UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER II
SESI 2008/2009

NAMA MATAPELAJARAN	:	MIKROPENGAWAL
KOD MATAPELAJARAN	:	DEK 3133
KURSUS	:	3 DET, DEE
TARIKH PEPERIKSAAN	:	APRIL/MEI 2009
JANGKAMASA	:	3 JAM
ARAHAN	:	JAWAB **EMPAT (4)** SOALAN DI MANA **TIGA (3)** SOALAN DARI BAHAGIAN **A DAN SATU (1)** SOALAN DARI BAHAGIAN **B ATAU DUA (2)** SOALAN DARI BAHAGIAN **A DAN DUA (2)** SOALAN DARI BAHAGIAN **B**.

KERTAS SOALAN INI MENGANDUNGI DUA PULUH SATU (21) MUKA SURAT

SOALAN DALAM BAHASA MALAYSIA

BAHAGIAN A

S1 (a) Nyatakan **definisi** bagi Mikropengawal dan berikan empat (4) **perkara** yang perlu diberi perhatian untuk memilih Mikropengawal yang sesuai

(5 markah)

(b) Berikan tiga (3) **perbezaan** di antara Mikropengawal dan Mikropemproses serta lakarkan gambarajah untuk membezakan di antara kedua-dua peranti tersebut.

(5 markah)

(c) Berikan **spesifikasi** bagi Mikropengawal 16F877A dari segi:

(i) Bilangan pin
(ii) Saiz *EEPROM* Ingatan Data *(bait)*
(iii) Saiz *Flash* Ingatan Program *(Kbait)*
(iv) Jumlah set suruhan
(v) Lebar dan bilangan aras bagi daftar tindanan *(Stack)*

(5 markah)

(d) **Lakarkan** satu litar ringkas untuk menyalakan sebuah *LED* apabila sebuah butang ditekan dengan berdasarkan komponen yang diberikan seperti dalam Jadual S1 (d). Pastikan wayar disambung pada pin yang betul dan namakan setiap komponen/pin.

(10 markah)

S2 (a) **Tukarkan** nombor desimal berikut kepada nombor binari dan heksadesimal.

(i) 500
(ii) 1023

(4 markah)

(b) Apakah yang dimaksudkan dengan sampukan dan daftar **manakah** yang mengawal sampukan dalam PIC168F77A?

(3 markah)

(c) Berikan **tiga (3) perisian** yang digunakan untuk membuat satu projek mikropengawal dan **apakah** fungsi setiap perisian tersebut?

(3 markah)

(d) **Berikan penerangan** berkenaan gambarajah blok dalam Rajah S2(d).

(4 markah)

(e) Berdasarkan Rajah S2(e) di bawah:

(i) **Berikan ulasan** bagi setiap baris suruhan (A hingga H).
(ii) **Berikan ulasan** bagi fungsi keseluruhan program tersebut.

(11 markah)

S3 (a) Berikan nilai dalam daftar-daftar dalam PIC16F877A yang ditunjukan dalam Rajah S3(a) selepas suruhan dibawah dilaksanakan. Tuliskan jawapan terakhir dalam bentuk jadual seperti di Rajah S3(a).

(i) SWAPF 11h
(ii) ADDWF 10h,w
(iii) ANDWF 12h

(6 markah)

(b) Rajah S3(b) adalah struktur ingatan sebuah Mikropengawal. Terdapat 8 talian data dan 16 talian alamat yang dihubungkan antara CPU dan ingatan. Dengan mengambil kira 1Kb adalah bersamaan 1024byte:

(i) Kirakan saiz ruangan ingatan tersebut.
(ii) Apakah jenis bas yang akan menentukan saiz ingatan sebuah Mikropengwal.

(4 markah)

(c) Kira jumlah kitar suruhan bagi turutan suruahan di bawah.

```
Delay  MOVLW 0xFF
       MOVWF timer
       NOP
       NOP
Down   DECFSZ timer
       GOTO   down
       RETURN
```

(5 markah)

(d) Berdasarkan Rajah S3(d), apabila butang *COUNT* ditekan, PIC akan memaparkan nyalaan LED untuk pengiraan nilai nombor asas perduaan bermula 1 sehingga 255. Apabila butang *CLEAR* ditekan nyalaan LED akan dipadamkan. Lengahan nyalaan LED adalah setiap 0.5 saat. **Lengkapkan** aturcara S3(d) di bawah dengan mengisi suruhan yang sesuai pada tempat kosong yang disediakan (A hingga J).

(10 markah)

S4 (a) Sekiranya anda menggunakan pemasa *TMR0* bersama pengayun berkelajuan 20MHz dan *Prescaler* 1:256, **kirakan masa** yang diperlukan untuk *TMR0* menghasilkan satu (1) limpahan.

(5 markah)

(b) PIC16F877A menggunakan bekalan jam berfrekuensi 40MHz. **Tunjukkan pengiraan** untuk mengetahui tempoh masa yang diambil oleh Mikropengawal menyelesaikan satu (1) suruhan dan **berapakah** suruhan yang mampu dilaksanakan oleh Mikropengawal dalam tempoh 5.0μs dan 125.0 μs?

