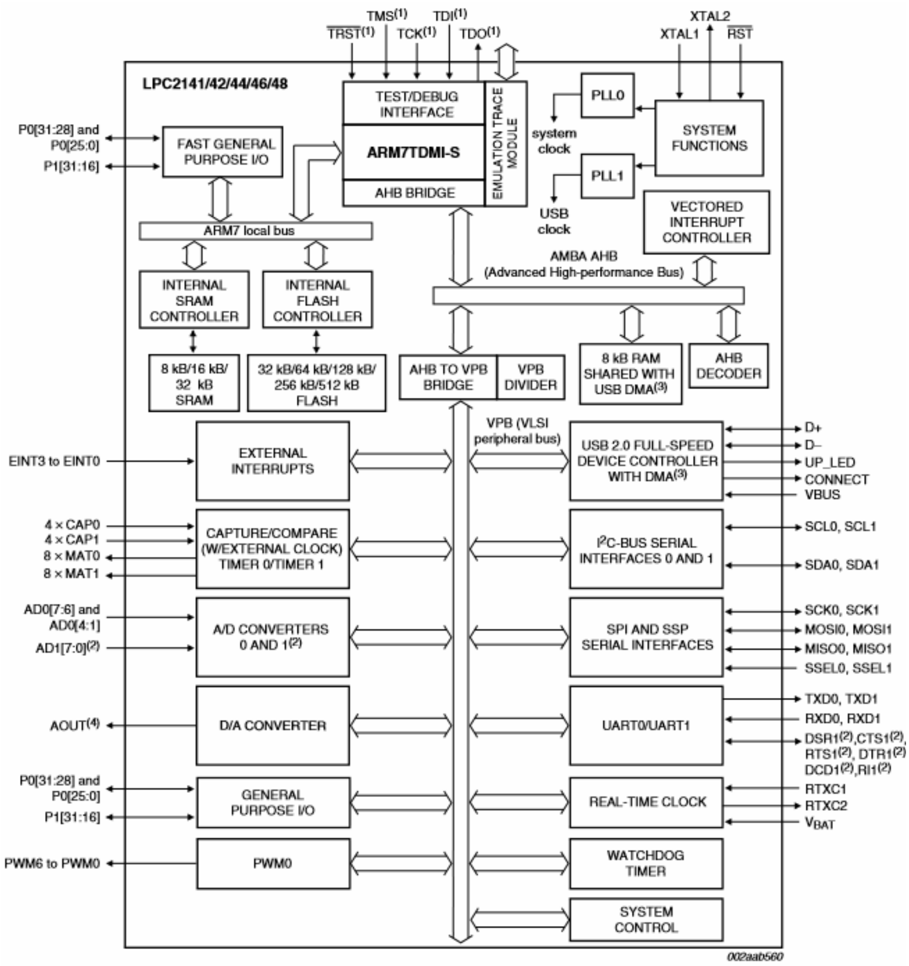
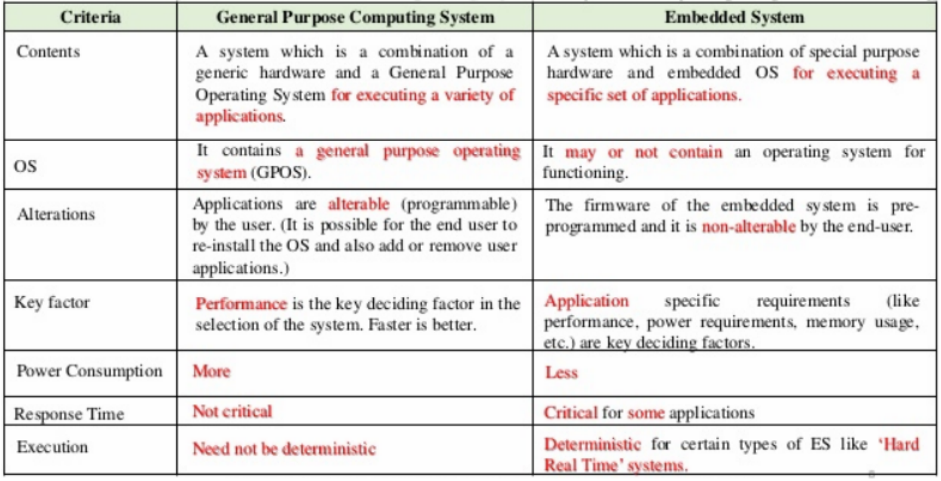
	R V College of Engineering Department of Computer Science and Engineering CIE - I: Scheme	
Course: (Code)	IOT & Embedded Computing (CS344AI)	Semester : 4th semester

