KALASALINGAM
ACADEMY OF RESEARCH & EDUCATION
(DEEMED TO BE UNIVERSITY)

Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

SCHOOL OF COMPUTING

DEPARTEMENT OF COMPUTER SCIENCE AND ENGINEERING

COMPUTER ARCHITECTURE AND ORGANIZATION (CSE18R174)

COURSE INFORMATION SHEET

ACADEMIC YEAR (2018 -2019)

ODD SEMESTER

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UNIVERSITY VISION	UNIVERSITY MISSION
To be a Centre of Excellence of International Repute in Education and Research.	To Produce Technically Competent, Socially Committed Technocrats and Administrators through Quality Education and Research

COMPUTERE SCIENCE AND ENGINEERING DEPARTMENT	
VISION	**MISSION**
To become a Centre of Excellence in Teaching and Research in the field of Computer Science and Engineering	To prepare the students for a prospective career in IT industry and for higher learning by imparting soundtechnical knowledge. • To carry out research in cutting edge technologies in computer engineering to meet the requirement of the industry and society

PROGRAMME EDUCATIONAL OBJECTIVES

Within a few years of obtaining an undergraduate degree in Electronics and Communication Engineering, the students will be able to:

PEO1: TECHNICAL PROFICIENCY:

The Graduates will be technically competent to excel in IT industry and to pursue higher studies.

PEO2: PROFESSIONAL GROWTH:

The Graduates will possess the skills to design and develop economically and technically feasible computing systems using modern tools and techniques.

PEO3: MANAGEMENT SKILLS:

The Graduates will have effective communication skills, team spirit, ethical principles and the desire for lifelong learning to succeed in their professional career.

PROGRAMME SPECIFIC OUTCOMES

At the end of the programme, the students will be able to:

PSO1 :Problem-Solving Skills : The ability to apply mathematics, science and computer engineering knowledge to analyze, design and develop cost effective computing solutions for complex problems with environmental considerations.

PSO2:Professional Skills: The ability to apply modern tools and strategies in software project development using modern programming environments to deliver a quality product for business accomplishment.

PSO3: Communication and Team Skill: The ability to exhibit proficiency in oral and written communication as individual or as part of a team to work effectively with professional behaviours and ethics.

PSO 4: Successful Career and Entrepreneurship: The ability to create a inventive career path by applying innovative project management techniques to become a successful software professional, an entrepreneur or zest for higher studies.

PROGRAMME OUTCOMES (R2017)

At the end of the programme, the students will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life -long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life -long learning in the broadest context of technological change.

SYLLABUS

CSE18R174	COMPUTER ARCHITECTURE AND ORGANIZATION	L	T	P	Credit
		4	0	2	5

Pre-requisite :--

Course Category : Program Core **Course Type:** Integrated Course

Course Objective:

1. To make acquainted the students about the functional units of computer and how each unit works along with the architectural and performance issues.

Course Outcomes:

CO1 : Examine functional units of computer, bus structure and addressing mode
CO2 : Apply the knowledge of algorithms to solve arithmetic unit problems.
CO3 : Demonstrate single bus, multiple bus organization and pipelining concepts
CO4 : Analyze RAM, ROM, Cache memory and virtual memory concepts
CO5 : Evaluate the various I/O interfaces

Mapping of Course Outcomes with PO, PSO:

	POs												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	S												S			
CO2	S			S	S								S			S
CO3	S	S		S	S						M		S	S		
CO4	S	S		S	S								S	S		
CO5	S	S	S	S	S	M	M				M	M	S	S		S

UNIT I BASIC STRUCTURE OF COMPUTERS

Functional Units - Basic Operational Concepts - Bus Structures - Software Performance – Memory Locations and Addresses – Memory Operations – Instruction and Instruction Sequencing – Addressing Modes – Assembly Language – Basic I/O Operations – Stacks and Queues.

UNIT II ARITHMETIC UNIT

Addition and Subtraction of Signed Numbers – Design of Fast Adders – Multiplication of Positive Numbers - Signed Operand Multiplication and Fast Multiplication – Integer Division – Floating Point Numbers and Operations.

UNIT III BASIC PROCESSING UNIT

Fundamental Concepts – Execution of a Complete Instruction – Multiple Bus Organization – Hardwired Control – Micro Programmed Control - Pipelining – Basic Concepts – Data Hazards – Instruction Hazards – Influence on Instruction Sets – Data Path and Control Consideration – Superscalar Operation.

