There is a requirement to develop an advanced Digital Volt Meter (DVM) that employs an ARM Cortex M4 STM32F4 Discovery Board to digitise a voltage in a 0- 5V range using the on-board Analogue-to-Digital Converter (ADC). The voltage should be displayed on several peripherals as described:

LCD

* The digital voltage measurement should be displayed on the top line of the LCD display accurate to 3 decimal places.
* The bottom line of the LCD should display the voltage as an analogue representation, ie a line whose length is proportional to the voltage.

8 LEDS

* The LEDs should display the rounded percentage of the full scale output. Since there are 8 LEDs each one represents 12.5%. However, since we want the rounded percentage the LED on the LSB should be illuminated if the voltage is above 6.25% and the next LED should illuminated if the voltage is above 18.75% etc…. E.g 50% voltage = 4 LEDs lit, 75% brightness = 6 LED lit.
* The brightness of the most significant illuminated LED should represent the voltages between the ranges so that if the value is half way between the range then the LED should be 50% brightness. This can be achieved by using Pulse Width Modulation (PWM) ie. Turn the LED ON for 50% and OFF for 50% of the timel.

USART

* The digital voltage measurement, accurate to 3 decimal places, should also be displayed on a PC terminal emulator (Realterm) using the USART RS232 interface running at 19200 baud. The display should also represent the voltage as an analogue representation, ie a line whose length is proportional to the voltage.

SWITCHES

* Switch 1 should freeze (hold) the voltage display constant.
* Switch 2 should switch between AC and DC

When in AC mode the display should display True RMS voltage.

* Switch 3 should display the frequency of an AC signal
* Switch 4 should display the maximum and minimum voltage values.

DAC

The STM32F4 on-board Digital to Analogue Converter (DAC) should be used to generate a range of voltages to test the system functionality.

**You are required to create and submit electronically:**

1. Circuit diagrams (in Proteus or pdf) required to connect the above peripherals.

**20 Marks**

2. Flowcharts (pdf) to show the operation of the DVM with the peripherals described above. **30 Marks**

3. C code, (in Keil project), to initialise and utilise the peripherals and implement the desired functionality. The code should be fully commented to accurately describe functionality.**50 Marks**