JSC «Kazakh-British Technical University»
Faculty of Information Technology

APPROVED BY
Dean of FIT
_____Rasim Suliyev
«____»_____ 201__

SYLLABUS

Discipline: Advanced Computer Architecture
Number of credits: 3
Term: Fall 2019
Instructor's full name: Raman Buzaubakov

Personal Information about the Instructor	Time and place of classes		Contact information	
	Lessons	Office Hours	Tel.:	e-mail
Raman Buzaubakov, MSc	According to the schedule	According to the schedule		raman.buzaubakov@gmail.com

Course duration: 3 credits, 15 weeks, 60 class hours

Course description:
This course aims to provide students with a fundamental knowledge of computer hardware and computer systems, with an emphasis on system design and performance. The course concentrates on the principles underlying systems organisation, issues in computer system design, and contrasting implementations of modern systems.

Course objectives
The objective of this course is to introduce different types of computer architectures and understand the fundamental techniques on which high-performance computing is based, to develop the foundations for analysing the benefits of design options in computer architecture, and to give some experience of the application of these techniques.

Couse outcomes
By the end of the course, a student should be able to:

- Discuss the organisation of computer-based systems and how a range of design choices are influenced by applications
- Understand different processor architectures and system-level design processes.
- Understand the components and operation of a memory hierarchy and the range of performance issues influencing its design.
- Understand the organisation and operation of current generation parallel computer systems, including multiprocessor and multicore systems.
- Understand the principles of I/O in computer systems, including viable mechanisms for I/O and secondary storage organisation.
- Develop systems programming skills in the content of computer system design and organisation.

Course pre-requisites
Computer Organisation and Architecture.

Literature
1. Advanced Computer Architecture, 3rd edition, Kai Hwang, Naresh Jotwani, McGraw-Hill Education, 2016

2. Computer Architecture: Pipelined and Parallel Processor Design, Michael J. Flynn, Jones & Bartlett Learning, 1995.
3. W. Stallings, Computer Organization and Architecture: Designing for Performance (9th Edition), Prentice Hall, May 2012.
4. J. L. Hennessy, D. A. Patterson, Computer Architecture: A Quantitative Approach (5th Edition), Morgan Kaufmann, October 2011.

COURSE CALENDAR

Week	Topic	Lecture
1	Introduction and Background. Review of basic computer architecture. Technology trend and design goals. Performance metrics and performance enhancement techniques. Key concepts of parallel processing and pipelining.	3
2	Parallel Computer Models. The State of Computing. Multiprocessors and Multicomputer. Muttivector and SIMD computers. PRAM and VLSI models. Architectural Development tracks.	3
3	Program and Network Properties. Conditions of Parallelism. Program Partitioning and Scheduling. Program Flow Mechanisms. System Interconnection Architectures.	3
4	Principles of Scalable Performance. Performance Metrics and Measures. Parallel Processing Applications. Speedup Performance Laws. Scalability Analysis and Approaches.	3
5	Processor and Memory Hierarchy. Advanced Processor Technology. Superscalar and Vector Processors. Memory Hierarchy Technology. Virtual Memory Technology.	3
6	Bus, Cache and Shared Memory. Bus Systems. Cache Memory Organizations. Shared-Memory Organizations. Sequential and Weak Consistency Models.	3

7	Pipelining and Superscalar Techniques. Linear Pipeline Processors. NonLinear Pipeline Processors. Instruction Pipeline Design. Arithmetic Pipeline Design. Superscalar and Superpipeline Design.	3
8	**Midterm Exam**	3
9	Multiprocessors and Multicomputers. Multiprocessor System Interconnects. Cache Coherence and Synchronization Mechanisms. Three generations of Multicomputers. Message Passing Mechanisms.	3
10	Multivector and SIMD Computers. Vector Processing Principles. Multivector Multiprocessors. Compound Vector Processing. SIMD Computer Organizations. The Connection Machine (CM-5).	3
11	Scalable, Multithreaded and Dataflow Architectures. Latency-Hiding Techniques. Principles of Multithreading. Fine-Grain Multicomputers. Scalable and Multithreaded Architectures. Dataflow and Hybrid Architectures.	3
12	Parallel Models, Languages and Compilers. Parallel Programming Models. Parallel Languages and Compilers. Dependency Analysis of Data Arrays. Code Optimization and Scheduling. Loop Parallelization and Pipelining.	3
13	Parallel Program Development and Environments. Parallel Programming Environments. Synchronization and Multiprocessing Models. Shared-Variable Program Structures. Message-Passing Program Development. Mapping Programs onto Multicomputers.	3
14	Quantum Computers Overview. Differences between tradittional computers and quantum ones. Performance comparisons.	3
15	**Endterm Exam**	3

Course assessment parameters

Type of activity	1	2
Quiz	5	5
Midterm/Endterm	25	25
Attendance / participation	7	6

Final exam	40
Total	**113**

Criteria for evaluation of students during semester

No	Assessment criteria	Weeks															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1.	Quiz					*							*				10
3.	Attendance / participation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	13
4.	Midterm / end of term								*							*	50
5.	Final exam																40
	Total																113

Academic Policy

KBTU standard academic policy is used.

- Cheating, duplication, falsification of data, plagiarism, and crib are not permitted under any circumstances!
- Attendance is mandatory.

  Attention. Missing 20% attendance to lessons, student will be taken from discipline with filling in F (Fail) grade.

  Students must participate fully in every class. While attendance is crucial, merely being in class does not constitute “participation”. Participation means reading the assigned materials, coming to class prepared to ask questions and engage in discussion.
- Students are expected to take an active role in learning.
- Written assignments (independent work) must be typewritten or written legibly and be handed in time specified. Late papers are not accepted!
- Students must arrive to class on time.
- Students are to take responsibility for making up any work missed.
- Make up tests in case of absence will not normally be allowed.
- Mobile phones must always be switched off in class.
- Students should always be appropriately dressed (in a formal/semi-formal style).
- Students should always show tolerance, consideration and mutual support towards other students.

Master of Science *Raman Buzaubakov*

Minutes # __ of Faculty of Information Technology on , «__»_____,20__.