UNIT IV MEMORY SYSTEM

Basic Concepts – Semiconductor RAMs - ROMs – Speed - Size and Cost – Cache Memories - Performance Consideration – Virtual Memory - Memory Management Requirements – Secondary Storage.

UNIT V I/O ORGANIZATION

Accessing I/O devices – Interrupts – Direct Memory Access – Buses – Interface Circuits – Standard I/O Interfaces (PCI, SCSI, USB).

List of Practical Components:

1. Implementation of booth algorithm
2. Implementation of sequential circuit binary multiplier
3. Implementation of bit pair recording
4. Implementation of carry save addition
5. Implementation of Integer restoring division
6. Implementation of Integer Non restoring division
7. Implementation of twos complement addition
8. Implementation of twos complement subtraction

Text Book:

1. Carl Hamacher, ZvonkoVranesic and SafwatZaky, Computer Organization, McGraw-Hill, 5th Edition 2012.

Reference Books:

1. William Stallings, Computer Organization and Architecture – Designing for Performance, PHI pvt Ltd, 4th Edition, 2012.
2. David A.Patterson and John L.Hennessy, Computer Organization and Design: The hardware software interface, Morgan Kaufmann, 3rd Edition, , 2007.
3. John P.Hayes, Computer Architecture and Organization, McGraw Hill, 3rd Edition, 1998

WEIGHTAGE:

Component	Marks
Internal Exam 1. Sessional Examinations : 20% 2. Assignments/Seminars/Tutorial/Quiz : 10% 3. Laboratory Work(Internal) : 20	50
External Exam End Semester Exam : 35% External Practical Exam : 15%	50
Total	100

COURSE INFORMATION SHEET

Course Name / Code	Computer Architecture and Organization – CSE18R174		
Degree / Branch	B.Tech., CSE		
Course Credit	5 (4-0-2)		
Course Category	Programme Core – Integrated Course		
Course Instructors	**Faculty Name**	**Contact Details**	
		Staff Room	**E-mail**
	Dr. S. P. Balakannan	8307A & KEEE office /Admin Block	balakannansp@klu.ac.in
	Mr. M. Raja	8611	mraja@klu.ac.in
	Mr. C. Balasubramanian	8611	c.balasubramanian@klu.ac.in
Course Coordinator	Mr. M. Raja		
Module Coordinator	Dr. A. Robert Singh		
Programme Coordinator	Dr. K. Kartheeban		

1. Pre-requisite:--

2. Course Description:

Thiscourseaimstoprovideastrongfoundationforstudents tounderstandcomputer systemarchitectureandtoapplytheseinsightsandprinciplestofuturecomputerdesigns.Thecourseisstructure daroundthethreeprimarybuildingblocksofgeneral-purposecomputingsystems:processors,memories,andinput/output.

Thiscourseincludestheorganizationandarchitectureofcomputersystemshardware;instructionsetarchitec tures;addressingmodes;registertransfernotation;processordesignandcomputerarithmetic;memorysyste ms;hardwareimplementationsofvirtualmemory,and input/outputcontrolanddevices.

3. Career Opportunities:

Computers have become a ubiquitous part of modern life, and new applications are introduced every day. The use of computer technologies is also commonplace in all types of organizations, in academia, research, industry, government, private and business organizations. As computers become even more pervasive, the potential for computer-related careers will continue to grow and the career paths in computer-related fields will become more diverse.

4. Course Objectives:

To make acquainted the students about the functional units of computer and how each unit works along with the architectural and performance issues.

5. Course Outcomes:

At the end of the course, the students will be able to

CO1: Examine functional units of computer, bus structure and addressing mode
CO2: Apply the various algorithms to solve arithmetic unit problems.
CO3: Demonstrate single bus, multiple bus organization and pipelining.
CO4: Analyze RAM, ROM, Cache memory and virtual memory.
CO5: Explore the various I/O interfaces

6. Mapping of Course Outcomes with PO, PSO:

	POs												PSOs			
	1	2	3	4	5	6	7	8	7. 9	10	11	12	1	2	3	4
CO1	S												S			
CO2	S			S	S								S			S
CO3	S	S		S	S						M		S	S		
CO4	S	S		S	S								S	S		
CO5	S	S	S	S	S	M	M				M	M	S	S		S

