Pokhara University
Faculty of Science and Technology

Course Code: ELX 176 (3 Credits) Full Marks: 100
Course Title: Microprocessor and Computer Architecture (3-1-2) Pass Marks: 45
Nature of Course: Theory and Practical Total Lectures: 45 Hrs
Level: Bachelor Program: BE(IT/Software)

1. Course Description

This course is designed to encompass the concepts of contains fundamental concepts of 8085 and 8086 microprocessor and assembly level programming. It also provides major notions for the design of processing unit, control unit architectures. It presents the various computer arithmetic algorithms to solve the computer arithmetic problems. This course also introduces memory and input/ output organization and the advance computer architecture. After completion of this course, students can design very simple CPU and Control Unit.

2. General Objectives

The major objectives of this course are to provide knowledge of:

- To acquaint the students with basic concepts of basic architecture details of microprocessor (8085/8086)
- To acquaint the students with concepts of assembly level programming using 8-bit microprocessor
- To acquaint the students with the knowledge of computer architecture and associated processing, control unit and ALU unit of very simple central processing unit.
- To develop the skills in students to choose the appropriate Memory and Input Output organization used in real world computing system.
- To acquaint the students with the knowledge of technology behind modern advance computer architectures for parallel processing and multicore architecture.

3. Methods of instructions

Lecture, Project work and Practical

4. Content in details

Specific objectives	Contents
• Understand the fundamentals of microprocessor-based system along with their real-world applications.	**Unit 1 An overview of computer and Microprocessor [2 Hrs]** 1.1.Brief overview of microprocessor and microcontroller 1.2.Organization of computer systems 1.3.Architecture of Computer 1.4.Applications of microprocessor and microcontroller
• Study the architecture of 8085 microprocessor and basic assembly level programming. • Should be able to	**UNIT 2 Architectural Details and assembly language programming of 8085 MPU [10 Hrs]** 2.1 Internal architecture and description 2.2 Instruction classification 2.3 Addressing modes 2.4 Instruction cycle, Machine cycle, t-state, Timing diagram,

understand the machine cycles involved during the execution of instructions.	RTL 2.5 Basic assembly language programs of 8085
• Familiarize with the architecture of 16 bit microprocessor 8086. • concept of memory segmentation and pipelining in modern processor.	**UNIT 3 Overview of 8086 microprocessor [3 Hrs]** 3.1 Architecture of 8086 microprocessor 3.2 Addressing modes 3.3 ALP Development Tools: Editor, Assembler and linker
• Demonstrate the design process of very simple CPU.	**UNIT 4 CPU Design [7 Hrs.]** 1.1 Overview of Generic CPU 1.2 Design and implementation of very simple CPU 1.3 Specification of very simple CPU 1.4 Fetch, decode and execution of instruction 1.5 Complete state diagram of very simple CPU 1.6 Design of register section and arithmetic logical Unit 1.7 Design of Hardwired Control Unit 1.8 Control Signal generation
• Examine the basic structure of a micro-sequencer and design a micro-sequencer control unit for a very simple CPU.	**UNIT 5 Micro-Sequencer Control Unit Design [6 Hrs.]** 5.1 Micro-sequencer operations and microinstruction format 5.2 Design and implementation of a very simple Micro sequencer 5.3 Basic layout, Control sequence generation and design of mapping logic 5.4 Generation of Micro operations using Horizontal and vertical microcode 5.5 Generation of control signals from the microcode directly 5.6 Reduction of numbers of microinstructions 5.7 Comparative analysis of Micro programmed control and Hardwired Control
• Understand the representation of binary numbers in signed and unsigned notation along with the algorithms used for the basic arithmetic operations.	**UNIT 6 Computer Arithmetic [6 Hrs.]** 6.1 Numeric format and Representation of Binary Number in signed and unsigned Notation 6.2 Addition and Subtraction in signed and Unsigned notation. 6.3 Shift and add multiplication algorithm, Booth's algorithm. (signed and unsigned) 6.4 Restoring Division Algorithm and Non Restoring Method 6.5 Floating point numbers, -IEE754 Standard, 6.6 Specialized arithmetic Hardware: Lookup ROM, Wallace Tree, Arithmetic pipeline
• Review memory Hierarchy of computer system and study the	**UNIT 7 Memory Organization [3 Hrs.]** 7.1 Memory Hierarchy 7.2 Associative memory

concept of associative and cache memory in real world scenario.	7.3 Cache Memory, Cache mapping techniques 7.4 Cache Replacement algorithm(FIFO,LRU,LFU)
• Familiarize with serial and parallel communication interfaces and introduce various methods for improving I/O performances.	**UNIT 8 Input Output Organization [4 Hrs.]** 8.1 Serial and Parallel communication interfaces 8.2 Programmed I/O 8.3 Interrupts, Types of Interrupts, Interrupt processing, Interrupt Hardware and priority 8.4 Direct Memory Access, I/O Processors 8.5 UART 8.6 USB and HDMI Standards
• Understand with the concept of instruction pipelining and multicore architecture in modern processor.	**UNIT 9 Advance Architectures [4 Hrs.]** 9.1 RISC and CISC Fundamentals 9.2 Instruction Pipeline, Register window 9.3 Flynn's Taxonomy, MIMD system topologies and architectures 9.4 Introduction to Multicore architecture

