Lahore University of Management Sciences

EE 520 / CS 622 – Computer Architecture

(Fall 2025)

Instructor	Dr. Shahid Masud
Room No.	EE Dept. 9-223A, Maxwell Wing
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Secretary/TA	Will be announced on LMS
TA Office Hours	Will be announced on LMS
Course URL (if any)	LMS will be used
Support Services	LUMS offers a range of academic and other services to support students. These are mentioned below, and you are encouraged to use these in addition to in-class assistance from course staff. For a complete list of campus support services available for you click here (https://advising.lums.edu.pk/#supportservices)

Course Details	
Credit Hours	**3 (Theory)**
Core	MS EE (Electronics and Embedded Systems Stream), MS DES (Digital Embedded Systems)
Elective	BS EE, BS CS, MS CS, MS EE
Open for Student Category	EE Seniors, CS Juniors, CS Seniors, EE Graduate Students, CS Graduate Students
Closed for Student Category	Freshman / Sophomore

Course Catalog Description

This course extends the concepts of computer organization and microprocessor architecture to more advanced topics. Hence a strong background in undergraduate level computer design is mandatory to take this course. The students are assumed to have taken EE/CS-320, EE-324, CS-225 or similar courses in their undergraduate studies. These topics taught in this course include advanced pipelining, Instruction Level Parallelism (ILP), dynamic scheduling, thread level parallelism (TLP), multi-processors, memory systems, storages, and I/O devices. The course provides the students with current trends and future insight into modern computer architecture design.

Course Prerequisite(s)/Co-Requisite(s)

Pre-requisite: EE 322 OR EE 324 OR CS 320 / EE 320 OR CS 225 OR Grad Standing

Course Offering Details (online offering may require some changes)						
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	75 min	Timings and Venue	TBA
Recitation (per week)	Nbr of Rec (s) Per Week	X	Duration			
Lab (if any) per week	Nbr of Session(s) Per Week	X	Duration			
Tutorial (per week)	Nbr of Tut(s) Per Week	X	Duration			

Course Learning Outcomes

The students completing EE 421 / CS 425 should be able to:

CLO1: Describe the performance evaluation criteria of computers and compare performance of different computing systems.

CLO2: Describe advanced concepts for performance improvement in computer architecture like multi-cycle pipeline, dynamic scheduling, dynamic branch prediction, loop unrolling, multi-issue, multi-threading, multi-cores, etc. and

CLO3: analyze their impact on a given machine.
Appreciate existing bottlenecks in computer architecture designs (e.g., control and data hazards, exceptions, limited ILP, etc.) and suggest potential solutions.

CLO4:	Describe the concepts of memory hierarchy, caches and virtual memory, and analyze their optimizations and contribution toward performance improvement of a computing machine.

Course Learning Relation to EE Program Outcomes				
EE/421 CLOs	**Related PLOs**	**Levels of Learning**	**Teaching Methods**	**CLO Attainment checked in**
CLO1	PLO1	Cog-2	Instruction, Assignments	Midterm, Final, Quizzes
CLO2	PLO1	Cog-2	Instruction, Assignments	Midterm, Final, Quizzes
CLO3	PLO2	Cog-5	Instruction, Assignments	Midterm, Final, Quizzes
CLO4	PLO2	Cog-4	Instruction, Assignments	Final, Quizzes

Grading Breakup and Policy
Class quizzes: (5 – 6 quizzes, one dropped): 20% Assignments: (1 - 2): 10% Midterm exam: 30% Final exam: 40%

Examination Detail	
Midterm Exam (online modalities)	Yes/No: Yes Combine Separate: NA Duration: 75 min (based on practical modalities) Preferred Date: TBA Exam Specifications: TBA
Final Exam (online modalities)	Yes/No: Yes Combine Separate: NA Duration: 120 min (based on practical modalities) Exam Specifications: TBA