8. Books:

Sl.		Book Name	Author(s)	Publisher	Year, Edition
Text(s)	1	ComputerOrganization	CarlHamacher,ZvonkoVranesicand SafwatZaky	McGraw Hill, India	(5th Edition) 2016
Reference(s)	1	WilliamStallings	ComputerOrganizationandArchitecture–Designing forPerformance	PearsonEducation	6thEdition,2003.
	2	ComputerArchitectureandOrganization	JohnP.Hayes	McGrawHill	3rdEdition,1998
	3	ComputerOrganization and design:Thehardwaresoftwareinterface	DavidA.Patterson and JohnL.Hennessy	MorganKaufmann,	2ndEdition,2002

9. Lesson Plan:

ABBREVIATION	TEACHING METHOD
L	Class Room Lecture (Chalk Based Lecture)
EL	Smart Class Room Lecture/ Web-Facilitated Course Delivery/ Flipped Class Lecture/ Multimedia Lecture/ Animation
SS	Self-Study Topic – Student Seminar
T	Tutorial/ Case-Study/ Scenario
P	Practical/ Laboratory Demonstration/ Model Demonstration/ Simulation
GD	Group Discussion/ Debate/ Role Play
GL	Guest Lecture/ Workshop/Interview with Experts/ Webinars
IV	Industrial Visit/ Field Trip
PJ	Project Design/ Project Demonstration/Literature Survey

Topic No	TopicName	Reference	No.ofPeriods	Cumulative No.ofperiods	Teaching Methodology
UNITI–BASICSTRUCTUREOFCOMPUTERS					
1.	Functionalunits-Basicoperationalconcepts	T1:1-9	2	2	L
2.	Busstructures-Softwareperformance	T1:9-17	2	4	L
3.	Memorylocationsandaddresses	T1:33-36	1	5	L, EL
4.	Instructionandinstructionsequencing	T1:37-47	2	7	L, EL
5.	Addressingmodes	T1:48-56	2	9	L, EL
6.	Assemblylanguage–BasicI/Ooperations	T1:58-64	2	11	L
7.	Stacksandqueues(**StudentSeminar**)	T1:68	1	12	GD , SS
UNITII–ARITHMETICUNIT					

8.	Additionandsubtractionofsignednumbers,Designoffastadders	T1: 368-372	2	13	L, EL
9.	Multiplicationofpositivenumbers-	T1: 376	1	14	L, EL
10.	Signedoperandmultiplicationandfastmultiplication	T1: 380-385	2	16	L, EL
11.	Integerdivision	T1: 390-392	2	18	L, EL
12.	Floatingpointnumbersandoperations.	T1: 393-400	2	20	L, EL
13.	Tutorials		1	21	GD , T
UNIT III – BASIC PROCESSING UNIT					
14.	Fundamentalconcepts–Executionofacompleteinstruction	T1: 412-422	2	23	PPT
15.	Multiplebusorganization	T1: 423-424	1	24	L, EL
16.	Hardwiredcontrol	T1: 425-428	1	25	L, EL
17.	Microprogrammedcontrol	T1: 429-443	2	27	L, EL
18.	Pipelining–Basicconcepts	T1: 454-458	1	28	L, EL
19.	Datahazards–Instructionhazards	T1: 461-470	2	30	L, EL
20.	InfluenceonInstructionsets(**StudentSeminar**)	T1: 476-478	1	31	FL
21.	Datapathandcontrol consideration–Superscalaroperation.	T1: 479-486	2	33	PPT
UNIT IV – MEMORY SYSTEM					
22.	Basicconcepts	T1: 292-294	1	34	L, EL
23.	SemiconductorRAMs-ROMs–Speed-sizeandcost	T1: 295-313	3	37	L, EL
24.	Cachememories-Performance	T1: 314-335	3	40	L, EL
25.	Virtualmemory	T1: 337-339	2	42	L, EL
26.	MemoryManagementrequirements	T1: 343	1	43	FL
27.	Secondarystorage.(**StudentSeminar)**	T1: 344-358	2	45	GD , SS
UNIT V – I/O ORGANIZATION					
28.	AccessingI/Odevices	T1: 204-207	1	48	L, EL
29.	Interrupts	T1: 208-220	2	50	L, EL
30.	DirectMemoryAccess	T1: 234-239	2	52	L, EL
31.	Buses	T1: 240-247	1	53	L, EL
32	Interfacecircuits	T1: 248-258	2	55	L, EL
33	StandardI/OInterfaces(PCI,SCSI,USB)(**StudentSeminar**)	T1: 259-272	3	58	GD , SS
34	Assessment of CO5		1	59	--
35	Course End Survey and Discussion		1	60	GD