(6 markah)

(c) PIC16F877A mempunyai resolusi 10-Bit (0b1111111111=1023) bagi penukaran analog kepada digital. Diberi voltan rujukan 5V, dapatkan nilai **Saiz Langkah** dan **Keluaran Digital** bagi *ADC* tersebut sekiranya voltan masukan analog adalah 1.23V. Berikan jawapan dalam nombor binari mengikut turutan *bit*.

(8 markah)

(d) **Berikan arahan** *MikroC* yang sesuai untuk:

(i) Proses menyimpan data pada ingatan *EEPROM*.
(ii) Melakukan konfigurasi *LCD* pada *PORTB*.
(iii) Mencetak perkataan DEK3133 pada paparan *LCD* di kedudukan baris 2 dan lajur 2.

(6 markah)

BAHAGIAN B

S5 Rajah S5 menunjukkan sebuah system kawalan untuk mengekalkan suhu sebuah bilik pada tahap 30°C hingga 40°C. Sistem ini menggunakan pengesan suhu yang mengukur suhu di antara 0°C - 100°C. Keluaran litar pengesan suhu adalah voltan analog (0V-5V) yang merupakan masukan kepada litar PIC. Terdapat dua komponen LED yang berfungsi untuk menunjukkan tahap suhu semasa (D2:normal dan D1:panas) dan sebuah komponen kipas yang berfungsi untuk menyejukkan suhu bilik sekiranya suhu tertentu dicapai. LED dan kipas akan berfungsi berdasarkan Jadual S5. Voltan rujukan PIC adalah 5V.

(a) Dapatkan :

(i) Saiz Langkah.
(ii) **Nilai ADC** apabila nilai V_{in} pada AN0 adalah 3V.
(iii) **Nilai suhu** dalam *Celsius* sekiranya V_{in} = 2V

(5 markah)

(b) Sekiranya PIC menggunakan Voltan rujukan +5V, **tuliskan aturcara C** yang menunjukkan proses penukaran analog kepada digital dan seterusnya mengawal suhu bilik.

(20 markah)

S6 Litar dalam Rajah S6 beroperasi dengan memaparkan nilai pengiraan secara menaik bermula dari nombor 0 hingga 9 dengan sela masa 1 saat. Pemasa lengahan PIC adalah daripada pemasa TMR0 dengan skala 1:64 dan nilai awalan TMR0 adalah 131. Sekiranya PIC dibekalkan pengayun (*Fosc*) dengan frekuensi 4Mhz.

(a) Dapatkan:

(i) **Tempoh masa** bagi limpahan TMR0 bermula dari 131 hingga 255.

(ii) **Bilangan limpahan** TMR0 yang diperlukan untuk mendapatkan tempoh lengah satu (1) saat.

(5 markah)

(b) Dengan menggunakan pemasa TMR0 **binakan kod pengaturcaraan C** di mana paparan *Seven Segment* akan memaparkan nilai pengiraan bermula dari 0 hingga 9 dengan sela masa 1 saat. Gunakan jadual S6(b) untuk nilai-nilai binari *Seven Segment*.

(20 markah)

SOALAN DALAM BAHASA INGGERIS

PART A

Q1 (a) Give **definition** of Microcontroller and give four (4) important points required attention to choose suitable Microcontroller.

(5 marks)

(b) Give three (3) **differences** between Microcontroller and Microprocessor. Sketch the figures to differentiate between these two devices.

(5 marks)

(c) Give the **specifications** for Microcontroller 16F877A from the aspect of:

(i) Pin numbers
(ii) Size of EEPROM (bytes)
(iii) Size of Flash Program Memory (Kbyte)
(iv) Number of instruction set
(v) Width and level of stack register

(5 marks)

(d) **Sketch** a simple circuit to light a LED when a button is press based on the components given in Table Q1(d). Make sure wires are connected to the right pin and name each component/pin.

(10 marks)

Q2 (a) **Convert** the following decimal numbers to binary and hexadecimal number.

(i) 500
(ii) 1023

(4 marks)

(b) What is the meaning of **Interrupt** and which **register** is used to control the interrupt in PIC16F877A?

(3 marks)

(c) Give three (3) **softwares** used to build a microcontroller project and what are the **functions** for each software?

(3 marks)

(d) **Give explanation** for the block diagram in Figure Q2(d)

(4 marks)

(e) Based in Figure Q2(e):
(i) **Give comment** for each line of instruction (A to H).
(ii) **Give overall comment** for the function of the program

(11 marks)

Q3 (a) Give the register values in Figure Q3(a) of PIC16F877A after execute the instruction below. Write the final answer in table form like in Figure Q3(a).

(j) SWAPF 11h
(iv) ADDWF 10h,w
(v) ANDWF 12h

(6 marks)

(b) Figure Q3(b) shows the memory structure of microcontroller. There are 8 data buses and 16 address buses connected between CPU and memory. Considering 1Kb is equal to 1024bytes:

(i) Calculate the size of the memory for thus microcontroller.
(ii) What type of buses will determine the memory size of the microcontroller?

