MICROCONTROLLER EXERCISE 2

QUESTION 1

REACTIVE SYSTEM: An embedded system is said to be reactive if it can continuously interact with the environment and external stimulus. This can be implemented as shown in this simple Do-while loop C program:

```
#include <stdio.h>

int main()

{

	int a=0;

	do

	{

		printf("Value of variable a is: %d\n", a);

		a++;

	}while (a<=3);

	return 0;

}
```

REAL-TIME SYSTEM: An embedded system is real-time if it can respond to a given event within a constrained time known as deadline. A typical example of a real time embedded system is the Cruise control system of a vehicle which constantly responds to the acceleration and deceleration readings it receives from its accelerator and brake sensors to control the vehicle movement.

DEADLINE: This is defined as the latest time which a real-time system must react to a stimulus to retain its functionality. We can ensure that a system does not miss its deadline by introducing a round-robin or queuing system of scheduling tasks or in a more complex situation, an RTOS (Real time Operating System) can be used. An RTOS utilizes the design patterns of scheduling and queuing, but it adds further functionality including task priority, interrupt handling, inter-task communications, file systems, multi-threading, and more. All this results in the most effective method for meeting and exceeding time-constraint goals. Examples of some RTOS are VxWorks, QNX, eCos, MbedOS, and FreeRTOS.

QUESTION 2

ATTRIBUTES OF DEPENDABILITY:

AVAILABILITY: This attribute of dependability explains the degree to which a system is in specified operable state at the start of a process, even if the process is called for randomly.

RELIABILITY: This is the ability of a system to always provide the required services as specified.

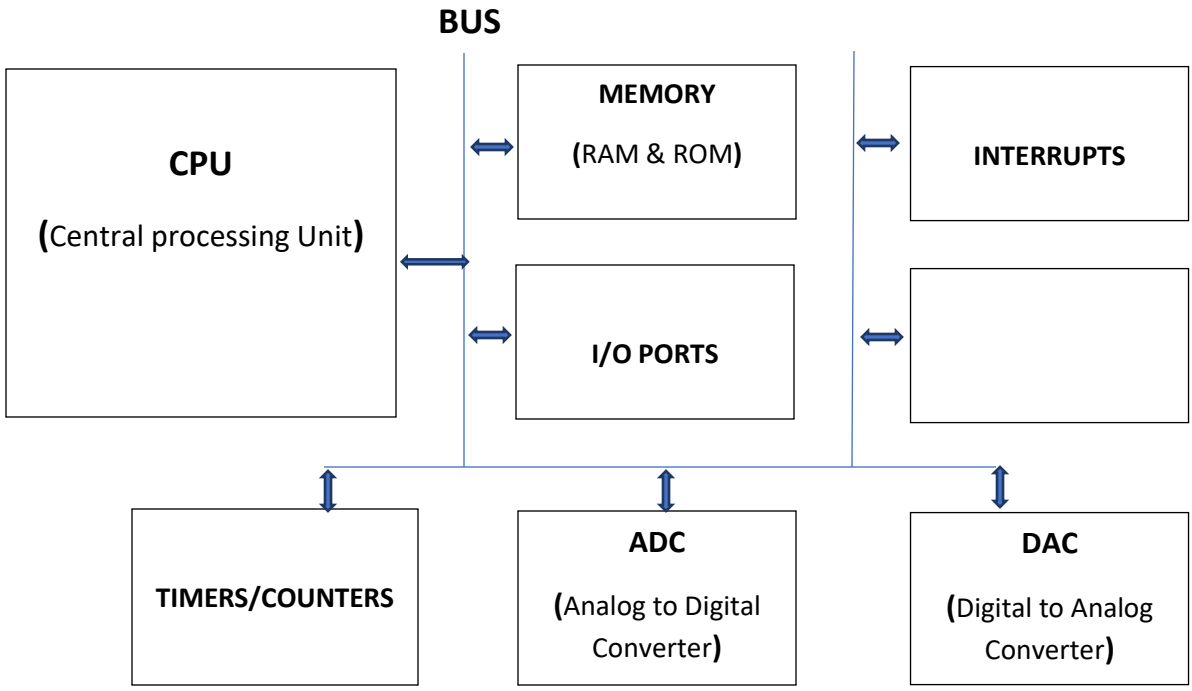
SAFETY: This attribute of dependability refers to the ability of a system to operate without catastrophic failure or consequences. This attribute is important as it is implemented in various systems like the vehicle cruise-control system and the Auto-pilot system of Aircrafts.

SECURITY: This refers to the attribute of dependability which ensures that a system is able to protect itself from accidental and unwanted intrusion. This attribute can be seen implemented in the central locking system of a car.

QUESTION 3

ELEMENTS OF A MICROCONTROLLER: A typical microcontroller comprises of the following elements;

- A Central Processing Unit (CPU)
- BUS
- Memory (RAM & ROM)
- Interrupts
- I/O Ports
- Timers/Counters
- Analog to Digital Converter (ADC)
- Digital to Analog Converter (DAC)



STM32F0 MICROCONTROLLER:

STMicroelectronics STM32 F0 Entry-level Arm Cortex-M0 MCUs offer rich connectivity with crystal-less USB 2.0 and a CAN bus interface, making them ideal for communication gateways, smart energy devices, and game terminals. The STM32F0 is well-suited for use in portable consumer applications such as smartphones, accessories, and media devices. This microcontroller has the following properties:

- Arm 32-bit Cortex-M0 CPU, frequency up to 48MHz
- CRC calculation unit
- Reset and power management
- Analog supply: $V_{DDA} = V_{DD}$ to 3.6V
- Power-on / Power down reset (POR/PDR)
- Low power modes include Sleep, Stop, Standby
- Clock management
    - 4MHz to 32MHz crystal oscillator
    - 32kHz oscillator for RTC with calibration
    - Internal 8MHz RC with x6 PLL option
    - Internal 40kHz RC oscillator
    - All mappable on external interrupt vectors
- 5-channel DMA controller
    - 0V to 3.6V conversion range
    - 2.4V to 3.6V separate analog supply
- Calendar RTC with alarm and periodic wakeup from Stop / Standby
    - Independent and system watchdog timers
    - SysTick timer
- Communication interfaces (1Mbit/s) with 20mA current sink
    - One supporting SMBus/PMBus
    - Up to two SPIs (18Mbit/s) with 4 to 16 programmable bit frames
- Serial wire debug (SWD).