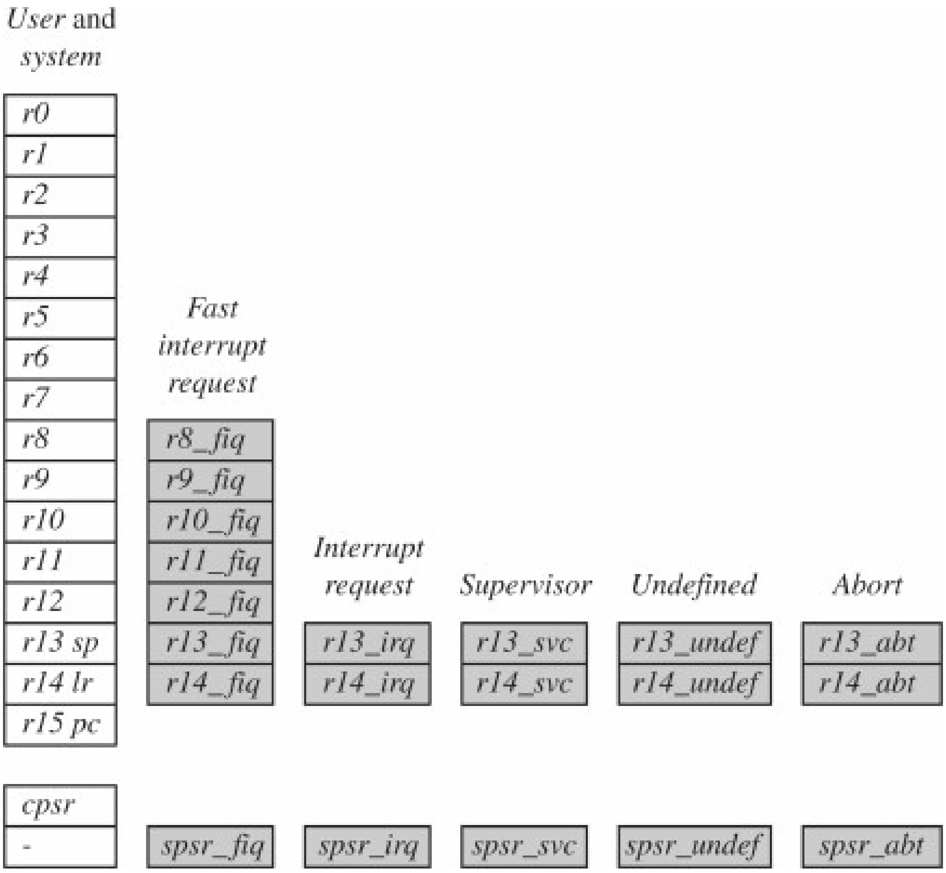
PART B

1	Block diagram – 4 marks Listing peripherals and corresponding Applications – 6 Marks 	10	L2	CO2
2	Each sub question carries 5 marks 1.	10	L3	CO2



Criteria	General Purpose Computing System	Embedded System
Contents	A system which is a combination of a generic hardware and a General Purpose Operating System for executing a variety of applications.	A system which is a combination of special purpose hardware and embedded OS for executing a specific set of applications.
OS	It contains a general purpose operating system (GPOS).	It may or not contain an operating system for functioning.
Alterations	Applications are alterable (programmable) by the user. (It is possible for the end user to re-install the OS and also add or remove user applications.)	The firmware of the embedded system is pre-programmed and it is non-alterable by the end-user.
Key factor	Performance is the key deciding factor in the selection of the system. Faster is better.	Application specific requirements (like performance, power requirements, memory usage, etc.) are key deciding factors.
Power Consumption	More	Less
Response Time	Not critical	Critical for some applications
Execution	Need not be deterministic	Deterministic for certain types of ES like 'Hard Real Time' systems.