(4 marks)

(c) Base on the assembly language below, calculate the total cycle of instructions.

```
Delay  MOVLW 0xFF
       MOVWF timer
       NOP
       NOP
Down   DECFSZ timer
       GOTO  down
       RETURN
```

(5 marks)

(d) Based on Figure Q3(d), PIC will turns ON the LEDs base on binary counting start from 1 to 255 when COUNT button is pressed. LEDs will be switched OFF when the CLEAR button is pressed. The delay for LEDs to switch ON is every 0.5 second. **Complete the Programme Q3(d)** by filling suitable instruction in the given blanks (A to J).

(10 marks)

Q4 (a) If you use TMR0 timer with 20MHz Oscillator and Prescaler 1:256, **calculate the time required** for TMR0 to produce one (1) Overflow (0 to 255)

(5 marks)

(b) A PIC16F877A uses a clock frequency of 40MHz. **Show the calculation** to know a time period taken by Microcontroller to complete one (1) instruction and **how many Instructions** can be executed by microcontroller within 5.0μs and 125.0μs?

(6 marks)

(c) A PIC16F877A has 10-Bit resolutions (0b1111111111=1023) for analog to digital conversion (ADC). By using the voltage reference of 5V, find the **Step Size** and **Digital Output** of ADC when the analog input is 1.23V. Give your answer in binary format by following the bit order.

(8 marks)

(d) Give **suitable MikroC *instruction*** for:
(i) Write a data to EEPROM.
(ii) Configure LCD to be used at PORTB.
(iii) Print word DEK3133 on LCD screen at row 2 and column 2.

(6 marks)

PART B

Q5 Figure Q5 shows a control system to maintain room temperature between 30°C to 40°C. The system is used a temperature sensor to measure the temperature between 0°C to 100°C. The output of temperature sensor is analog voltage (0V-5V) which is the input to the PIC circuit. There are two LED components which work as indicator for the current temperatures level (D2: normal and D1: hot) and a fan component which operate to cool down the room temperature when a certain temperature is achieved. LEDs and fan will functioned based on Table S5. Voltage reference used by PIC is 5V.

(a) Find:
(i) **Step size**.
(ii) **ADC result** when V_{in} to AN0 is 3V.
(iii) **Temperature Value** in degree celsius when V_{in} = 2V.

(5 marks)

(b) If the PIC uses voltage reference of +5V, **write a C program** to show the conversion process from analog to digital and then to control the room temperature.

(20 marks)

Q6 Circuit in Figure Q6 operates by showing the counter value by rising up the number value beginning from 0 to 9 with time interval 1 second. Delay Timer PIC is from Hardware Timer (TMR0) with prescaler 1:64 and prefix value TMR0 is set to 131. If the PIC is provided with Oscillator frequency (Fosc) 4 MHz.

(a) Find:

(i) **Time taken** for TMR0 to overflow starting from 131 ~ 255.
(ii) Number of TMR0 **overflows required** to get 1 second delay.

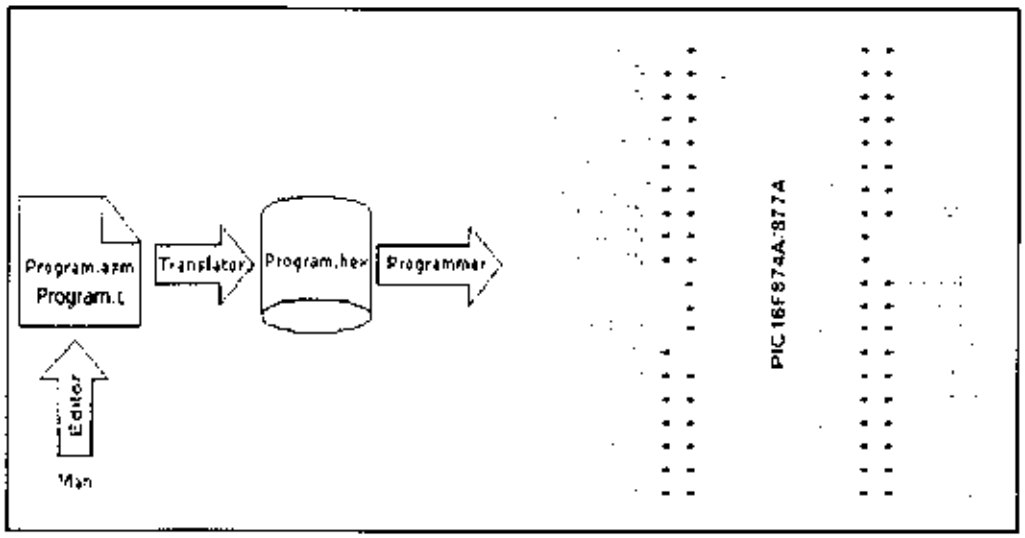
(5 marks)

(b) By using the TMR0 Timer **build a C program** where the Seven Segment display will show counting value from 0 to 9 with time interval 1 second. Use the Table S6 (b) for Seven Segment binary number.

