**1522/204**
**1602/204**
**MICROELECTRONICS, ELECTRICAL PRINCIPLES II, INSTRUMENTS AND ELECTRONIC FAULT DIAGNOSIS**
**June/July 2023**
**Time: 3 hours**

**THE KENYA NATIONAL EXAMINATIONS COUNCIL**

# CRAFT CERTIFICATE IN ELECTRICAL AND ELECTRONIC TECHNOLOGY (TELECOMMUNICATION OPTION)

## MODULE II

MICROELECTRONICS, ELECTRICAL PRINCIPLES II, INSTRUMENTS AND ELECTRONIC FAULT DIAGNOSIS

**3 hours**



**INSTRUCTIONS TO CANDIDATES**

*You should have the following for this examination:*
- *Answer booklet;*
- *Non-programmable scientific calculator;*
- *Mathematical tables;*
- *Intel 8080/8085 instruction set;*
- *Drawing instruments.*

*This paper consists of **EIGHT** questions in **THREE** sections; **A**, **B** and **C**.*
*Answer **ONE** question from section **A**, **TWO** questions from section **B** and **TWO** questions from section **C** in the answers booklet provided.*
*All questions carry equal marks.*
*Maximum marks for each part of a question are as indicated.*
***Candidates should answer the questions in English.***

**This paper consists of 9 printed pages.**

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

 **Turn over**

## SECTION A: MICROELECTRONICS

*Answer **ONE** question from this section.*

1. (a) (i) Distinguish between software and hardware with respect to microprocessor systems.

(ii) Describe each of the following buses in a microprocessor:

I. control bus;
II. data bus. (6 marks)

(b) State **four** features of the pentium microprocessor family. (4 marks)

(c) **Figure 1** shows the pin diagram of the 8085 microprocessor IC.

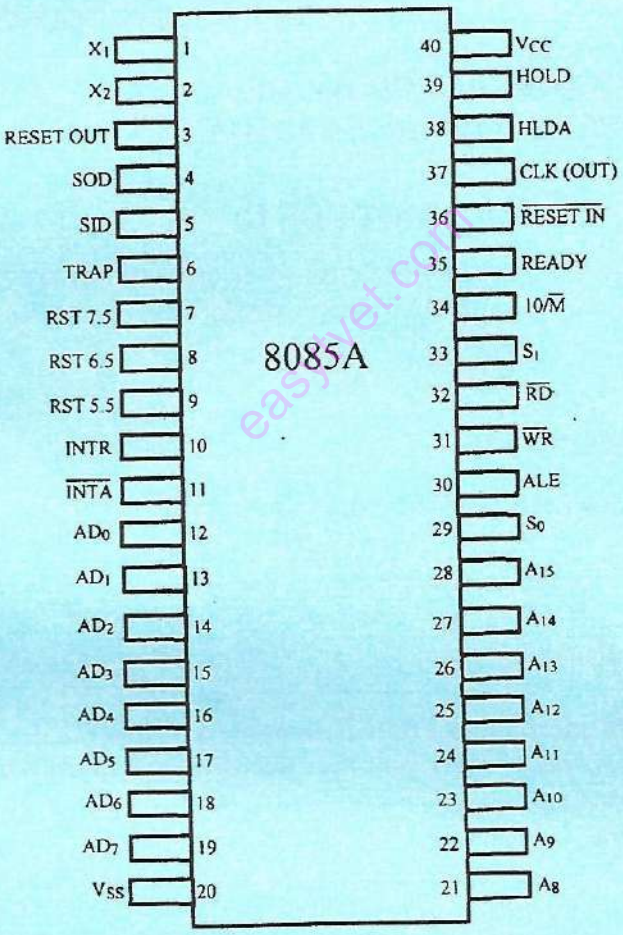


**Fig. 1**

(i) Explain the function of each of the following pins:

I. 32
II. 34
III. 3
IV. 5

(ii) Identify the pins for each of the following:

I. power supply;
II. data bus. (10 marks)

2. (a) Define each of the following with respect to memories:

(i) volatile;
(ii) random access;
(iii) address. (6 marks)

(b) Draw a schematic block diagram to show how a 64K × 8 PROM can be realised from two 32K × 8 PROM chips. (9 marks)

(c) Write an assembly language program to add 16 H to 34 H and save the result in register D. (5 marks)

## SECTION B: ELECTRICAL PRINCIPLES II

*Answer **TWO** questions from this section.*

3. (a) (i) State **two** advantages of digital-over analogue - instruments.

