2201/303
2203/303
2206/303
MICROPROCESSOR SYSTEMS
Oct./Nov. 2007
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ELECTRONIC ENGINEERING
DIPLOMA IN TELECOMMUNICATION ENGINEERING
DIPLOMA IN INSTRUMENTATION AND CONTROL ENGINEERING

MICROPROCESSOR SYSTEMS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet
8080/8085 MICROPROCESSOR INSTRUCTION SET
Mathematical tables/calculator

*Answer any **FIVE** of the following **EIGHT** questions.*
All questions carry equal marks.

This paper consists of 7 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and no questions are missing.

1. (a) (i) Define memory access time.

(ii) State why a(i) is a necessary factor to be considered when choosing a memory device.

(iii) Arrange the following memories according to their access time in ascending order; magnetic tape, semi-conductor memories, magnetic disk, magnetic drum, charge coupled devices. (4 marks)

(b) From the memory diagram of Fig. 1, determine the:

(i) total capacity and word size;

(ii) RAMs that will place data on the data bus when $R/\overline{w} = 1$ and the address on the address bus is 70 FCH;

(iii) range of addresses for the following:

(I) RAM – 1
(II) RAM –3. (10 marks)

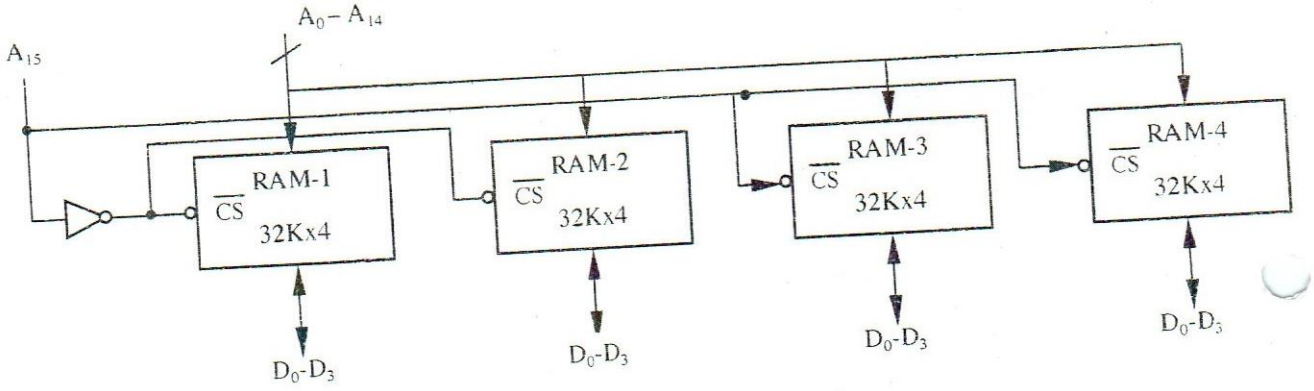


Figure 1

(c) A floppy disk has 40 tracks/side, 30 sectors/track, 512 bytes/sector and 46 tracks/inch. The inside track has radius of 1.632 inches. Calculate the:

(i) radius of the outside track;

(ii) total area on the disk used for storing data;

(iii) total disk capacity. (6 marks)

2. (a) Define the following microprocessor addressing modes; giving an example in each case:

(i) relative

(ii) indexed

(iii) page zero (6 marks)

(b) (i) List the next **four** elements of the following series: 1, 2, 3, 5, 8, ...

(ii) Draw a flowchart to generate the first twenty elements of the series in b(i).

(iii) Write an assembly language program to generate the series in b(ii) and store the series elements in memory, starting from location 7000 H. (11 marks)

(c) State any **three** advantages of assembly language programming over high level language programming. (3 marks)

3. (a) (i) Describe the sequence of operations performed by a two-pass assembler during the assembling process.

(ii) Define an assembler directive.

(ii) Describe any two assembler directives. (9 marks)

(b) A main program calls a subroutine K, which in turn calls a subroutine L. Subroutine L itself calls another subroutineM. Subroutine K is in memory starting at address 03AOH, subroutine L starts at address 04D4H and subroutine M starts at address 0605 H. The CALL instruction to K from main program is at address OOBE H, the CALL instruction to L from K is at address 03B6H and the CALL instruction to M from L is at address 04EI H.

The stack pointer (SP) is initialised at OFOOH.

(i) Draw a block diagram showing the program and the nested subroutine calls.

(ii) Determine the contents of the program counter (PC), the stack pointer (SP), and the stack contents at the following points in the program:

(I) just after entry has been made to subroutine K;
(II) just after entry has been made to subroutine M. (11 marks)

4. (a) Define the following interrupts:

(i) Vectored

(ii) Non-maskable. (2 marks)

(b) A microcomputer system using an Intel 8085 processor is to be connected to three interrupt signals. These are:

1. an interrupt from a counter-timer chip which updates a real-time clock;

2. an interrupt from a voltage sensing circuit indicating a power failure;

3. interrupt from a keyboard indicating that a character is ready after typing.

(i) List and explain a suitable priority ranking, in descending order, for these signals.