(20 marks)

No.	Komponen	Spesifikasi	Kuantiti
1	PIC 16F877A	-	1
2	LED	-	1
3	Ground	-	3
4	Button	-	2
5	Power	-	2
6	Resistor	1KΩ	2
7	Resistor	220Ω	1

Jadual S1(d) / Table Q1(d)



Rajah S2(d) / Figure Q2(d)

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```
;############### Program S2(e) ##############

#define BUTTON PORTA.F4     ;  A

#define LED PORTB.F0

void main(void)             ;  B

{

 TRISB = 0b00000000         ;  C

 PORTB = 0

 ADCON1 = 0b00000110        ;  D

 TRISA = 0b11111111         ;  E

 While (1)                  ;  F
       {
       if (BUTTON == 0)     ;  G
          {
           LED = 1          ;  H
          }
          else
          {
           LED = 0
          }
       }
}

;################ END Program S2(e) ################
```

Program S2(e) / Program Q2(e)

PEPERIKSAAN AKHIR

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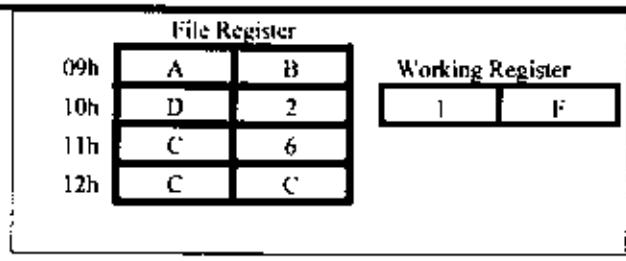
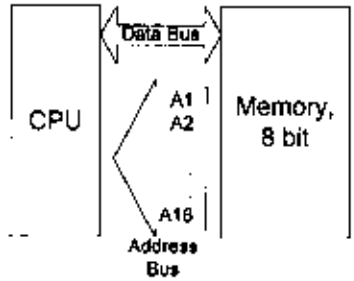
MATAPELAJARAN : MIKROPENGAWAL

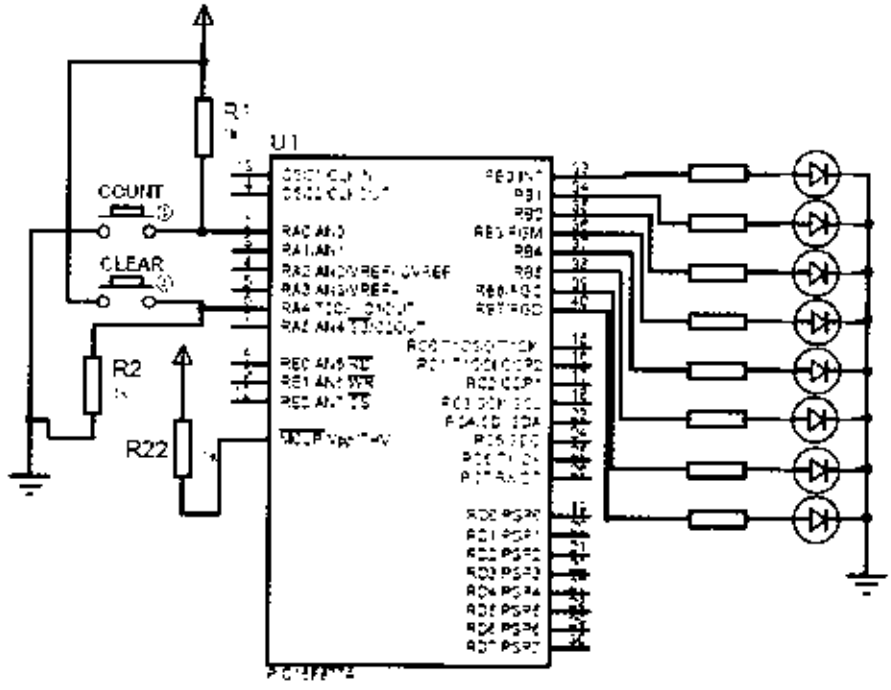
KURSUS : 3 DEE, DET
KOD MP : DEK 3133



Rajah S3(a) / Figure Q3(a)



Rajah S3(b) / Figure Q3(b)



Rajah S3(d) / Figure Q3(d)

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MATAPELAJARAN : MIKROPENGAWAL

KURSUS : 3 DET,DEE
KOD MP : DEK 3133