(ii) **Figure 2** shows a block diagram of a digital voltmeter.

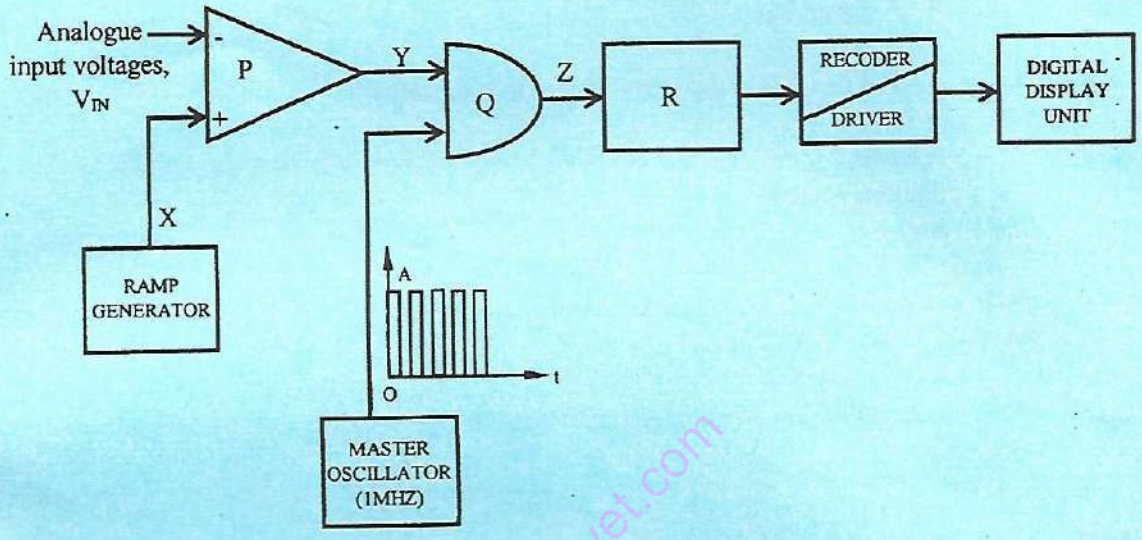


**Fig. 2**

I. Identify the blocks marked P, Q and R.
II. Sketch the waveforms at points X, Y and Z. (11 marks)

(b) Explain the function of each of the following in analogue indicating instruments:

(i) controlling torque;
(ii) damping torque. (4 marks)

(c) A voltmeter of resistance 100 Ω reads 1.47 V when connected across a dry cell. A potentionmeter is used to measure the e.m.f of the dry cell and balance is obtained at 73 cm with dry cell and 50 cm with a standard cell. The standard cell has an e.m.f of 1.018 V. Determine the:

(i) e.m.f of the dry cell;
(ii) internal resistance of the dry cell. (5 marks)

4. (a) Define each of the following with respect to alternating current (a.c) generation:

(i) form factor;
(ii) cycle;
(iii) waveform. (6 marks)

(b) A rectangular coil has 40 runs and measures 30 cm by 20 cm. It is rotated at a speed of 1500 r.p.m in a uniform magnetic field of flux density 0.075 Wb/m$^2$. The axis of rotation is at right angles to the direction of the flux. Determine the:

(i) angular frequency, in rad/sec;
(ii) maximum value of flux;
(iii) maximum value of induced e.m.f. (8 marks)

(c) A 3-phase star connected generator supplies a 3-phase balanced delta-connected load. The generator line voltage is 400 V.

