 1 counts external events.

M1: Timer 1 Mode bit 1.

M0: Timer 1 Mode bit 0.

GATE:

- 1: Timer only counts when TR0 bit is high and there is an external interrupt at INT1.

C/T: Counter or Timer.

- 0: Timer 0 serves as XTAL-driven delay generator (timer)
- 1: Timer 0 counts external events.

M1: Timer 0 Mode bit 1.

M0: Timer 0 Mode bit 0.

Timer mode configurations:

Timer Mode	M1	M0
0	0	0
1	0	1
2	1	0
3	1	1

TCON (Timer Control):

TCON.7	TCON.6	TCON.5	TCON.4	TCON.3	TCON.2	TCON.1	TCON.0
TF1	TR1	TF0	TR0	IE1	IT1	IE0	IT0

Descriptions:

TF1: Timer 1 Overflow Flag

- 1: when overflow occurs. Must be cleared in software; auto. cleared when leaving ISR

TR1: Timer 1 run bit (software controlled).

- 1: Start timer.
- 0: Stop timer.

TF0: Timer 0 Overflow Flag

- 1: When overflow occurs.
- 0: Must be cleared in software; auto. cleared when leaving ISR.

TR0: Timer 0 run bit (software controlled).

- 1: Start timer.
- 0: Stop timer.

IE1: External interrupt 1 edge flag.

- 1: External interrupt occurred.
- 0: External interrupt processed (hardware controlled; no need to edit this).

IT1: Interrupt 1 trigger type select bit.

- 1: Interrupt occurs on the falling edge of INT1.
- 0: Interrupt occurs on INT1's level being LOW.

IE0: External interrupt 0 edge flag.

- 1: External interrupt occurred.
- 0: External interrupt processed (hardware controlled; no need to edit this).

IT0: Interrupt 0 trigger type select bit.

- 1: Interrupt occurs on the falling edge of INT1.
- 0: Interrupt occurs on INT1's level being LOW.

IEN (Interrupt Enable):

IEN0.7	IEN0.6	IEN0.5	IEN0.4	IEN0.3	IEN0.2	IEN0.1	IEN0.0
EA	EC PCA	ET2	ES	ET1	EX1	ET0	EX0

Descriptions:

EA: Enable all interrupts.

- 1: interrupts may be enabled individually.
- 0: All interrupts are disabled.

EC PCA: Interrupt enable.

- 1: PCA interrupt is enabled. A C8051F020 specific interrupt.

ET2: Timer 2 overflow interrupt enable.

- 1: Timer 2 interrupt is enabled.

ES: Serial port interrupt enable bit.

- 1: Serial port interrupt is enabled.

ET1: Timer 1 overflow interrupt enable.

- 1: Timer 1 interrupt is enabled.

EX1: External interrupt 1 enable bit.

- 1: External Interrupt 1 is enabled.

ET0: Timer 0 overflow interrupt enable.

- 1: Timer 0 interrupt is enabled.

EX0: External interrupt 0 enable bit.

- 1: External Interrupt 0 is enabled.