10. COs, Teaching Methodologies and Assessment Tools:

CO	Content Delivery Methodology	Bloom's Level	Assessment Tools	
			Direct	Indirect
CO1	Class Lectures, Tutorials Flipped Classes / Multimedia Lectures	Understand	SE–I – 30%, END SEM – 50% Assignment – 10% Lab Exercises – 10%	Course End Survey
CO2	Class Lectures, Tutorials Flipped Classes/ Multimedia Lectures, Laboratory Experiments	Apply	SE–I – 20%, END SEM – 30% Unit Test – 10% Assignment – 10% Lab Exercises – 10%	
CO3	Class Lectures, Tutorials Flipped Classes/ Multimedia Lectures, Guest Lecture Laboratory Experiments	Analyse	SE–II – 20%, END SEM – 30% Assignment – 10%, Unit Test – 10%, Lab Experiments – 30%	
CO4	Class Lectures, Tutorials Flipped Classes/ Multimedia Lecture, Laboratory experiments	Apply	SE–II – 20%, END SEM – 30% Lab Report – 30% Assignment – 10%, Quiz – 10%	
CO5	Class Lectures, Tutorials Flipped Classes/ Multimedia Lectures	Understand	END SEM – 50%, Unit Test – 10%, Assignment – 10% Lab Report – 30%	

11. Assessment Topics:

CO	Measurement Tool	Topic(s)	Beyond Syllabus/ Self- Study	Submission Date (Tentative)	Measurement Time
CO1	Assignment - 1	Instruction Types, Addressing Modes		7th Aug, 2018	4 Days after Submission
CO2	Assignment - 2	Arithmetic Unit		23rd Aug, 2018	
CO2	Lab Report	Arithmetic Logic Unit, Booth's Multiplier		3 Days	
CO3	Assignment- 3	Bus Organization	Y	18th September 2018	
CO3	Lab Report	Memory Design		3 Days after experiment conduction	
CO4	Quiz	Memory Organization	Y	15th October 2018	
CO4	Lab Report	MEMORY SYSTEM		3 Days after experiment conduction	
CO5	Assignment - 4	PCI,SCSI,USD bus	Y	25th October 2018	

12. Exam Portions

CO	Measurement Tool	Date (Tentative)	Measurement Time
CO1	Unit test – 1	After the completion of Unit 1	2 Days after Test
CO1, CO2	Sessional Examination – I	15th Feb – 28th Feb, 2018	3 Days after Exam
CO3	Unit test - 2	After the completion of Unit 3	2 Days after Test
CO3, CO4	Sessional Examination – II	29th Mar – 7th Apr, 2018	3 Days after Exam
CO5	Unit test – 3	After the completion of Unit 3	2 Days after Test
CO1 to CO5	End Semester Examination	As per Academic Calendar	As per Academic Calendar

13. Tutorial Topics

Tutorial	Topic No(s).	Mapped CO(s)
Tutorial – 1	BASIC STRUCTURE OF COMPUTERS	CO1
Tutorial – 2	ARITHMETIC UNIT	CO2
Tutorial – 3	BASIC PROCESSING UNIT	CO3
Tutorial – 4	MEMORY SYSTEM	CO4
Tutorial – 5	I/O ORGANIZATION	CO5

14. Web Resources:

Unit No	Topic	Weblink
1	**BasicStructureofcomputers**	1. http://www.cs.mcgill.ca/~mhawke1/cs208/02a-ComputerStructureNotes.pdf 2. http://www.stat.auckland.ac.nz/~dscott/782/Computers.pdf 3. people.bu.edu/bkia/PDF/Computer%20Architecture.pdf
2.	**ArithmeticUnit**:	1. ecl.incheon.ac.kr/courses/ca5/ca00f.pdf 2. www.csag.ucsd.edu/teaching/cse141w00/lectures/Introduction.
3.	**BasicProcessingUnit:**	1. www.cise.ufl.edu/~prabhat/Teaching/cda5155-su09/lecture.html 2. ecl.incheon.ac.kr/courses/ca6/ca00.syllabus.pdf
4	**MemorySystem:**	1. www.ece.eng.wayne.edu/~gchen/ece4680/lecture-notes/lecture-notes.html 2. www.cs.berkeley.edu/~pattrsn/252S01/index.html 3. 140.113.88.21/course/Computer/handout/Ch0.pdf
5.	**I/Oorganization:**	1. www.cs.utwente.nl/~co/co213030/sheets/col10.pdf 2. www.ece.eng.wayne.edu/~gchen/ece4680/lecture- notes/lecture-notes.html 3. www.cs.utwente.nl/~co/co213030/sheets/col10.pdf