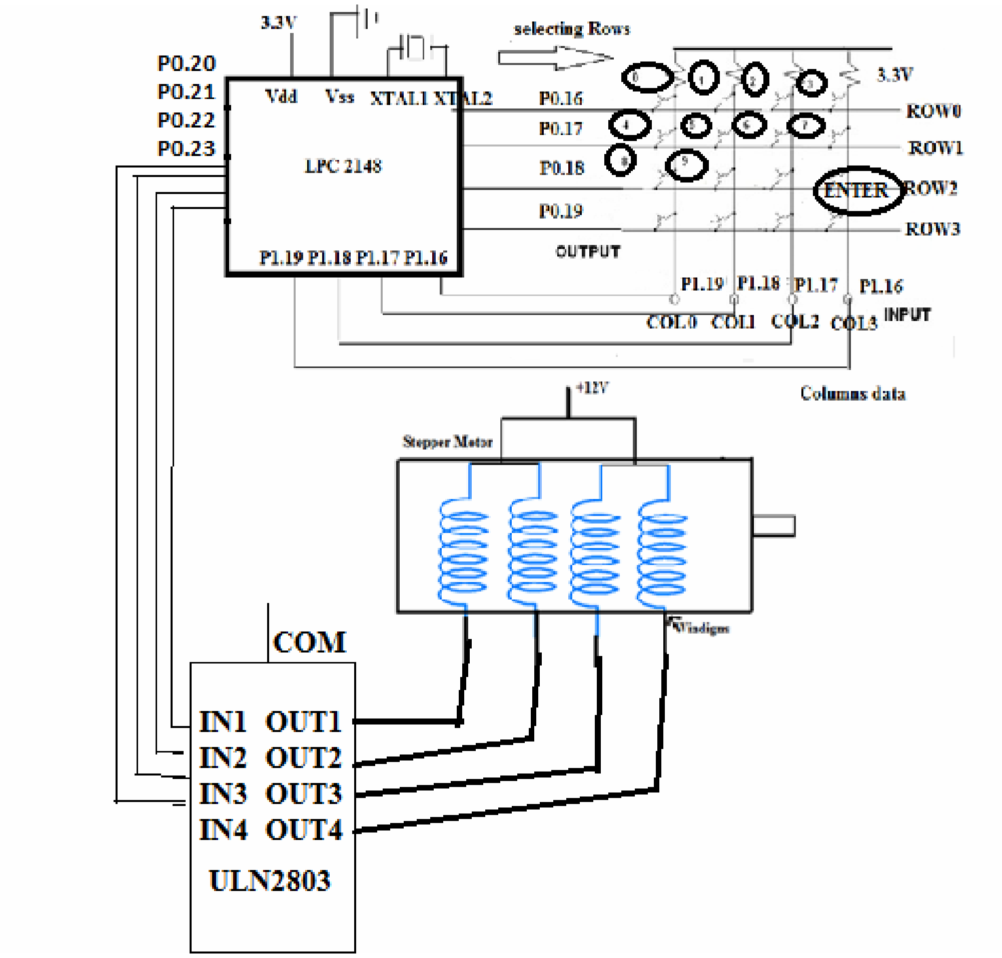
2. Explain the registers corresponding the ARM modes of operating



3	*Seven Segment Display Program:*
	//P0.19 Data pin of 1st shift register
	//P0.20 Clock pin of shift registers, make 1 to 0
	//P0.30 Strobe pin of shift registers: 1 to 0
	#include <lpc214x.h>
	#define LED_OFF (IO0SET = 1U << 31)
	#define LED_ON (IO0CLR = 1U << 31)
	#define PLOCK 0x00000400
	void delay_ms(unsigned int j);
	void SystemInit(void);
	unsigned char getAlphaCode(unsigned char alphachar);
		10	L3	CO3

```
void alphadisp7SEG(char *buf);
int main()
{
IO0DIR |= 1U << 31 | 1U << 19 | 1U << 20 | 1U << 30 ; // to set as o/ps
LED_ON; // make D7 Led on .. just indicate the program is running
while(1)
{
alphadisp7SEG("fire ");
delay_ms(500);
alphadisp7SEG("help ");
delay_ms(500);
}
}
unsigned char getAlphaCode(unsigned char alphachar)
{
switch (alphachar)
{
// dp g f e d c b a - common anode: 0 segment on, 1 segment off
case 'I': return 0xf9;
case 'O': return 0xc0;
case 'T': return 0x93;
case 'B':return ox80;
case 'O':return 0xc0;
case 'A': return 0xf7;
case 'R':return 0xf7;
case 'D':return 0xa1;
case ' ': return 0xff;
//simmilarly add for other digit/characters
default : break;
}
return 0xff;
}
void alphadisp7SEG(char *buf)
{
unsigned char i,j;
unsigned char seg7_data,temp=0;
for(i=0;i<5;i++) // because only 5 seven segment digits are present
{
seg7_data = getAlphaCode(*(buf+i));
// instead of this look up table can be used
// to shift the segment data(8bits)to the hardware (shift registers) using
Data,Clock,Strobe
for (j=0 ; j<8; j++)
{
//get one bit of data for serial sending
temp = seg7_data & 0x80; // shift data from Most significan bit (D7)
if(temp == 0x80)
IOSET0 |= 1 << 19; //IOSET0 | 0x00080000;
else
IOCLR0 |= 1 << 19; //IOCLR0 | 0x00080000;
//send one clock pulse
IOSET0 |= 1 << 20; //IOSET0 | 0x00100000;
delay_ms(1);
IOCLR0 |= 1 << 20; //IOCLR0 | 0x00100000;
seg7_data = seg7_data << 1; // get next bit into D7 position
}
}

// send the strobe signal
IOSET0 |= 1 << 30; //IOSET0 | 0x40000000;
delay_ms(1); //nop();
IOCLR0 |= 1 << 30; //IOCLR0 | 0x40000000;
return;
}
void delay_ms(unsigned int j)
{
unsigned int x,i;
for(i=0;i<j;i++)
{
for(x=0; x<10000; x++);
}
}
```