(ii) State with reasons, which inputs of the 8085 processor should be used by each signal. (9 marks)

(c) (i) Describe the **two** main processor control signals used to implement Direct Memory Access (DMA).

(ii) State:

(I) any **three** applications of DMA in modern microcomputer systems

(II) any **two** modes of DMA transfer. (9 marks)

5. (a) Distinguish between the following:

(i) Multiprocessor and multicomputer system;

(ii) Asynchronous and Synchronous Bus. (4 marks)

(b) Describe the following software development aids:

(i) Macro instruction

(ii) Text-editor

(iii) Simulator

(iv) Debugger

(v) Loader

(vii) Linker. (12 marks)

(c) Explain the **two** basic methods of testing a new software. (4 marks)

6. (a) Explain the role of a programmable input/output (PIO) chip in a microprocessor system. (5 marks)

(b) Fig. 2 shows an I/0 port.

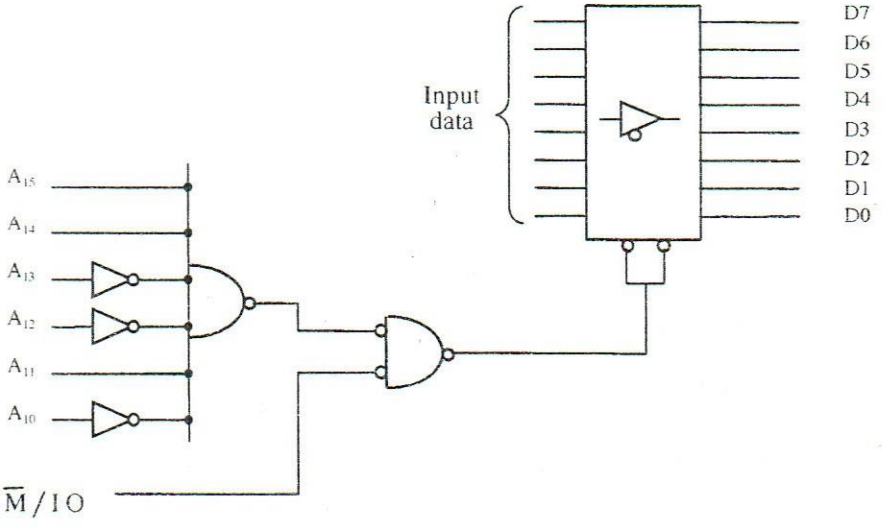


Figure 2

(i) State with reasons, whether the port is I/0 – mapped or memory –mapped.

(ii) Determine the range of addresses assigned to the I/0 port.

(iii) Write a program to read the port and branch to location READY when bits 0 and 1 are both low else branch to WAIT. (9 marks)

(c) (i) Define the following with respect to Digital – analogue – converters (DAC):

(I) Resolution
(II) Settling time.

(ii) A 8-bit DAC has a10V reference voltage.
Determine the:

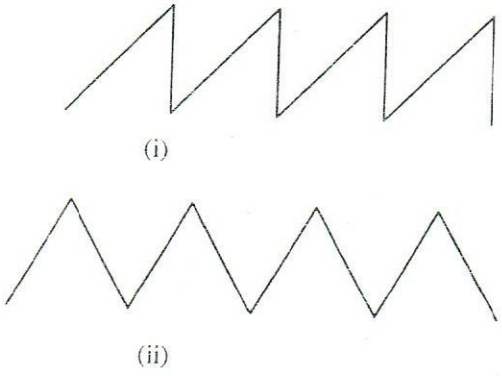
I Resolution
II Full-scale analogue output. (6 marks)

7. (a) (i) With the aid of a diagram, describe a microprogrammed processor control unit.

(ii) State the **two** advantages of a hardwired control unit.

(iii) Describe multi-programming in a single processor system, stating its advantages. (13 marks)

(b) (i) Write a program to generate the waveform of Fig. 3(i).
(ii) Modify the program in b(i) to generate the waveform of fig. 3 (ii). (7 marks)



(i)

(ii)

Figure 3

8. (a) Describe each of the following trouble-shooting aids:

(i) single stepping

(ii) Break-points (4 marks)

(b) A microcomputer system you have been using for several months suddenly goes "dead". The system uses a machine language monitor in PROM, hexadecimal keypad, and seven segment LED displays. In its dead state it will not respond to the keypad, and although the displays are lit, they do not change. Describe with the aid of a flow chart the steps followed to troubleshoot this problem, stating the reason for your argument. (16 marks)

