

University :	Menoufia	Date :	30/12/2019
Faculty :	Electronic Engineering	Time :	3 Hours
Department :	Industrial Electronics	No. of Questions :	Part A&B
Academic level :	4 th Year	Full Marks :	Part A 50 Marks Part B 50 Marks
Course Name :	Real Time Control Systems	Exam :	Final Exam
Course Code :		Examiners :	Dr. El Bardini Dr.Emmad
Academic Year :	2019-2020		



Part A : 3 Pages

Q1

(24 Marks)

Retype the table, including the only sentences that are underlined with matching sentences that followed in each row

A batch process is :

- A centralized system.
- A process in which a sequence of operation is carried out.
- Laboratory process.
- A test process .

One future of real time programming

- Not support analog interface
- Cannot access external hardware
- Not Support interrupt
- Can access external hardware.

The microcontroller based control system is

- Not real time system
- Real time system type 1
- Real time system type 2
- Real time interactive system

Part B

Q1. Choose the correct answer

(20 Marks)

- 1- A valve is opened or closed can be interfaced with Microcontroller using ...
a- Analog interface b- Digital interface c- Pulse interface
- 2- In real time control system:
a- The shorter the time constant of the process the slower the required sampling time.
b- The shorter the time constant of the process a medium sampling rate is required.
c- The shorter the time constant of the process the faster the required sampling time.
- 3- For data transfer techniques, it is better to use ...
a- polling b- Interrupt c- averaging
- 4- Which communication interface is preferred when speed rather than space is the main objective?
a- Parallel interface b- Serial interface c- Bus interface
- 5- Which communication interface that uses several data lines (pins) to transfer more than one bit at a time?
a- Serial interface b- USART c- Parallel interface
- 6- The data is saved and transmitted block by block, this is done in...
a- Synchronous mode b- Asynchronous mode c- polling mode
- 7- All nodes are equal i.e. any node can begin to transmit if the medium is free....
a- Master-Slave systems b- Peer to Peer systems c- Half duplex
- 8- For ADC, when the sampling rate is increased...
a- Improves the accuracy in measuring the amplitude of the analog signal.
b- Signals with small amplitudes can be detected.
c- The maximum frequencies that can be measured increases.
- 9- If 10 bits are used to quantize a sampled signal in ADC, what is the number of available quantized levels?
a- 256 level b- 1024 level c- 10 level
- 10- For the previous problem; if the analog input range is (0:5 v), what is the minimum change in the input voltage that ADC can sense?
a- 4.89 mv b- 39 mv c- 19.5 mv
- 11- For ADC, if the Insulation between input channels is Shared point. It means
a- There is only one ADC converter internally
b- The conversion of channels is sequentially
c- The time of conversion is based on the number of channels
d- All of the above
- 12- If a system have four sensors and multiple time constants. If the smallest $T_c = 10$ ms and the largest $T_c = 40$ ms, which conversion time of the ADC in practical is preferred?
a- 80 ms b- 40 ms c- 10 ms d- 2 ms
- 13- Output module provides an interfacing between
a- Output modules and field devices. b- CPU and Field devices. c- Input modules and the CPU.
- 14- To avoid the occurrence of aliasing effect, the sampling frequency must be
a- Larger than twice of minimum input signal frequency
b- Larger than twice of maximum input signal frequency
c- Lower than twice of maximum input signal frequency

15- How to overcome the limitation of binary-weighted resistor type DAC?

- a- Multiplying DACs b- Using monolithic DAC c- Using R-2R ladder type DAC.

16- The task of time sharing, in which large number of data signals are sent through cables or buses, is performed by...

- a- sensors or transducers b- central processing unit (CPU) c- multiplexer

17- The capacity of data acquisition system (DAQ) can be specified in terms of...

- a- number of control elements b- number of channels c- number of interfaces

18- The temperature control system which maintains the temperature of a room at 30 °C when it is set is an example of...

- a. Open loop system b. Closed loop system c. Both a. and b. d. None of the above

19- For SPI protocol; MOSI means.....

- a- Line for the slave to send data to the master
b- Line for master to send data to the slave
c- Line for the master to select which slave to send data

20- Which instruction set architecture is used in Raspberry Pi?

- a- X86 b- MSP c- AVR d- ARM

Q2. Solve the following questions

(30 Marks)

1- A boiler has a heater, an analog temperature sensor and one alarm. The system is controlled on line using a computer via Arduino interface module, in which the sequence of operation is as follows:

- 1- Turn heater on
- 2- Wait 10 minutes
- 3- DDC begin using PD controller (the desired temperature (T_d) is supplied from keyboard and the sampling period is $T_s = 0.5$ sec, $K_p = 1.2$, $K_d = 0.5$).
- 4- If the alarm is ON, Turn heater OFF.
- 5- Repeat.

1- What are input, output, control and communication tasks?

2- Draw a flowchart and write the real time program to control in the system.

3- What are the software and hardware requirements to realize a real-time controller for this system?

Notes:

- a- The digital I/O addresses begins from 2 and the Analog input addresses begins from 14.
- b- Do not forget scale input and output signals in your program into suitable ranges.
- c- Do not forget limit the output control signal in the limit range [U_{min} , U_{max}]

2- If you have a DC motor and plan to use it in an application which requires soft starting and soft stopping operation. The motor is controlled by a computer via a Raspberry Pi as a DAQ card, in which:

- 1- The motor starting its operation gradually (accelerating from 0% to 100 % in one second)
- 2- The motor runs at a constant speed for 1-Minute.
- 3- The motor stopping its operation gradually (decelerating from 100% to 0 % in one second) using PWM.

Draw a flowchart and write the real time program to implement this operation.

End of Questions

Best Wishes

Pulse interfaces

- Contain counter.
- Contain decoder.
- Contain digital to analog converter
- Contain analog to digital converter

The important features of the computer CPU which determine the processing power in real time applications are :

- Information transfer rates.
- The controller type
- The time constant.
- Hard disk size

Ruggedized industrial PC offers benefits such as:

- Storing large data
- anti-vibration shock mountings
- Large size.
- Running word processing.

Reading a scaled $\sin(\omega t)$ signal from computer ports requires

- Analog interface
- Digital interface
- Pulse interface
- Digital and Pulse interface

One of the disadvantages of the PID controller in position form

- Needs more time of computation.
- Used only for stable system.
- Wind up problem.

Clock based system is one type of

- Sensor based system
- Not real time system
- Real time system

Interrupts are used when

- Storing the registers on the memory stack.
- Hardware failure.
- The system is slow

The assembly language command to input a byte is:

- IN AL,DX
- V=INP(AL)
- IN(AL)
- INP(AL,DX)

The Importance of Timing in Real Time Control System is

- The controller must be done within infinite period of time
- The controller must be done after a finite period of time
- The controller must be done within a finite period of time

Q2

(26 Marks)

A computer receives a measured temperature from a furnace in a scaled form such that the voltage is $V = 0.01 T + 0.001 T^2$ for the thermocouple, where T is in C^0 . The control signal is the output of a PI controller in which $k_p = 0.1$, $k_I = 0.01$, the desired temperature is $60 C^0$, and the sampling period is 0.1 sec. If the temperature is greater than $100 C^0$ stop the operation otherwise repeat

1-What are the input task, output task, control task, and the communication task?

2-Write a real time program to control this system. (Note: use DECLARE DYNAMIC LIBRARY "inpout32")