```
#define COUNT ____A____
#define CLEAR ____B____
#define LED ____C____
void main(void)
{
 unsigned int i;
 ADCON1 = ____D____;
 TRISA = ____E____;
 TRISB = ____F____;
 PORTB = 0x00;
 while (1)
 {
   if (COUNT == ____G____)
   {
    for(i=1;i<=255;i++){
      LED = LED + 1;
      Delay_ms(____H____);
      }
   }
   if (CLEAR == ____I____)
   {
    LED = ____J____;
   }
 }
}
```

Rajah S3(d) / Figure Q3(d)

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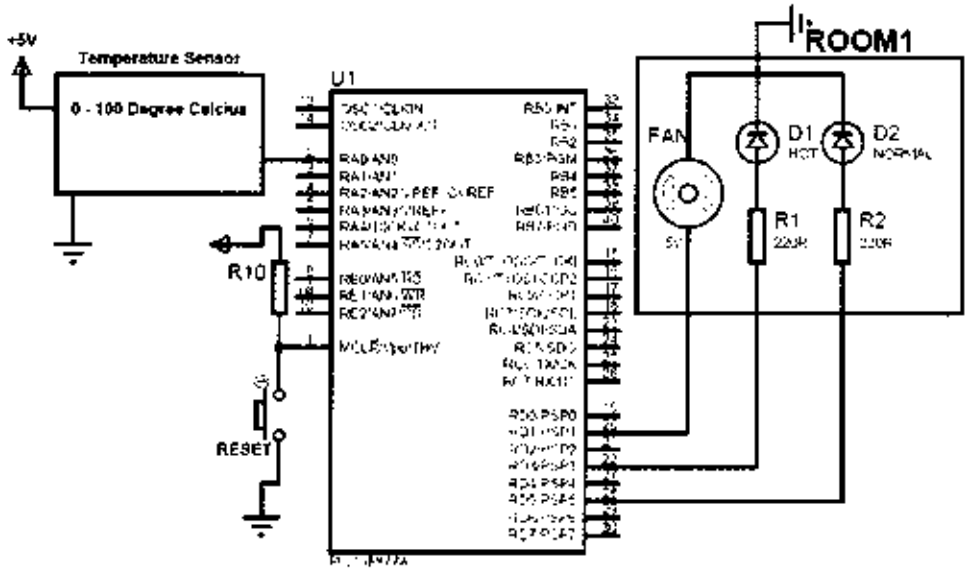
MATAPELAJARAN : MIKROPENGAWAL

KURSUS : 3 DET/DEE
KOD MP : DEK 3133



Rajah S5 / Figure Q5

Temperatures	LED and Fan Status
Above 39°C	Fan = Rotate (Fan is rotate and stop when reach at 30°C)
Above 35 °C	LED D1(Hot) = ONN LED D2(Normal) = OFF
Below 35°C	LED D1(Hot) = OFF LED D2(Normal) = ON
Below 30°C	Fan = Stop

Jadual S5 / Table Q5

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KURSUS : 3 DET/DEE
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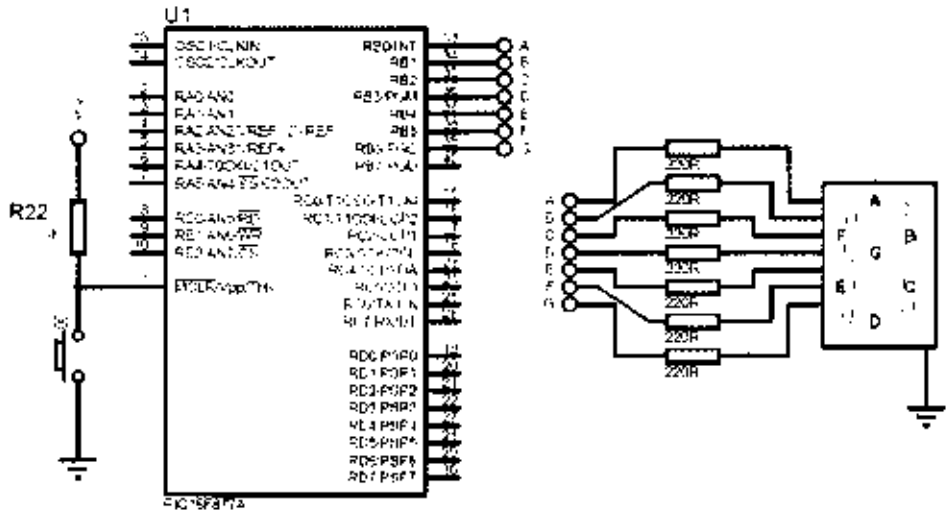

Rajah S6 / Figure Q6

Seven Segment No.	Binary value
9	01101111
8	01111111
7	00000111
6	01111101
5	01101101
4	01100110
3	01001111
2	01011011
1	00000110
0	00111111

Jadual S6 (b) / Table Q6 (b)

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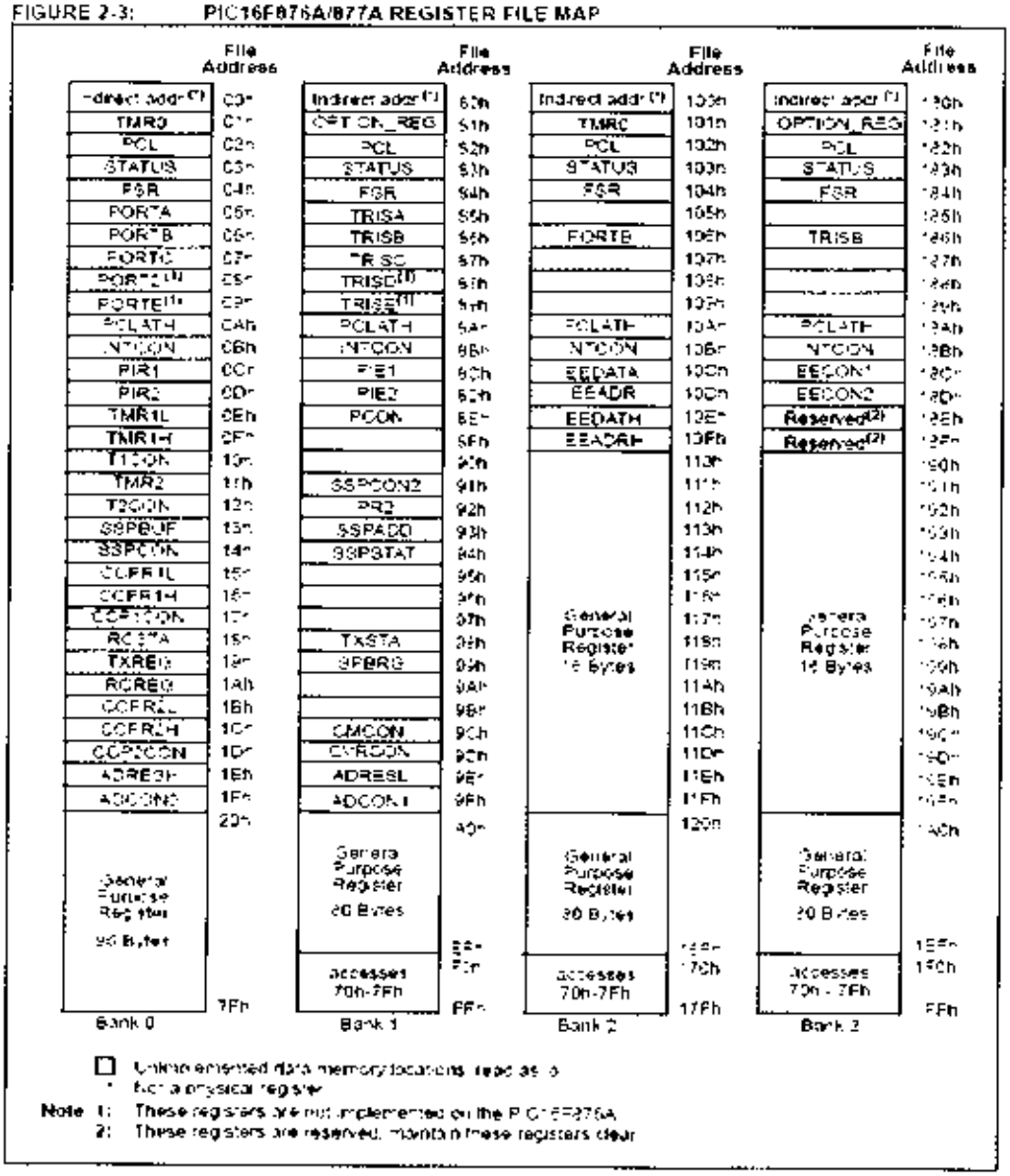
RUJUKAN 1

FIGURE 2-3: PIC16F876A/877A REGISTER FILE MAP



Unimplemented data memory locations, read as '0'.
* Not a physical register.
Note 1: These registers are not implemented on the PIC16F876A.
2: These registers are reserved, maintain these registers clear.

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RUJUKAN II

PIC16F87XA

TABLE 15-2: PIC16F87XA INSTRUCTION SET

Mnemonic, Operands		Description	Cycles	14-Bit Opcode MSb			LSb	Status Affected	Notes
BYTE ORIENTED FILE REGISTER OPERATIONS									
ADDWF	f, d	Add W and f	1	00	0111	dfff	ffff	C, DC, Z	1, 2
ANDWF	f, d	AND W with f	1	00	0101	dfff	ffff	Z	1, 2
CLRF	f	Clear f	1	00	0001	lfff	ffff	Z	2
CLRW	-	Clear W	1	00	0001	0xxx	xxxx	Z	
COMF	f, d	Complement f	1	00	1001	dfff	ffff	Z	1, 2
DECF	f, d	Decrement f	1	00	0011	dfff	ffff	Z	1, 2
DECFSZ	f, d	Decrement f, Skip if 0	1(2)	00	1011	dfff	ffff		1,2,3
INCF	f, d	Increment f	1	00	1010	dfff	ffff	Z	1, 2
INCFSZ	f, d	Increment f, Skip if 0	1(2)	00	1111	dfff	ffff		1,2,3
IORWF	f, d	Inclusive OR W with f	1	00	0100	dfff	ffff	Z	1, 2
MOVF	f, d	Move f	1	00	1000	dfff	ffff	Z	1, 2
