MICROPROCESSOR SYSTEMS

Introduction

The module unit is intended to provide the trainees with theoretical and practical skills for selection, installation and maintenance of microelectronics, micro-computers and microprocessor based systems. Trainees undertaking this course will be expected to have covered digital electronics in module 11 of this course.

General Objectives

By the end of the module unit, the trainee should be able to;

a) Understand the concepts of a microprocessor system.

b) Program a microprocessor system.

c) Write and implement microprocessor programs.

d) Diagnose faults in microprocessor systems.

Module Unit Summary and Time Allocation

Microprocessors Systems

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### 30.3.4 Interrupts
- Need for interrupts
- Operation of the interrupts
- Types of interrupts
- Application of interrupts

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### 30.3.1 MICROPROCESSOR ARCHITECTURE

**Theory**

**30.3.1 T0 Specific objectives**

By the end of the sub-module unit, the trainee should be able to:

a) Describe the organization of data registers

b) Explain the operation of machine cycle
30.3.1 TI  Description of organization of data registers

i. Instruction registers
ii. Programme counter
iii. Store address register
iv. General purpose
v. Accumulator
vi. Stack pointer
vii. Arithmetic and logic unit
viii. Status register

30.3.1 T2  Explanation of operation of machine cycle

30.3.2 INTRODUCTION TO ASSEMBLY LANGUAGE PROGRAMMING

Theory

30.3.2 T0 Specific Objectives

By the end of the sub-module unit, the trainee should be able to:

a) Describe a machine cycle
b) Explain instruction format
c) Describe data transfer instructions in programming
d) Describe the instructions in data manipulation group
e) Describe the input and output instructions
f) Describe the machine control instructions
g) Describe transfer of control instructions in programming
h) Explain the need and use of assembly directives
i) Explain various addressing modes
j) Write application programs
30.3.2C Competence

The trainee should have the ability to: write machine code programs for application in microprocessor systems.

Content

30.3.2T1 Machine Cycle
   i. Definition
   ii. Fetch
   iii. Decode
   iv. Execute
   v. Time diagram

30.3.2T2 Instruction format
   i. Label
   ii. Opcode
   iii. Operand
   iv. Comment

30.3.2T3 Data Transfer

30.3.2T4 Data Manipulation

30.3.2T5 Input/output Instructions

30.3.2T6 Machine control Instructions

30.3.2T7 Transfer of instructions
   v. Branch instructions
   vi. Status register/flag register
   vii. Subroutines
   viii. Passing parameter
   ix. Stack operations

30.3.2T8 Assembly directives
   i. Standard
   ii. Macros
   iii. Conditional

30.3.2T9 Addressing modes
   i. Register
ii. Register indirect
iii. Immediate
iv. Absolute
v. Relative
vi. Indexed
vii. Implied
viii. Direct
ix. Bit
x. Implied
xi. Stack addressing

30.3.2T10 Application programs

Practice

30.3.2P0 Specific Objectives

By the end of the sub-module unit, the trainee should be able to:

a) Write machine code programs using instruction sets
b) Hand coding and input machine code programs

Content

30.3.2P1 writing machine code programs
   i. Machine coding
   ii. Inputting a machine code program
   iii. Running the programs

Suggested teaching/learning Activities

- Discussion
- Illustration
- Demonstration
- Note taking
- Practical exercise

Learning Aids/Resources

- Microprocessor training kits
- Assorted microprocessors
- Internet
- Text books
Suggested Evaluation Methods

- Oral tests
- Timed written tests
- Assignments
- Timed practical tests
- Project

30.3.3 INPUT/OUTPUT TECHNIQUE

Theory

30.3.3T0 Specific Objectives

By the end of the sub module unit, the trainee should be able to:

a) Describe the operation of memory mapped input/output
b) Describe the operation of programmed input/output
c) Describe the operation of handshake controlled input/output
d) Describe the operation of polled input/output

30.3.3C Competence

The trainee should have the ability to perform inputs to a programmable controller

Content

30.3.3T1 Memory mapped input/output
30.3.3T2 Programmed input/output
30.3.3T3 Handshake controlled input/output
30.3.3T4 Polled input/output

Suggested teaching/Learning Activities

- Discussion
- Illustration
- Demonstration
- Note taking
- Project work
- Visits to industries

Suggested Evaluation Methods
• Oral tests
• Timed written tests
• Assignments

30.3.4 INTERRUPTS

Theory

30.3.4T0 Specific Objectives

By the end of the sub module unit, the trainee should be able to:

a) Explain the need for interrupt
b) Describe an interrupt operation
c) Describe operation of various types
d) Explain application of interrupts

30.3.4C Competence

The trainee should have the ability to use interrupts

Content

30.3.4T1 Need for interrupt

30.3.4T2 Operation of interrupt

30.3.4T3 Description of the various types of interrupts

i. Vectored
ii. Polled
iii. Hand wired
iv. Peripheral interrupt controller (PIC)
v. Masked

30.3.4T4 Applications of interrupts

i. Single user
ii. Multi programming
iii. Polling
iv. DMA
v. Job scheduling

Suggested teaching/Learning Activities
Suggested Evaluation Methods

- Oral tests
- Timed written tests
- Assignments
- Project

30.3.5 DIRECT MEMORY ACCESS

Theory

30.3.5T1 Specific Objectives

By the end of the sub-module unit, the trainee should be able to:

a) Explain the need for Direct memory access (DMA)
b) Describe the DMA operation
c) Describe the operation of DMA controller