15. Web links for similar courses offered at other Universities:

Nameofthecourse	University/ Org	Weblink
ComputerArchitecture	PrincetonUniversity	https://www.coursera.org/course/comparch
ComputerSystemArchitecture	MIT	http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-823-computer-system-architecture-fall-2005/
ComputerSystemArchitecture	Stanford	https://class.stanford.edu/courses/Engineering/EE282/Spring2014/about
Computer Architecture	NPTEL	http://www.nptel.ac.in/courses/106102062/

16. Topic(s) Beyond Syllabus:

1. Types of Storage Devices – Buses - RAID
2. Case studies: Intel, AMD, Qualcomm Processors
3. Symmetric and Distributed Shared Memory Architectures

17. Lab Experiments

1. Study of peripherals, components of a Computer System [CO1]
2. Binary Addition[CO2]
3. Binary Multiplication[CO2]
4. Booth's Multiplication algorithm[CO2]
5. Restoring Division[CO2]
6. Non Restoring Division Algorithm[CO2]
7. Realization of the basic logic and universal gates[CO2]
8. Design of half-adder circuit using basic gates[CO3]
9. Design of full-adder circuit using basic gates[CO3]
10. Ripple Carry adder[CO3]

EVALUATION PROCEDURE FOR LAB EXPERIMENTS:

Modules	Very good	Satisfied	Poo r	Marks (100)
Level Of understandin gthe given problem	Very Clear understandin g (20 - 25)	Able to interpret but not having clear cut ideas (10 - 19)	Poor understandi ng (0 - 9)	25
Program Logic	With good time and space complexity (30 - 40)	Acceptable logic with not so good space/time complexity (11-29)	Poor Logic (0 - 10)	30
Out put	Output as expected (25 -35)	Output is not upto the expectation level (10 - 24)	Partial (0 - 10)	35
Viva questions	Answered for more than 90% of the questions (9 - 10)	Answered for 70% - 90% of the questions. (5 - 8)	Answered for less than 70% of the questions (0 - 4)	10

ASSESSMENT FOR INDIVIDUAL EXPERIMENTS:

S.No	Experiments	Efficien cy of Algorith m	Efficienc y of program/ Design	Output	VIVA VOICE
1	Study of peripherals, components of a Computer System	20	50	25	5
2	Binary Addition	25	50	20	5
3	Binary Multiplication	25	50	20	5
4.	Booth's Multiplication algorithm	20	45	20	10
5.	Restoring Division	20	55	15	10
6.	Non Restoring Division Algorithm	25	50	20	5
7.	Realization of the basic logic and universal gates	25	40	25	10
8.	Design of half-adder circuit using basic gates	25	50	20	10
9.	Design of full-adder circuit using basic gates	20	50	20	10
10.	Ripple Carry adder	20	45	25	10

Additional and advanced exercises

1. Carry look ahead adder
2. Design a 4-bit parallel Binary adder circuit
3. Design of ALU

18. Virtual Laboratory Topics:

Topic(s).	Virtual Laboratory URL
Virtual Lab – Computer Architecture	**http://172.16.5.175/elearn**

19. Flipped Class Topics:

Topic(s).	Streaming URL
Addressingmodes, Multiplicationofpositivenumbers Pipelining, MemoryManagement, DirectMemoryAccess	**http://172.16.5.175/elearn**

20. Participative Learning (if any):

- Discussion
- Workshop
- Webinar
- Case Studies

22. Materials (LMS):

Elearn Site	LMS Site
http://172.16.5.175/elearn For Student Access: Username: Register No. Password: CSE2K18	http://121.200.55.237 For Student Access: Username: Register No. Password: Register No.

Course Coordinator

Module Coordinator

Programme Coordinator

HoD/CSE