Instruction set of

8080/8085

OP CODE	MNEMONIC	OP CODE	MNEMONIC	OP CODE	MNEMONIC	OP CODE	MNEMONIC	OP CODE	MNEMONIC	OP CODE	MNEMONIC
00	NOP	2B	DCX H	56	MOV D,M	81	ADD C	AC	XRA H	D7	RST 2
01	LXI B,D16	2C	INR L	57	MOV D,A	82	ADD D	AD	XRA L	D8	RC
02	STAX B	2D	DCR L	58	MOV E,B	83	ADD E	AE	XRA M	D9	–
03	INX B	2E	MVI L,D8	59	MOV E,C	84	ADD H	AF	XRA A	DA	JC Adr
04	INR B	2F	CMA	5A	MOV E,D	85	ADD L	B0	ORA B	DB	IN D8
05	DCR B	30	SIM	5B	MOV E,E	86	ADD M	B1	ORA C	DC	CC Adr
06	MVI B,D8	31	LXI SPD16	5C	MOV E,H	87	ADD A	B2	ORA D	DD	–
07	RLC	32	STA Adr	5D	MOV E,L	88	ADC B	B3	ORA E	DE	SBI D8
08	–	33	INX SP	5E	MOV E,M	89	ADC C	B4	ORA H	DF	RST 3
09	DAD B	34	INR M	5F	MOV E,A	8A	ADC D	B5	ORA L	E0	RPO
0A	LDAX B	35	DCR M	60	MOV H,B	8B	ADC E	B6	ORA M	E1	POP H
0B	DCX B	36	MVI M,D8	61	MOV H,C	8C	ADC H	B7	ORA A	E2	JPO Adr
0C	INR C	37	STC	62	MOV H,D	8D	ADC L	B8	CMP B	E3	XTHL
0D	DCR C	38	– –	63	MOV H,E	8E	ADC M	B9	CMP C	E4	CPO Adr
0E	MVI C,D8	39	DAD SP	64	MOV H,H	8F	ADC A	BA	CMP D	E5	PUSH H
0F	RRC	3A	LDA Adr	65	MOV H,L	8G	SUB B	BB	CMP E	E6	ANI D8
10	– –	3B	DCX SP	66	MOV H,M	91	SUB C	BC	CMP H	E7	RST 4
11	LXI D,D16	3C	INR A	67	MOV H,A	92	SUB D	BD	CMP L	E8	RPE
12	STAX D	3D	DCR A	68	MOV L,B	93	SUB E	BE	CMP M	E9	PCHL
13	INX D	3E	MVI A,D8	69	MOV L,C	94	SUB H	BF	CMP A	EA	JPE Adr
14	INR D	3F	CMC	6A	MOV L,D	95	SUB L	C0	RNZ	EB	XCHG
15	DCR D	40	MOV B,B	6B	MOV L,E	96	SUB M	C1	POP B	EC	CPE Adr
16	MVI D,D8	41	MOV B,C	6C	MOV L,H	97	SUB A	C2	JNZ Adr	ED	—
17	RAL	42	MOV B,D	6D	MOV L,L	98	SBB B	C3	JMP Adr	EE	ERI D8
18	– –	43	MOV B,E	6E	MOV L,M	99	SBB C	C4	CNZ Adr	EF	RST 5
19	DAD D	44	MOV B,H	6F	MOV L,A	9A	SBB D	C5	PUSH B	F0	RP
1A	LDAX D	45	MOV B,L	70	MOV M,B	9B	SBB E	C6	ADI D8	F1	POP PSW
1B	DCX D	46	MOV B,M	71	MOV M,C	9C	SBB H	C7	RST 0	F2	JP Adr
1C	INR E	47	MOV B,A	72	MOV M,D	9D	SBB L	C8	RZ	F3	DI
1D	DRC E	48	MOV C,B	73	MOV M,E	9E	SBB M	C9	RET Adr	F4	CP Adr
1E	MVI E,D8	49	MOV C,C	74	MOV M,H	9F	SBB A	CA	JZ	F5	PUSH PSW
1F	RAR	4A	MOV C,D	75	MOV M,L	A0	ANA B	CB	—	F6	ORI D8
20	RIM	4B	MOV C,E	76	HLT	A1	ANA C	CC	CZ Adr	F7	RST 6
21	LXI H,D16	4C	MOV C,H	77	MOV M,A	A2	ANA D	CD	CALL Adr	F8	RM
22	SHLD Adr	4D	MOV C,L	78	MOV A,B	A3	ANA E	CE	ACI D8	F9	SPHL
23	INX H	4E	MOV C,M	79	MOV A,C	A4	ANA H	CF	RST 1	FA	JM Adr
24	INR H	4F	MOV C,A	7A	MOV A,D	A5	ANA L	D0	RNC	FB	EI
25	DCR H	50	MOV D,B	7B	MOV A,E	A6	ANA M	D1	POP D	FC	CM Adr
26	MVI H,D8	51	MOV D,C	7C	MOV A,H	A7	ANA A	D2	JNC Adr	FD	– –
27	DAA	52	MOV D,D	7D	MOV A,L	A8	XRA B	D3	OUT D8	FE	CPI D8
28	– –	53	MOV D,E	7E	MOV A,M	A9	XRA C	D4	CNC Adr	FF	RST 7
29	DAD H	54	MOV D,H	7F	MOV A,A	AA	XRA D	D5	PUSH D		
2A	LHLD Adr	55	MOV D,L	80	ADD B	AB	XRA E	D6	SUI D8		

D8 = constant, or logical/arithmetic expression that evaluates to an 8-bit data quantity. D16 = constant, or logical/arithmetic expression that evaluates to a 16-bit data quantity. Adr = 16-bit address.