Campus supports & Key university policies

Campus Supports

Students are strongly encouraged to meet course instructors and TA's during office hours for assistance in course-content, understand the course's expectations from enrolled students, etc. Beyond the course, students are also encouraged to use a variety of other resources. (Instructors are also encouraged to refer students to these resources when needed.) These resources include Counseling and Psychological Services/CAPS (for mental health), LUMS Medical Center/LMC (for physical health), Office of Accessibility & Inclusion/ OAI (for long-term disabilities), advising staff dedicated to supporting and guiding students in each school, online resources (https://advising.lums.edu.pk/advising-resources), etc. To view all support services, their specific role as well as contact information click here (https://advising.lums.edu.pk/#supportservices).

Academic Honesty/Plagiarism

LUMS has zero tolerance for academic dishonesty. Students are responsible for upholding academic integrity. If unsure, refer to the student handbook and consult with instructors/teaching assistants. To check for plagiarism before essay submission, use similarity@lums.edu.pk. Consult

the following resources: 1) Academic and Intellectual Integrity (http://surl.li/gpvwb), and 2) Understanding and Avoiding Plagiarism (http://surl.li/gpvwo).

LUMS Academic Accommodations/ Petitions policy

Long-term medical conditions are accommodated through the Office of Accessibility & Inclusion (OAI). Short-term emergencies that impact studies are either handled by the course instructor or Student Support Services (SSS). For more information, please see Missed Instrument or 'Petition' FAQs for students and faculty (https://rb.gy/8sj1h)

LUMS Sexual Harassment Policy

LUMS and this class are a harassment-free zone. No behavior that makes someone uncomfortable or negatively impacts the class or individual's potential will be tolerated.

To report sexual harassment experienced or observed in class, please contact me. For further support or to file a complaint, contact OAI at oai@lums.edu.pk or harassment@lums.edu.pk. You may choose to file an informal or formal complaint to put an end to the offending behavior. You can also call their Anti-Harassment helpline at 042-35608877 for advice or concerns. *For more information: Harassment, Bullying & Other Interpersonal Misconduct: Presentation (http://surl.li/gpvwt)*

Lecture / Week	Course Topics	Readings
1 / Wk 1	Introduction to Computer Architecture	Chap 1
2 / Wk 1	Performance Metrics of a Computer System	
3 / Wk 2	Review – Principles of ISA	App A
4 / Wk 2		
5 / Wk 3	Pipelining, Limitations, Hazards, Static Branch Prediction	App C
6 / Wk 3		
7 / Wk 4	//	
8 / Wk 4		
9 / Wk 5	Instruction Level Parallelism, Static and Dynamic Scheduling, Tomasulo's Algorithm, Dynamic Branch Prediction	Chap 2
10 / Wk 5		
11 / Wk 6	//	
12 / Wk 6		
13 / Wk 7	Hardware Based Speculation	Chap 3
14/ Wk 7		
15 / Wk 8	**Midterm Exam**	
16 / Wk 8	Superscalar and VLIW Architectures	Chap 3
17 / Wk 8		
18 / Wk 9	Limitations of ILP and Thread Level Parallelism	Chap 5
19 / Wk 9		
20 / Wk 10	Caches – Hits, Miss, Types and Organization	App B, Chap 2
21 / Wk 10		
22 / Wk 11	//	
23 / Wk 11		
24 / Wk 11	Simultaneous Multithreading (SMT), Multiprocessors, Memory Hierarchy, Cache Coherence	Chap 5
25 / Wk 12		Notes
26 / Wk 13	System protection, Virtual Memory, Virtual Machines	Chap 2
27 / Wk 14		
	Final Exam Week 15 or 16	

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Textbook(s)/Supplementary Readings
Textbook: "Computer Architecture: A Quantitative Approach" by John L. Hennessy and David A. Patterson, 6th Ed. Supplementary Reading: Hand-outs and online links will be provided where needed

Prepared by:	**Dr. Shahid Masud**
Date:	**Updated: 12 June 2025**