UNITED STATES INTERNATIONAL UNIVERSITY
SCHOOL OF SCIENCE AND TECHNOLOGY

APT2020: COMPUTER ORGANIZATION AND ASSEMBLY PROGRAMMING

Credit: 3 units

Pre-requisites:

MTH2215: Discrete mathematics
IST 1020: Introduction to Information Technology
3 Credit Units

1. PROGRAMME LEARNING OUTCOME

The following excerpts of the University Mission align the teaching of APT2020 course to the overall Program Learning Outcomes of the Applied Computer Technology degree Program

APT Program Mission Statement

The Applied Computer Technology Programme will equip graduates with knowledge, skills and values for professional success. The Programme will focus on the development, application and effective management of technology as a fundamental tool of modern society. It will contribute to the university mission outcomes which are higher order thinking; literacy; global understanding and multicultural perspective; preparedness for career; community service; and leadership and ethics.

The mission of APT program is to prepare students for job market demanding ICT Systems and Technology skills. The aim is to produce ICT specialists capable of providing ICT business solutions and leadership for organizations.

The Mission will be achieved through the following Goals and Learning Outcomes

a. Acquire IT principles in real world perspectives;
b. Develop Analytical and logical thinking, problem solving, communication skills and team work;
c. Develop Computer Technology solutions and show how they are used to enhance business and organizations run efficiently and more productively.

APT Course Learning Outcomes

At the end of this course the student should:

1. Identify and describe the basic the elements of a computer
2. Demonstrate how these elements link together
3. Describe the different forms of memory organization
4. Describe the basics of logic and number representation
5. Distinguish the different levels of programs
6. Demonstrate the structure of Pentium processor
7. Identify the new trends and technologies of computer architecture and organization.
8. Recognize the computer architecture and organization from the software standpoint.
9. Be able to write assembler programs

Course Rationale

The general rationale for this module is to gain a working understanding of the fundamental principles of computer systems. This is an essential part of a computing professional.

Course Description

The course outlines the fundamental way in which a computer works: starting with simple logic and progressing to a simple model of a microprocessor. This is followed by an appreciation of low-level programming leading to a clear understanding of the key points of machine performance.

2. Course Content

Generation of computers. Classification of computers, Organization, Structure and function, Von Neumann architecture. Performance parameters. System bus, Bus Structure. Elements of Bus design, Interrupts, Instruction Cycle state Diagram with interrupts/Without interrupts, Functions of OS, Uniprogramming , Multiprogramming, Time Sharing systems, Internal memory-ROM, PROM, EPROM, Flash memory, External memory-Magnetic memory, RAID, Optical memory, Magnetic Tape, I/O Devices-Function of I/O module, Programmer I/O, Interrupt Driver I/O DMA , External Interface (Serial, Parallel), ALU, Binary Arithmetic, Floating point Arithmetic, Basic combinational and sequential Circuit Design, Instruction sets, Instruction Pipelining, Types of processors, Micro operations, Control unit Implementation-Hardwired, Micro programmed, Overview of parallel Processing.

3. PROGRAMME LEARNING OUTCOMES

The APT2020 addresses the following Programme Learning Outcomes (PLOs)

- **PLO2:** Conceptualize and Implement integrated Systems.
- **PLO5:** Explain the Concepts Underlying Computer Information Processing

LINK TO UNVERSITY MISSION OUTCOMES, SCHOOL OF SCIENCE OUTCOMES, AND APT PROGRAMME

i. University Mission Outcomes
The course content for APT2020 directly contributes to the attainment of University Mission Outcomes in:

- Higher Order Thinking
- Literacy
- Preparedness for career

ii. School of Science and Technology Outcomes.
The course content directly contributes to the School of Science and Technology Mission Outcomes in:

- Multidiscipline – Computer Technology in Industries and Business
- Globe Oriented – Innovation and Creativity
- Change Oriented – Innovation and Creativity
- Initiative and Problem solving
- Team Player – Project Work, Discussion
- Effective Communication – Class Participation, writing skills

