Basic Information:

Title:	Advance Computer Architecture	**Code**	IT 665
Program:	MBIT (Major in Information Technology)	**Credit Hours:**	Three (03)
Sessions:	30 Classes + Mid Term + Final Term	**Pre-Requisite:**	BBIT (Major in IT)

Course Description:

The course of computer architecture is concerned with the structure and behavior of the various functional modules of computer and how the interact to provide the processing needs of the user. Computer design is concerned with the development of hardware for the computer taking into consideration a given set of specifications. Detailed steps that a computer designer must go through in the organization and architecture of CPU are also covered

Learning Outcomes:

After the completion of this course, it is expected that students who will involve themselves in the knowledge base working of the course will be capable to

1. *an ability to understand the design of a pipelined CPU and cache hierarchy*
2. *an ability to analyze and evaluate CPU and memory hierarchy performance*
3. *an understanding of trade-offs in modern CPU design including issues affecting superscalar and dynamically scheduled architectures*
4. *an understanding of hardware design of multiprocessors including cache coherence and synchronization*
5. *an ability to understand the advanced domain specific architectures.*

Teaching Learning Methodology:

The formal teaching component of this course consists of active student participation in and contribution to all forms of teaching and learning i.e. lectures, discussions, research assignments and projects. Lectures will be twice a week of 90 min each.

Group Configurations:

One of the objectives of this course is to encourage and facilitate teamwork. Class will have to make a group of four for projects and research assignments. It is recommended that student will form their own groups. As a general guideline, your group should have members with diverse skill sets including people who are proficient or have aptitude for different subject areas.

Weekly Term Plan

Wk	Lecture Topic
01	*Course Introduction and Quantifying Cost and performance*
02	*Instruction Set Architecture*
03	*Register Reference Instructions, Verilog I*
04	*MIPS Architecture*
05	*Data Path design of MIPS Instructions, Verilog II*
06	*Pipelining of MIPS*
07	*Handling Pipeline Hazards*
08	*Memory Hierarchies and Performance,*
09	*Mid Term Examinations*
10	*Single Cycle and Multi Cycle Implementation of MIPS*
11	*Multicore, Multiprocessor and Clusters Architecture*
12	*New Era of Architecture: Domain specific architecture (DSA)*
13	*GPUs Architecture*
14	*NVIDIA Architecture*
15	*AMD Architecture*
16	*Final Term Examination*

Topics in Detail

Quantifying cost and performance
- *Performance*
- *Power Wall*

Computer Organization
- *8086 architecture*
- *Memory addressing*
- *Memory segments*

MIPS
- *Logical Instructions*
- *Instructions for making decision*
- *MIPS addressing for 32-bit immediate and Addresses*

ARM Instructions

X86 Instructions

Processor Design
- *Logic Design Conventions*
- *Building a Datapath*
- *An overview of Pipelining*
- *Pipelined Datapath and control*
- *Data Hazards*
- *Control Hazards*
- *Exceptions*
- *Parallelism and Advanced Instructions level parallelism*

Memory Hierarchy
- *Cache basic*
- *Measuring and Improving cache performance*
- *Virtual memory and Virtual machines*
- *Cache coherence*
- *Cache controllers*

Multicore, Multiprocessor and Clusters Architecture
- *The difficulty of creating parallel programs*
- *Shared Memory Multiprocessors*
- *Hardware Multithreading*
- *Multiprocessors Network Topologies*
- *Multiprocessors Benchmarking*
- *Four Multicores using Roofline Model*

Domain Specific Architecture
- *NVIDIA Architecture*
- *AMD Architecture*

Verilog

Text & Recommended Readings

1. *Computer Organization and Design by Hennessy and Patterson*
2. *Computer System Architecture by Morris Mano*

Assignment Specification

Microsoft Word for Documentation

Headings	*Arial 11pt Bold*
Normal Text	*Times New Roman 10pt*
Header Footer	*Times New Roman 8pt*
Paragraph	*Single Line Spacing*
	First Line Indent 1.0 cm
Page Margins	*2 cm from each side*

Grading Policy:

Final Grade for this course will be the cumulated result of the following term work with relevant participation according to the quoted percentage.

Sessional	**25%**		***Mid Term***	**35%**		***Final Term***	**40%**
Assignments	10 %		*Mid Term Exam*	25%		*Final Exam*	30%
Quizzes	10%		*Major Report/Work*	10%		*Case Study/ Project/ Term Paper*	10%
Presentations	05%						

Remember subdivision of Mid Term and Final Term Examination should be done only in extreme cases of very essential and major Grading Instruments.

Dishonest Practices & Plagiarism

Any student found responsible for dishonest practice/cheating (e.g. copying the work of others, use of unauthorized material in Grading Instruments) in relation to any piece of Grading Instrument will face penalties like deduction of marks, grade 'F' in the course, or in extreme cases, suspension and rustication from IBIT.
For details consult Plagiarism Policy of PU at http://pu.edu.pk/dpcc/downloads/Plagiarism-Policy.pdf

Grading System:

Letter Grade	Grade Point	Num Equivalence
A	4.00	85 – 100 %
A-	3.70	80 – 84 %
B+	3.30	75 – 79%
B	3.00	70 – 74 %
B-	2.70	65 – 69 %
C+	2.30	61 – 64 %
C	2.00	58 – 60 %
C-	1.70	55 – 57 %
D	1.00	50 – 54 %
F	0.00	Below 50 %
I	Incomplete	*
W	Withdraw	*

Norms to Course:

- ✓ *Submission Date and Time for the term instruments is always* **Un-Extendable**.
- ✓ *7 Absentees in class will be result in forced withdrawal.* ***(PU Policy)***
- ✓ *Re-sit in Mid and Final Term will cause you a loss of 2 and 3 grade marks respectively.* ***(PU Policy)***
- ✓ *This is your responsibility to keep track of your position in class evaluation units.*
- ✓ *After the submission date, NO excuse will be entertained.*
- ✓ ***Keep a copy of all submitted Grading Instruments.***
- ✓ *Assignment is acceptable only in its Entirety.*
- ✓ *No make up for any assignment and quiz.*
- ✓ *Copied & Shared work will score Zero.*
- ✓ *Assignments are Individual.*

Good Luck