Content

30.3.5T1 Explanation of the need of DMA
30.3.5T2 Description of operation of DMA
30.3.5T3 Operation of DMA controller

i. Burst mode
ii. Cycle stealing
iii. Transparent

30.3.6 INTERFACING DEVICES

Theory

30.3.6T1 Specific Objectives

By the end of the sub-module unit, the trainee should be able to:

a) Describe the internal structure of input/output (i/o) computer interfacing devices
b) Describe the serial and parallel ports
Content

30.3.6T1 Internal I/O computer interface devices
   i. Operation of typical I/O chip
   ii. Components of I/O chips

30.3.6T2 Serial and parallel ports
   i. Serial controller
   ii. Communication interface devices
      - UART
      - ACIA
      - RS 232/422
      - IEE/488

Suggested teaching/learning Activities
   - Discussion
   - Illustration
   - Visit to industries

Suggested teaching/learning Resources
   - Programmable logic controller

Suggested Evaluation Methods
   - Oral tests
   - Timed written tests
   - Assignments
   - Timed practical tests

30.3.7 TOOLS IN ASSEMBLY LANGUAGE PROGRAMMING

Theory

30.3.7T0 Specific Objectives

By the end of the sub-module unit, the trainee should be able to:
   a) Describe tools used in assembly language
   b) Explain the procedure of documentation
Content

30.3.7T1 Description of assembly language tools
   i. The editor
   ii. Assembler
   iii. Programmer
   iv. Compiler
   v. Loader etc

30.3.7T2 Explanation of Documentation procedure
   i. Comments
   ii. Printing
   iii. Downloading
   iv. Linking

Suggested teaching/learning Activities
   • Discussion
   • Illustration
   • Visit to industries

Suggested teaching/learning Resources
   • Programmable logic controller

Suggested Evaluation Methods
   • Oral tests
   • Timed written tests
   • Assignments
   • Timed practical tests

30.3.8 CONTROL STRUCTURES

Theory

30.3.8T0 Specific Objectives

By the end of the sub-module unit, the trainee should be able to:
   a) Describe the various control levels
   b) Explain micro-programmed controllers
Content

30.3.8T1 Description of control levels
   i. Instruction sequencing
   ii. Instruction interpretation
   iii. Hard wire control
   iv. C.P.U control unit

30.3.8T2 Explanation of Documentation procedure
   i. Micro-programmed control
   ii. Micro-programmed computers
   iii. One-chip computers

30.3.9 MICRO-COMPUTER DEVELOPMENT SYSTEMS

Theory

30.3.9T0 Specific Objectives
By the end of the sub-module unit, the trainee should be able to:
   a) Explain the various development aids for microcomputers.
   b) Define concepts features and facilities of system development
   c) Apply development aids system developments

Content

30.3.9T1 Explanation of development aids
   i. Hardware
   ii. Micro-processor system
   iii. EPROM programmers
   iv. UV eraser
   v. Software programmes

30.3.9T2 Definition of concepts, feature and facilities
   i. Need
   ii. Types of operating systems
   iii. Functions
   iv. Applications
30.3.9T3 Application of the various system development aids

- Use hardware and software development aids

*Suggested teaching/learning Activities*

- Discussion
- Illustration
- Visit to industries

*Suggested teaching/learning Resources*

- Programmable logic controller
- Computers

*Suggested Evaluation Methods*

- Oral tests
- Timed written tests
- Assignments
- Timed practical tests

30.3.10 MICROPROCESSOR APPLICATIONS

*Theory*

30.3.10T0 *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to apply the microprocessor to solve various industrial problems

*Content*

30.3.10T1 Application of microprocessor in

i. Traffic lights
ii. Weighing machines
iii. Level control
iv. Timing etc.

30.3.11 MICROPROCESSOR FAULTY DIAGNOSIS

*Theory*
30.3.11T0 Specific Objectives

By the end of the sub-module unit, the trainee should be able to:

a) Identify faults in microprocessor systems
b) Describe operation of fault finding equipment
c) Explain methods of fault location in microprocessor systems

30.3.11C Competence

The trainee should have the ability to troubleshoot and repair faults in microprocessor systems.

Content

30.3.11T1 Identification of faults

a) Timing
b) Earthing
c) Noise
d) Contact bounce
e) Races
f) Constructional faults
g) Wire wrap
h) Printed grant board (PCB)
i) Internal and external faults

30.3.11T2 Fault finding equipment

i. Logic probes
ii. Current tracer
iii. Cathode ray oscilloscope
iv. Logic comparator
v. Logic pulser
vi. Logic analyser
vii. Signature analyser
viii. Bench mark tests
ix. Automatic test equipment
x. ROM test programs
xi. RAM test programs
xii. Fault location assignments

30.3.11T3 Fault finding methods
Practice

30.3.11P0 Specific Objectives

By the end of the sub-module unit, the trainee should be able to:

   a) Identify fault finding equipments using microprocessor systems
   b) Perform fault tracing and repair in microprocessor systems

Content

30.3.11P1 Fault finding equipments

30.3.11P2 Fault tracing and repair

Suggested teaching/learning Activities

   • Discussion
   • Illustration
   • Visit to industries

Suggested teaching/learning Resources

   • Programmable logic controller
   • Computers
   • Microprocessor unit

Suggested Evaluation Methods

   • Oral tests
   • Timed written tests
   • Assignments
   • Timed practical tests