4. CORE CURRICULUM INTELLECTUAL COMPETENCIES

Reading: the ability to analyze and interpret a variety of printed materials - books, documents, and articles

Writing: the ability to produce clear, correct and coherent prose adapted to purpose, occasion and audience

Speaking: ability to communicate orally in clear, coherent, and persuasive language appropriate to purpose, occasion, and audience

Listening: analyze and interpret various forms of spoken communication, possess sufficient literacy skills of writing, reading

Critical Thinking: think and analyze at a critical level

Computer Literacy: understand our technological society, use computer based technology in communication, solving problems, acquiring information.

5. COURSE OUTLINE

Week	Topic/Lecture	Laboratory/Assignment	Readings/Resources
Week 1	**Review of Computer Systems** • Overview of the course. • Computer Generations	Assignment 1: Computer Generations	1. History of Computers: ▪ Stallings pg16-23; 2. Tanenbaum: chap1-pg13-24
Week 2	**Number Systems** ▪ Number Bases • Decimal System • Binary System • Octal System • Hexadecimal system • **Numbers, arithmetic operations and characters.** • Addition and subtraction of integer signed (binary) numbers - One's and two's complements • Overflow in integer arithmetic. • **Floating Point Arithmetic**	Assignment 2: Number Systems 1. Tanenbaum: Q1,2,3, 5, 6, 7, 9, 10, 12	1. Tanenbaum : Appendix A;Pg631-642 2. Stallings: Appendix B, pg 733-740: Chapter 9 3. Allen Clements: Chapter 4.
3.	**Digital Logic** • Gates and Boolean algebra • Basic Digital Logic Circuits • Basic combinational and sequential Circuit Design • Properties of Boolean Algebra: The Sum-of-Products Form, and Logic Diagrams The Product-of-Sums Form	• Introduction to digital logic using Digital Works o Lab1: Creating logic circuits o Lab2: Creating inputs and observing outputs using o Demonstrating Digital Logic and Boolean Algebra	**Tanenbaum** Chap 3: pg 135-146; **Stallings:** Chap. 11, pg387-392 Exercises: Problems1, 2, 3, 5, 11
4.	• **Computer Organization, Structure and function; Von Neumann architecture** • System bus, Bus Structure. • Elements of Bus design, • Performance Parameters	• Demonstration – Components of a computer • Connecting of input/output devices • Introduction to Using the Processor Boards	1. Tanenbaum Chap1: pg18-19; Chap2:pg
5	▪ **Memory System** • Primary • Secondary • Internal memory-ROM, PROM, EPROM, Flash memory, Cache • External memory-Magnetic memory, RAID, Optical memory, Magnetic Tape, • Memory locations and addresses. Byte accessibility and alignment	• **<u>Test 1: Previous topics</u>** • Stallings Chap 5: Q1, 4 Chap6: Review questions 5,6,7 Problems: 2, 4 See supplementary problems on blackboard handout. • Class experiments with Basic ICs using Digital works	1. Tanenbaum – Chap 2: pg.56-88;69-102 2. Stallings: Chap.5,6 3. Clements Chap 9

	• . Static and dynamic random access memories (RAM, DRAM). Synchronous and asynchronous DRAMs. Latency and bandwidth.		
6	**CPU** • CPU Chips o ALU • Examples of CPU's • The 80x86 family • SPARCs • Motorola • RISC and CISC computers ▪ Buses • Examples of Buses • Memory Configuration	• Analysis of internal microprocessor's registers and addressing modes • Lab experiments with ICs Assignment 3 – On blackboard	1. Tenebaum - Chap 3, pg.173-174 2. Stallings – Chap 12, pg 412-444 3. Allen Clements: Chapter 5
7	• **Mid Semester Exam** • **Interfacing I/O Devices** • Peripheral Devices • Memories • I/O devices • Function of I/O module, • Programmer I/O (Program), • Interrupt Driver I/O • DMA	Tanenbaum: Exercises pg133-134 No. 19, 26, 27, 28, 29 Assignment 4 – On blackboard	Tanenbaum:Chap2: pg102-131 Allen Clements Chap 8
8	**Field Visit** • Traps • **Interrupts** • Instruction Cycle state Diagram with interrupts/Without interrupts • Interrupt hardware. • Enabling and disabling interrupts. Interrupt Priorities. • Stacks and Queues. • Handling multiple devices. • Vectored interrupts. Interrupt nesting. Simultaneous requests • Functions of OS, - Uniprogramming , Multiprogramming, Time Sharing systems - Process	- Circuit designs with Basic ICs: - Hand out of Group Projects	1. Tanenbaum: pg404-408 2. Allen pg407-413; 542-544