5. **Laboratory Works**

The laboratory works should include following concepts:

1. Assembly language program using 8085 microprocessor trainer kit.
   1.1 Use of all types of instructions and addressing modes. Programs including basic arithmetical, logical, looping, bitwise and branching instructions.
2. Simulation of combinational and sequential logic circuit using VHDL.
   2.1 Simulation of logic Gates, Half Adder, Full Adder, Half Subtractor, Full subtractor, Multiplexer, Demultiplexer, Encoder and Decoder.
   2.2 Simulation of different types of Flipflops, Registers and Counters
3. Computer Arithmetic can be implemented with C/C++.

2. List of Tutorials:

The various tutorial activities that outfits this course should cover all the content of this course to give students a space to engage more actively with the course content in the presence of instructor. Students should submit tutorials as assignments or class works to the instructor for evaluation. The following tutorial activities of 15 hrs should be conducted to cover all the content of this course:

A. Discussion based Tutorials [2 hrs]

1. Comparative analysis of Von-Neumann, Harvard and modified Harvard Architecture.
2. Applications of microprocessor and microcontroller based system in real world.
3. Hardware and programmable module of 8 bit microprocessor.
4. Interpret the concept of memory segmentation and pipelining in 16 bit microprocessor.
5. Review each entity memory hierarchy for modern processors.
6. Interfacing of DMA, interrupt controller and UART with 8085 microprocessor.
7. Comparative analysis of different aspects of computing system as defined in Flynn's Classification.

B. Assembly level programming tutorials [3 hrs]

1. Assembly level programming illustrating data transfer instructions, arithmetic instructions, logical instructions and branching instructions in 8085 microprocessor.
2. Enlighten PUSH and POP instructions using appropriate assembly level programs.
3. Assembly level programming for simple sequencing program, multiplication, division, table processing and sorting.
4. Timing diagram for different types of instructions and RTL of each machine cycle involved during the execution of instructions.

C. Design Thinking tutorials[3 hrs]

1. Design a CPU for any given registers set, instruction set and state diagram. Show the RTL code for each execution cycle.
2. Develop a control unit for any given state diagram.
3. Design a micro-sequencer control unit for any given specifications following design procedure.

D. Computer Arithmetic tutorials[3 hrs]

1. Perform arithmetic addition and subtraction in signed and unsigned notation for any given numbers.
2. Perform Multiplication operation for any given numbers using shift-add multiplication algorithm and Booth's algorithm.
3. Perform Division operation for any given numbers using restoring and Non restoring Division algorithm.

E. Project work [4 hrs]

Develop a case study report about any of the modern Advance superscalar processors. It should include the architecture of processor, control unit, memory as well as input output organization in detail. An oral presentation with the submission of report should be a part of work and must be included as a component for evaluation.

F. Evaluation system and Students' Responsibilities

Internal Evaluation	**Weight**	**Marks**	**External Evaluation**	**Marks**
Theory		**30**	**Semester End examination**	**50**
Attendance and class Participation	10%			
Assignments	20%			
Project work/Presentations	20%			
Term Exam	50%			
Practical		**20**		
Attendance and Lab Participation	20%			
Lab report	30%			
Practical Exam	30%			
Viva	20%			
Total Internal Marks		**50**		
Full marks=50+50				

Students Responsibility:
Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the semester End Examination. Failing to get such score will be given NOT QUALIFIED(NQ) to appear the Semester End Examination. Students are advised to attend all the classes, formal exam, test and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

G. Prescribed Text Books and references

Text Books:

1. Gaonkar, Ramesh S., Microprocessor Architecture, Programming, and Applications with 8085, Prentice Hall. New Delhi
2. Carpineili, John D., Computer system Organization and Architecture, Addison Wesley. Pearson Education Asia(LPE),2001

References:

1. Hall, Douglas V. Microprocessor and Interfacing programming and Hardware, McGraw Hill, New Delhi
2. W. Stalling, Computer Organization and Architecture, Eighth Edition, 2011, Pearson Education.
3. Tanebaum, A.S., Structured Computer Organization, Fourth edition, 2003, Pearson Education.
4. Uffenbeck, John., Microcomputers and Microprocessors, The 8080, 8085 and Z-80 Programming, Interfacing and Troubleshooting, 3rd Edition 1999, Prentice Hall, New Delhi