4 10 L4 CO3

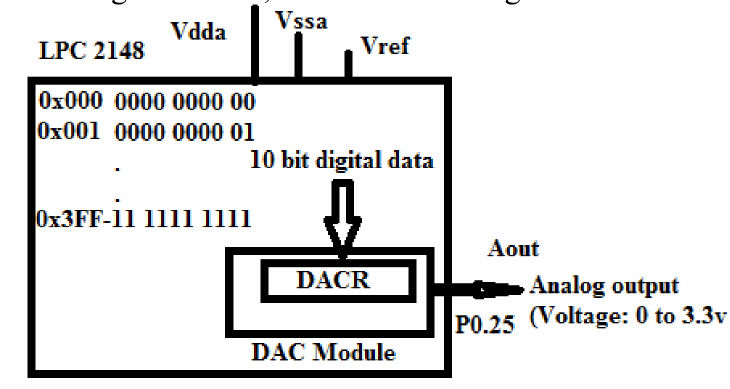


```
#include <lpc214x.h>
```

```
#include <string.h>

#define COL0 (IO1PIN & 1<<19)
#define COL1 (IO1PIN & 1<<18)
#define COL2 (IO1PIN & 1<<17)
#define COL3 (IO1PIN & 1<<16)

#define LED_ON (IO0CLR = 1U<<31)
#define LED_OFF (IO0SET = 1U<<31)
#define ENTER   10

void delay_ms(unsigned int);
char getKey(void);
void open(void);  // to open the door
void close(void); // to close the door


char ch,keys[5],password[5] = "0123";
unsigned char len = 0;

unsigned int i = 0;
int main ( )  {
        char ch;
        IO0DIR |=| 0x0f<<16 ;

        do
         {
             i = 0;
            // read the password
            while (1)
             {
                if ((ch = getKey()) == ENTER) break;
                keys[i++]=ch;
             }
            keys[i] ='\0';; // null character, to make it string
            if ( strcmp (keys, password) ==0 )
                {
                  open( ); // rotate clockwise for 90 degree, open the door

                    //Wait for a key 'b' to close the door
                 While ( ( ch = getKey ( ) ) != 'a')  { } ;
                    close( );// rotate anticlockwise for 90 degree, close the
        door

                }

         }while(1);

}


void delay_ms(unsigned int ms){
        unsigned int x, i;
        for(x = 0; x < ms; x++)
                for(i = 0; i < 10000; i++);
```

```
}

char getKey( ) {
unsigned char lookup_table[4][4]={ {'0', '1', '2','3'},
                                    {'4', '5', '6','7'},
                                    {'8', '9', ‘a’,10},
                                    {'c', 'd', 'e','f'}};
unsigned char rowsel=0,colsel=0;
while(1)
{
  //check for keypress in row0,make row0 '0',row1=row2=row3='1'
        rowsel=0;IO0SET = 0X000F0000;IO0CLR = 1 << 16;

        if(COL0==0){colsel=0;break;};if(COL1==0){colsel=1;break;};

        if(COL2==0){colsel=2;break;};if(COL3==0){colsel=3;break;};
  //check for keypress in other rows

        delay_ms(50); // debouncing delay
       // wait for a key release
        while(COL0==0 | COL1==0 | COL2==0 | COL3==0);
        delay_ms(50); // debouncing delay
        return lookup_table[rowsel][colsel];
}

void open ( ){

        for (int i = 0; i < 20; i++)
        {
                        IO0CLR  =  0X000F0000;  IO0SET  =  0X00080000;
        delay_ms(15);
                IO0CLR    =    0X000F0000;    IO0SET    =    0X00040000;
        delay_ms(15);
                IO0CLR    =    0X000F0000;    IO0SET    =    0X00020000;
        delay_ms(15);
                IO0CLR    =    0X000F0000;    IO0SET    =    0X00010000;
        delay_ms(15);
        }
                IO0CLR = 0x00ff0000;
}
void close ( ) {

        for (int i = 0; i < 20; i++)
        {
                        IO0CLR  =  0X000F0000;  IO0SET  =  0X00010000;
        delay_ms(15);
                IO0CLR    =    0X000F0000;    IO0SET    =    0X00020000;
        delay_ms(15);
                IO0CLR    =    0X000F0000;    IO0SET    =    0X00040000;
        delay_ms(15);
                IO0CLR    =    0X000F0000;    IO0SET    =    0X00080000;
        delay_ms(15);
        }
                IO0CLR = 0x00ff0000;
}
```