	- Process Management - Memory and File Management - Examples of Operating Systems • **Group Project Handout**		
9	• **Instruction Set** Addressing modes revisted • **Field Visit** • **Group Project**	• Analyses of flag register • Experiments with 8086	1. Tanenbaum Chap 5, pg360-370. 2. Stallings Chap 13, pg473-490;
10	• **Group Project** • **Instruction Pipelining, Types of processors, Micro operations**	**Test 2- From Mid-Sem** Lab: Group Projects Circuit Designs with basic ICs	Stallings Chap 14, pg505-532
11	• **Group Project** • Control unit Implementation-Hardwired • Micro programmed, • Overview of parallel Processing.	Lab work on group projects	Stallings Chap 17, pg634-644 Allen Chap 5
12	**Group Project Presentation** **Group Project Report**	Group Projects class presentations	
13	**Revision Exercises**	Revision	
14	**Final Semester Exam**	Final Examination	

6. TEACHING METHODOLOGY

1. Teaching
   - Classroom lectures, discussions, and problem-solving sessions. Homework, lab work
   - A series of lectures and laboratory exercises will be used to study the concepts. Audio-visual aids will be used in the lectures. The first **15 minutes** of every lecture will be for reviewing the concepts already covered and for testing students understanding of the reading assignment material. The laboratory exercises will cover digital logic and programming of an example of CPU.
2. **Instructional Material/Equipment**

Single board microcomputer, Digital simulators e.g. Digital Works, 8086 emulators

3. Methods of Evaluation

Participation	5%
Quizzes	5%
Assignments	15%
Labs	10%

Project	15%
Mid-semester	20%
Final semester exams	30%
Total	**100%**

4. GRADE DISTRIBUTION

Numeric Average (100% Maximum)	Letter grade	Numeric Average (100% Maximum)	Letter grade
90 or above	A	70-73	C
87-89	A-	67-69	C-
84-86	B+	64-66	D+
80-83	B	62-63	D
77-79	B-	60-61	D-
74-76	C+	0-59	F

5. Course Text

Computer organization and design: the hardware/software interface by David A. Patterson, John L. Hennessy 2009

6. Recommended Reading

Principles of computer organization and Assembly language: using the Java by *Patrick Juola 2007*

Computer Organization and Architecture: Designing for Performance, 7th edition, William Stallings, 2006, Prentice Hall.

Tanenbaum AS, Structured Computer Organization 5th Edition, Prentice Hall 2005

Computer Architecture and Organization: An Integrated Approach, Miles Murdocca & Vincent Heuring, Wiley, 2007, ISBN: 978-0-471-73388-1

M Morris Mano. Computer System Architecture. Pearson Higher Education. 1992. ISBN: 0131757385

Essentials of Computer Architecture, Douglas E. Comer, 2004, Prentice Hall.

Computer Systems Design and Architecture, 2nd edition, V. Heuring, and H. Jordan, 2004, Prentice Hall.

The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, and Pentium Pro Processor Architecture, Programming, and Interfacing, by Barry B. Brey, 7th edition (March 23, 2005), Prentice Hall, ISBN: 0131195069

Microcontroller Technology: ***The 68Hc11***, Spasov, Peter. ISBN 10: 0131129848 ISBN 13: 9780131129849