(i) Draw the circuit diagram for the connection.
(ii) Determine the phase voltage of the generator. (6 marks)

5. (a) A voltage, $v = 340 \sin \omega t$, is applied to a circuit and the resulting current is $i = 14 \sin (\omega t - 30^\circ)$. For the circuit, determine the:

(i) impedance;
(ii) resistance;
(iii) reactance;
(iv) power;
(v) power factor. (10 marks)



(b) A 15 $\mu$F capacitor is charged to 200 V through a 1.2 M$\Omega$ resistor. Determine the:

(i) time constant;
(ii) initial charging current;
(iii) initial rate of rise of voltage across capacitor;
(iv) voltage across capacitor after 4.5 seconds from zero;
(v) time taken for the capacitor to be fully charged. (10 marks)

## SECTION C: INSTRUMENTS AND ELECTRONIC FAULT DIAGNOSIS

*Answer any **TWO** questions from this section.*

6. (a) Define each of the following with respect to test signals:

(i) amplitude;
(ii) rise time;
(iii) period. (6 marks)

(b) (i) Sketch the waveform of a double sideband amplitude modulated wave, assuming sinusoidal modulation.

(ii) The waveform in (b)(i) has a maximum value of 16 V and a minimum value of 4 V. Determine the depth of modulation. (6 marks)

(c) A pulse waveform displayed on an oscilloscope has an amplitude of 15 V and a frequency of 6.25 KHz. The oscilloscope sensitivity settings are 10 V/cm and 20 $\mu$s/cm. Determine the:

(i) number of peak-to-peak cm occupied on the vertical axis;
(ii) period of the wave;
(iii) number of cm occupied by one cycle of the wave on the horizontal axis. (8 marks)

7. (a) Explain parallax error in measurements and state how it can minimized. (3 marks)

(b) **Figure 3** shows a diagram of the front panel of an analogue multimeter.

(i) Identify and state the function of the parts labelled X, Y and Z.

(ii) State the meaning of the labels $V-$, $A\sim$ and $\Omega$ on the meter. (9 marks)