MOVWF	f	Move W to f	1	00	0000	lfff	ffff		
NOP	-	No Operation	1	00	0000	0xx0	0000		
RLF	f, d	Rotate Left f through Carry	1	00	1101	dfff	ffff	C	1, 2
RRF	f, d	Rotate Right f through Carry	1	00	1100	dfff	ffff	C	1, 2
SUBWF	f, d	Subtract W from f	1	00	0010	dfff	ffff	C, DC, Z	1, 2
SWAPF	f, d	Swap nibbles in f	1	00	1110	dfff	ffff		1, 2
XORWF	f, d	Exclusive OR W with f	1	00	0110	dfff	ffff	Z	1, 2
BIT-ORIENTED FILE REGISTER OPERATIONS									
BCF	f, b	Bit Clear f	1	01	00bb	bfff	ffff		1, 2
BSF	f, b	Bit Set f	1	01	01bb	bfff	ffff		1, 2
BTFSC	f, b	Bit Test f, Skip if Clear	1(2)	01	10bb	bfff	ffff		3
BTFSS	f, b	Bit Test f, Skip if Set	1(2)	01	11bb	bfff	ffff		3
LITERAL AND CONTROL OPERATIONS									
ADDLW	k	Add Literal and W	1	11	111x	kkkk	kkkk	C, DC, Z	
ANDLW	k	AND Literal with W	1	11	1001	kkkk	kkkk	Z	
CALL	k	Call Subroutine	2	10	0kkk	kkkk	kkkk		
CLRWDT	-	Clear Watchdog Timer	1	00	0000	0110	0100	$\overline{TO}$, $\overline{PD}$	
GOTO	k	Go to Address	2	10	1kkk	kkkk	kkkk		
IORLW	k	Inclusive OR Literal with W	1	11	1000	kkkk	kkkk	Z	
MOVLW	k	Move Literal to W	1	11	00xx	kkkk	kkkk		
RETFIE	-	Return from Interrupt	2	00	0000	0000	1001		
RETLW	k	Return with Literal in W	2	11	01xx	kkkk	kkkk		
RETURN	-	Return from Subroutine	2	00	0000	0000	1000		
SLEEP	-	Go into Standby mode	1	00	0000	0110	0011	$\overline{TO}$, $\overline{PD}$	
SUBLW	k	Subtract W from Literal	1	11	110x	kkkk	kkkk	C, DC, Z	
XORLW	k	Exclusive OR Literal with W	1	11	1010	kkkk	kkkk	Z	

Note 1: When an I/O register is modified as a function of itself (e.g., MOVF PORTB, 1), the value used will be that value present on the pins themselves. For example, if the data latch is '1' for a pin configured as input and is driven low by an external device, the data will be written back with a '0'.

2: If this instruction is executed on the TMR0 register (and where applicable, d = 1), the prescaler will be cleared if assigned to the Timer0 module.

3: If Program Counter (PC) is modified, or a conditional test is true, the instruction requires two cycles. The second cycle is executed as a NOP.

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RUJUKAN III

Reference for C functions:

Functions	Using C Function samples
Initialize LCD to PORTD	Lcd_Init(&PORTD);
Clear LCD	Lcd_Cmd(Lcd_CLEAR)
Read ADC conversion at AN0	Adc_Read(0)

Convert floating value to String	Unsigned float ABC; //variable ABC as float