5	DAC Module of LPC 2148: LPC 2148, provides in-built 10-bit Digital to Analog Converter, as shown in the figure below.	10	L3	CO3



DAC module of LPC 2148 is a 10 bit Digital to Analog converter used to convert 10 bit Digital data to corresponding Analog voltage.

Digital I/P : **000 to 3FF (0 to 1023)**, corresponding Analog O/P : **0V to 3.3V**

Resolution = (3.3/1024) ≈ **3.2mili volts**

```
#include <lpc214x.h>
#include <stdio.h>
#define SW2 (IO0PIN & (1 << 14))
#define SW3 (IO0PIN & (1 << 15))
#define SW4 (IO1PIN & (1 << 18))
#define SW5 (IO1PIN & (1 << 19))
#define SW6 (IO1PIN & (1 << 20))
static void delay_ms(unsigned int j); //millisecond delay
short int sine_table[ ] =
{512+0,512+53,512+106,512+158,512+208,512+256,512+300,512+342,51
2+380,512+413,512+442,512+467,512+486,512+503,512+510,512+511,
512+510,512+503,512+486,512+467,512+442,512+413,512+380,512+342,
512+300,512+256,512+208,512+158,512+106,512+53,512+0,
512-53,512-106,512-158,512-208,512-256,512-300,512-342,512-380,512-
413,512-442,512-467,512-486,512-503,512-510,512-511,
512-510,512-503,512-486,512-467,512-442,512-413,512-380,512-342,512-
300,512-256,512-208,512-158,512-106,512-53};
short int sine_rect_table[ ] =
{512+0,512+53,512+106,512+158,512+208,512+256,512+300,512+342,51
2+380,512+413,512+442,512+467,512+486,512+503,512+510,512+511,
512+510,512+503,512+486,512+467,512+442,512+413,512+380,512+342,
512+300,512+256,512+208,512+158,512+106,512+53,512+0};
int main()
{
short int value,i=0;
PINSEL1 |= 0x00080000; /* P0.25 as DAC output :option 3 - 10
While(1){
if ( !SW4) /* If switch for triangular wave is pressed */
{
value = 0;
while ( value != 1023 )
{
DACR = ( (1<<16) | (value<<6) );
value++;
}
while ( value != 0 )
{
DACR = ( (1<<16) | (value<<6) );
value--;
}
}

void delay_ms(unsigned int j)
{
unsigned int x,i;
for(i=0;i<j;i++)
{
for(x=0; x<10000; x++);
}
}
```

Course Outcomes: After completing the course, the students will be able to:-	
CO 1	Apply Embedded System and IoT fundamentals and formulate sustainable societal relevant cost effective solutions.
CO 2	Demonstrate the development of software programs using Embedded C, using Microcontrollers and different sensors and peripherals to build embedded system applications.
CO3	Design smart systems using various I/O peripherals, Sensors, embedded protocols like UART,I2C,SPI using modern tools like Keil IDE software for various domains like Healthcare, automation, agriculture, smart cities and others.
CO 4	Indulge in developing Novel multi-disciplinary IoT projects using prototype boards, with effective oral & written communication skills and working in teams.
CO 5	Engage in Lifelong Learning by investigating and executing real world societal problems using engineering tools – Cross compilers, debuggers and simulators, emerging processor and controller-based hardware platforms, IOT cloud infrastructure & protocols.

BT LEVELS	L1	L2	L3	L4	L5	L6	COS	CO1	CO2	CO3	CO4
MARKS		10	30	10					20	30	