



PROGRAM : NATIONAL DIPLOMA
COMPUTER SYSTEMS ENGINEERING
ELECTRICAL ENGINEERING TECHNOLOGY

SUBJECT : DIGITAL SYSTEMS III

CODE : EDS341

DATE : MID YEAR EXAMINATION
10 JUNE 2014

DURATION : 08:30- 11:30

WEIGHT : 60:40

TOTAL MARKS : 100

ASSESSOR : Mr D.R. VAN NIEKERK 720011220

MODERATOR : Mr. J. SEBASTIAN

NUMBER OF PAGES : 4 PAGES AND 1 ANNEXURES

INSTRUCTIONS TO CANDIDATES

1. ATTEMPT ALL QUESTIONS. (100 MARKS = 100%)
2. MARKS WILL BE DEDUCTED FOR UNTIDY WORK.
3. ALL WORK DONE IN PENCIL, EXCEPT DIAGRAMS AND SKETCHES, WILL BE CONSIDERED AS ROUGH WORK AND WILL NOT BE MARKED.
4. ALL PARTS OF QUESTIONS MUST BE KEPT TOGETHER.
5. ONE POCKET CALCULATOR PER CANDIDATE

QUESTION 1

- 1.1 Name the three basic functions that all microprocessors perform. (3)
- 1.2 Describe with the aid of diagrams the two different microprocessor architectures and state which one is used by the PIC. (8)
- 1.3 Briefly discuss each of the following terms:
- 1.3.1 Address bus (3)
- 1.3.2 Data bus (2)
- 1.3.3 Control bus (2)
- 1.4 Discuss the operation of storing information into RAM. (4)
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QUESTION 2

- 2.1 Explain each of the following terminology terms:
- 2.1.1 Object program. (1)
- 2.1.2 Mnemonic. (1)
- 2.1.3 Assembler program. (1)
- 2.1.4 Pseudo-opcode. (2)
- 2.2 Sketch a flowchart demonstrating each of the steps involved in the software development process. (10)
- 2.3 Explain how pipelining is implemented in the PIC16F877A microcontroller and mention problems that can be experienced with the pipeline. (6)
- 2.4 Briefly describe the PIC16F877A program counter. (4)
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QUESTION 3

- 3.1 Write a PIC16F877A assembler fixed delay subroutine called "D500US" using a single register called "DR1" located in memory 20h. The PIC16F877A micro-controller is clocked by a 4 MHz crystal oscillator. (6)
- 3.2 With the aid of a diagram show how three port pins of a PIC16F877A can be expanded to a 16-bit output port using 74HC595 devices. (5)
- 3.3 Explain what the sleep instruction could be used for and how the micro-controller can be woken-up. (4)

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QUESTION 4

- 4.1 Show by means of a diagram how an external (manual) reset switch can be connected to the MCLR pin of the PIC micro-controller. (3)
- 4.2 List in point form the events that take place when a subroutine call is executed. (4)
- 4.3 Explain what the Brown-Out Reset protection circuit of the PIC16F877A micro-controller is used for and describe how it operates. (6)
- 4.4 With the aid of a diagram show how a 12-key, keypad can be connected to Port B of the PIC 16F877A. (5)
- 4.5 List a possible procedure to summarize the software events that take place to validate a key-press on the keypad. (6)

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QUESTION 5

- 5.1 Explain how “interrupts” are useful and how it improves the micro-controllers performance. (5)
- 5.2 Explain how an interrupt priority structure can be implemented in the PIC16F877A interrupt service routine. (3)
- 5.3 List the features of the PIC16F877A on-chip hardware timer0. (6)
- [14]**
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TOTAL [100]

TABLE 15-2: PIC16F87XA INSTRUCTION SET

Mnemonic, Operands	Description	Cycles	14-Bit Opcode				Status Affected
			Msb		Lsb		
BYTE-ORIENTED FILE REGISTER OPERATIONS							
ADDWF	f, d	Add W and f	1	00	0111	dfff ffff	C,DC,Z
ANDWF	f, d	AND W with f	1	00	0101	dfff ffff	Z
CLRF	f	Clear f	1	00	0001	1fff ffff	Z
CLRW	-	Clear W	1	00	0001	0xxx xxxx	Z
COMF	f, d	Complement f	1	00	1001	dfff ffff	Z
DECf	f, d	Decrement f	1	00	0011	dfff ffff	Z
DECFSZ	f, d	Decrement f, Skip if 0	1(2)	00	1011	dfff ffff	
INCF	f, d	Increment f	1	00	1010	dfff ffff	Z
INCFSZ	f, d	Increment f, Skip if 0	1(2)	00	1111	dfff ffff	
IORWF	f, d	Inclusive OR W with f	1	00	0100	dfff ffff	Z
MOVf	f, d	Move f	1	00	1000	dfff ffff	Z
MOVWF	f	Move W to f	1	00	0000	1fff ffff	
NOP	-	No Operation	1	00	0000	0xx0 0000	
RLF	f, d	Rotate Left f through Carry	1	00	1101	dfff ffff	C
RRF	f, d	Rotate Right f through Carry	1	00	1100	dfff ffff	C
SUBWF	f, d	Subtract W from f	1	00	0010	dfff ffff	C,DC,Z
SWAPf	f, d	Swap nibbles in f	1	00	1110	dfff ffff	
XORWF	f, d	Exclusive OR W with f	1	00	0110	dfff ffff	Z
BIT-ORIENTED FILE REGISTER OPERATIONS							
BCF	f, b	Bit Clear f	1	01	00bb	bfff ffff	
BSF	f, b	Bit Set f	1	01	01bb	bfff ffff	
BTFSC	f, b	Bit Test f, Skip if Clear	1(2)	01	10bb	bfff ffff	
BTFSS	f, b	Bit Test f, Skip if Set	1(2)	01	11bb	bfff ffff	
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	TO,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	TO,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