	Char CBA[13]; //variable CBA with 13 character long
	ABC = 123.456;
	FloatToStr(ABC, CBA); //CBA = "123.456" (string format)

Show text in LCD screen	Lcd_Out(2,1, "Hello"); // Show text "Hello" at Line 2 column 1
Configure Analog inputs with Vref using Internal Vref +5V.	ADCON1 = 0x80;

Special Function Registers

INTCON REGISTER (ADDRESS 0Bh, 8Bh, 10Bh, 18Bh)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-x
GIE	PEIE	TMR0IE	INTE	RBIE	TMR0IF	INTF	RBIF
bit 7							bit 0

bit 7 **GIE:** Global Interrupt Enable bit
1 = Enables all unmasked interrupts
0 = Disables all interrupts
bit 6 **PEIE:** Peripheral Interrupt Enable bit
1 = Enables all unmasked peripheral interrupts
0 = Disables all peripheral interrupts
bit 5 **TMR0IE:** TMR0 Overflow Interrupt Enable bit
1 = Enables the TMR0 interrupt
0 = Disables the TMR0 interrupt

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SEMESTER/SESI : SEMESTER II/2008/09 KURSUS : 3 DET, DEE
MATAPELAJARAN : MIKROPENGAWAL KOD MP : DEK 3133

RUJUKAN IV

bit 4 **INTE**: RB0/INT External Interrupt Enable bit
1 = Enables the RB0/INT external interrupt
0 = Disables the RB0/INT external interrupt
bit 3 **RBIE**: RB Port Change Interrupt Enable bit
1 = Enables the RB port change interrupt
0 = Disables the RB port change interrupt
bit 2 **TMR0IF**: TMR0 Overflow Interrupt Flag bit
1 = TMR0 register has overflowed (must be cleared in software)
0 = TMR0 register did not overflow
bit 1 **INTF**: RB0/INT External Interrupt Flag bit
1 = The RB0/INT external interrupt occurred (must be cleared in software)
0 = The RB0/INT external interrupt did not occur
bit 0 **RBIF**: RB Port Change Interrupt Flag bit
1 = At least one of the RB7:RB4 pins changed state; a mismatch condition will continue to set
the bit. Reading PORTB will end the mismatch condition and allow the bit to be cleared
(must be cleared in software).
0 = None of the RB7:RB4 pins have changed state

OPTION_REG REGISTER (ADDRESS 81h, 181h)

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
RBPU	INTEDG	T0CS	T0SE	PSA	PS2	PS1	PS0
bit 7							bit 0

RBPU: PORTB Pull-up Enable bit
1 = PORTB pull-ups are disabled
0 = PORTB pull-ups are enabled by individual port latch values
bit 6 **INTEDG**: Interrupt Edge Select bit
1 = Interrupt on rising edge of RB0/INT pin
0 = Interrupt on falling edge of RB0/INT pin
bit 5 **T0CS**: TMR0 Clock Source Select bit