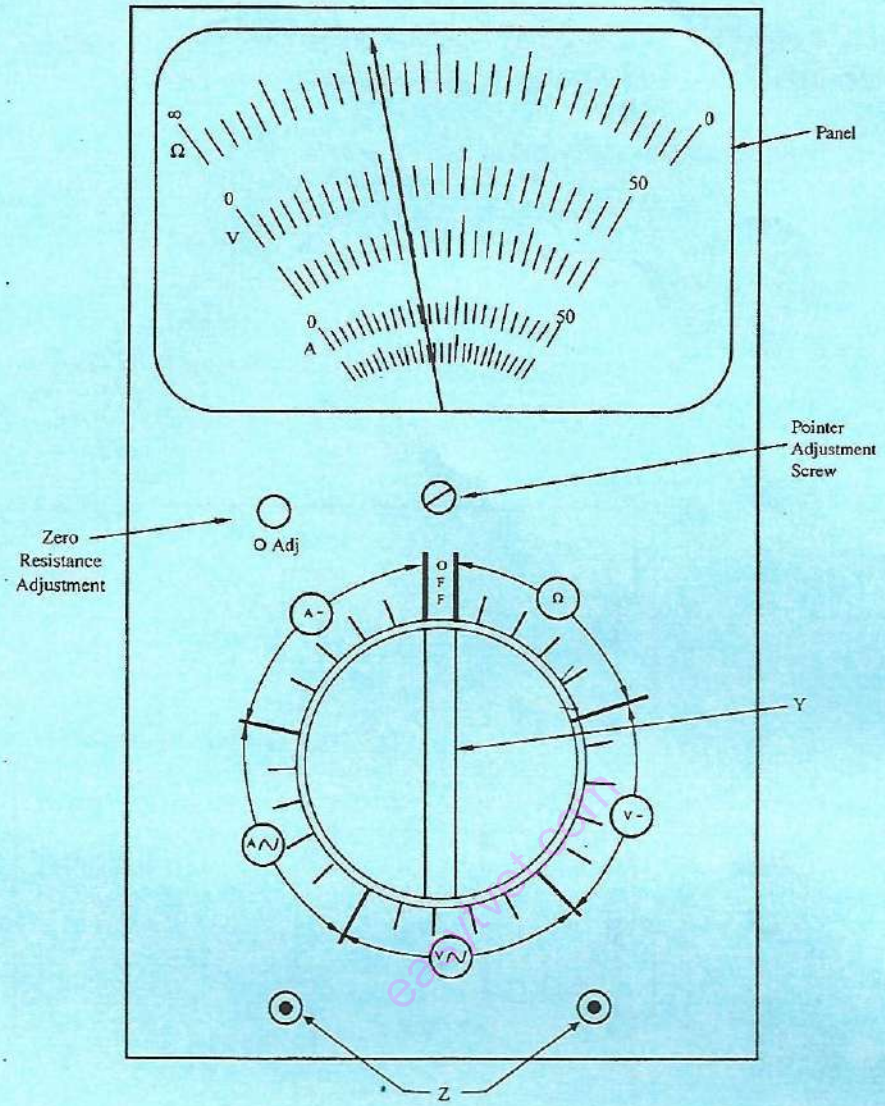


Fig. 3

(c) Draw a labelled block diagram of a spectrum analyzer and describe its operation. (8 marks)

8. (a) (i) State **three** causes of premature failure in semiconductor devices.

(ii) State **three** precautions to take when testing digital integrated circuits. (6 marks)

(b) Outline the procedure of testing a single-phase iron-cored transformer using an ohmmeter. (5 marks)

(c) **Figure 4** shows a circuit diagram of a common-emitter transistor amplifier. The base emitter voltage $V_{be} = 0.7V$ and the collector current $I_c = 3mA$.

(i) Estimate the bias voltages at the test points:

$TP_1$
$TP_2$
$TP_3$

(ii) State the voltages at each test point when the resistor $R_1$ is open circuited.

(9 marks)

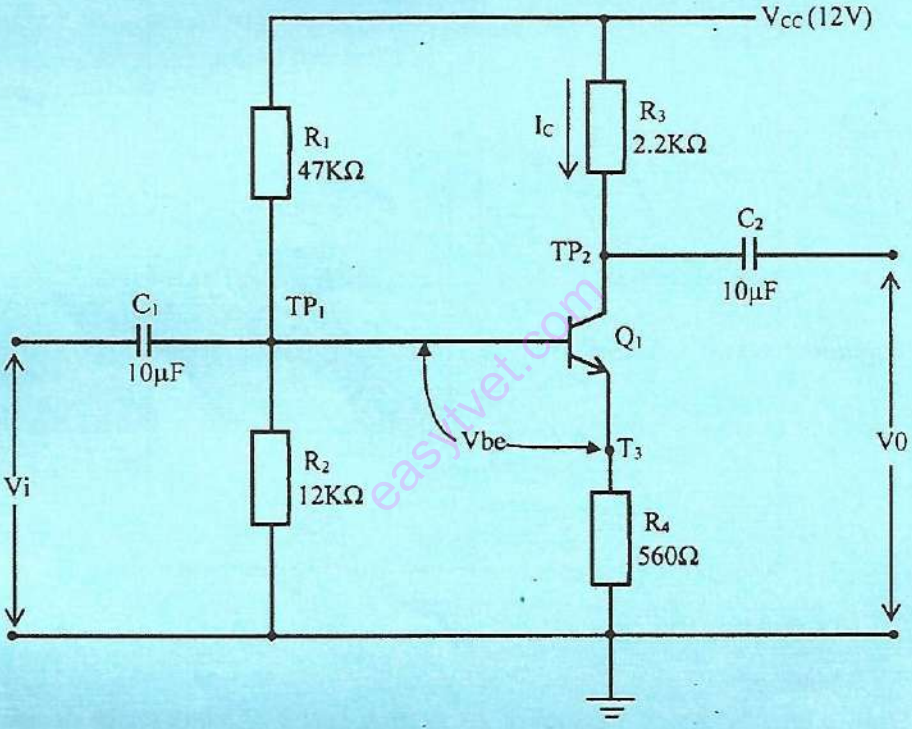


Fig. 4

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 | 28 | DCX H | 56 | MOV D,M | 81 | ADD C | AC | XRA H | D7 | RST 2 |
| 01 | LX1 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.

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