1 = Transition on RA4/T0CKI pin
0 = Internal instruction cycle clock (CLKO)

PEPERIKSAAN AKHIR

SEMESTER/SESI : SEMESTER II/2008/09 KURSUS : 3 DET/DEE
MATAPELAJARAN : MIKROPENGAWAL KOD MP : DEK 3133

RUJUKAN V

bit 4 **T0SE**: TMR0 Source Edge Select bit
1 = Increment on high-to-low transition on RA4/T0CKI pin
0 = Increment on low-to-high transition on RA4/T0CKI pin
bit 3 **PSA**: Prescaler Assignment bit
1 = Prescaler is assigned to the WDT
0 = Prescaler is assigned to the Timer0 module
PS2:PS0: Prescaler Rate Select bits

Bit Value	TMR0 Rate	WDT Rate
000	1 : 2	1 : 1
001	1 : 4	1 : 2
010	1 : 8	1 : 4
011	1 : 16	1 : 8
100	1 : 32	1 : 16
101	1 : 64	1 : 32
110	1 : 128	1 : 64
111	1 : 256	1 : 128

PEPERIKSAAN AKHIR

SEMESTER/SESI : SEMESTER II/2008/09
MATAPELAJARAN : MIKROPENGAWAL

KURSUS : 3 DET/DEE
KOD MP : DEK 3133

RUJUKAN VI

REGISTER 11-2: ADCON1 REGISTER (ADDRESS 9Fh)

R/W-0	R/W-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
ADFM	ADCS2	—	—	PCFG3	PCFG2	PCFG1	PCFG0
bit 7							bit 0

bit 7 **ADFM**: A/D Result Format Select bit
1 = Right justified. Six (6) Most Significant bits of ADRESH are read as '0'.
0 = Left justified. Six (6) Least Significant bits of ADRESL are read as '0'.

bit 4 **ADCS2**: A/D Conversion Clock Select bit (ADCON1 bits in shaded area are in bold)

ADCON1 <ADCS2>	ADCON0 <ADCS1:ADCS0>	Clock Conversion
0	00	Fosc/2
0	01	Fosc/8
0	10	Fosc/32
0	11	FRC (clock derived from the internal A/D RC oscillator)
1	00	Fosc/4
1	01	Fosc/16
1	10	Fosc/64
1	11	FRC (clock derived from the internal A/D RC oscillator)

bit 3-0 Unimplemented: Read as '0'

bit 3-0 **PCFG3:PCFG0**: A/D Port Configuration Control bits

PCFG <3:0>	AN7	AN6	AN5	AN4	AN3	AN2	AN1	AN0	VREF+	VREF-	C/R
0000	A	A	A	A	A	A	A	A	VDD	VSS	8/0
0001	A	A	A	A	VREF+	A	A	A	AN3	VSS	7/1
0010	D	D	D	A	A	A	A	A	VDD	VSS	5/0
0011	D	D	D	A	VREF+	A	A	A	AN3	VSS	4/1
0100	D	D	D	D	A	D	A	A	VDD	VSS	3/0
0101	D	D	D	D	VREF+	D	A	A	AN3	VSS	2/1
011x	D	D	D	D	D	D	D	D	—	—	0/0
1000	A	A	A	A	VREF+	VREF-	A	A	AN3	AN2	6/2
1001	D	D	A	A	A	A	A	A	VDD	VSS	5/0
1010	D	D	A	A	VREF+	A	A	A	AN3	VSS	5/1
1011	D	D	A	A	VREF+	VREF-	A	A	AN3	AN2	4/2
1100	D	D	D	A	VREF+	VREF-	A	A	AN3	AN2	3/2
1101	D	D	D	D	VREF+	VREF-	A	A	AN3	AN2	2/2
1110	D	D	D	D	D	D	D	A	VDD	VSS	1/0
1111	D	D	D	D	VREF+	VREF-	D	A	AN3	AN2	1/2

A = Analog input D = Digital I/O
C/R = # of analog input channels/# of A/D voltage reference inputs