



# **UE22EC352A: Computer Organization and Design (4-0-2-0-5)**

RR: Dr. BR, Dr. SSM, Dr.YJP, Prof. HRV 70 (Teaching) + 14 (A/H/P) + 42 (Lab) = 126 Slots EC: Prof.MA

Unit No.	Unit Title	Lectur e slots	A/H/P slots*	Lab slots*	DD in- charge	Status of DD
1	Instructions: The Language of Computer	19				TBR#
2	Data Flow Model - RISC-V	18				TBR#
3	Arithmetic for Computer	19				TBR#
4	Computer Abstractions and Technology	19				TBR#

<sup>\*</sup>TBR: To be reviewed by DD in-charge (AV summary, Slides, Notes, MCQs, QB and Q&A)

Clas			% of Portions covered				
s No.	Chapter Title / Reference Literature	Topics to be covered	Reference chapter	Cumulativ e			
	UNIT 1: Instructions: The Language of Computer						
1	Textbook 1:Sec: 2.1 pages:68	Introduction					
2	Textbook 1:Sec: 2.2 pages:69-72	Operations of Computer hardware, Operands of Computer hardware – Part 1					
3	Textbook 1:Sec: 2.3 pages:73-79	Operations of Computer hardware, Operands of Computer hardware – Part 2					
4	Textbook 1:Sec: 2.3 pages:73-79	Operations of Computer hardware, Operands of Computer hardware – Part 3					
5	Textbook 1:Sec: 2.3 pages:73-79	Operations of Computer hardware, Operands of Computer hardware – Part 3					
6	AHP 1 – Simple C Program-Introduction Ripes						
7 8 9	LAB -1 (Manual)	Introduction to Assembler Directives Program	s and Register	Transfer			
10	Textbook 1:Sec: 2.4 and 2.5 pages:80-86	Signed and Unsigned numbers					
11	Textbook 1:Sec: 2.5 pages:86-94	Representing Instruction in Computer					
12	Textbook 1:Sec: 2.5 pages:86-94	Representing Instruction in Computer					
13	Textbook 1:Sec: 2.5	Representing Instruction in					





	pages:86-94	Computer		
14	Textbook 1:Sec: 2.6	Logical operations		
	pages:95-97	8		
15	AHP 2			
16 17	LAB -2 (Manual)	C program and -Abstraction		
18	LAD -2 (Manuar)	C program and -Abstraction		
19	Textbook 1:Sec: 2.6 pages:95-97	Logical operations		
20	Textbook 1:Sec: 2.7 pages:98-103	Instructions for making decisions		
21	Textbook 1:Sec: 2.7 pages:98-103	Instructions for making decisions	25	25
22	Textbook 1:Sec: 2.7 pages:98-103	Instructions for making decisions		
23	Textbook 1:Sec: 2.8 pages:104-110	Supporting procedures in Computer hardware – Part 1		
24	AHP 3 –		1	1
25				
26	LAB -3 (Manual)	Programs on 1) Little Endian to Big	Endian 2) Arı	ay Addition
27				
28	Textbook 1:Sec: 2.8 pages:104-110	Supporting procedures in Computer hardware – Part 2		
29	Textbook 1:Sec: 2.10 pages:120-127	RISC-V Addressing for wide immediate and addresses		
30	Textbook 1:Sec: 2.10 pages:120-127	RISC-V Addressing for wide immediate and addresses		
		T 2: Data Flow Model - RISC-V	l.	
	Textbook 1:Sec: 2.11	Parallelism and Instructions:		
31	pages:128-130	Synchronization		
22	Textbook 1:Sec: 2.11	Parallelism and Instructions:		
32	pages:128-130	Synchronization		
33	AHP-4 Programming	Examples		
34		1) Write an ALP to add 'N' a)		S
35			bit numbers	
	LAB -4 (Manual)		8 bit numbers	
36		2) Write RISC-V program for the X=(Y+M) – (L-D) +(Z+C) -		
37	Textbook 1:Sec: 2.12 pages:131-139	Translating and Starting Programs		
38	Textbook 1:Sec: 2.13 A C Sort Example to put it All pages:140-147 together			
39	Textbook 1:Sec: 2.13 pages:140-147	A C Sort Example to put it All together		
40	Textbook 1:Sec: 2.14 pages:148-150	Arrays versus Pointers, Advanced Material		





AHP-5   Programming examples	41	Textbook 1:Sec: 2.15 pages:151					
LAB -5 (Manual)   Logical Operations: a) 2 out of 5 code	42						
Ath	43	Logical Operations: a) 2 out of 5 code					
Textbook 1:Sec: 2.20 pages p:167-168	44	LAB -5 (Manual)					
Part   Textbook 1:Sec: 4.2   Basic RISC-V Implementation   Part 2, Logic Design Conventions	45		, ,				
Pages:258-261   Part-2,Logic Design Conventions	46						
pages:261-268  49	47		<u> </u>				
pages:261-268 Textbook 1:Sec: 4.4 pages:269-281  Textbook 1:Sec: 4.4 pages:269-281  Textbook 1:Sec: 4.4 pages:269-281  Textbook 1:Sec: 4.4 pages:296-312  Textbook 1:Sec: 4.7 pages:296-312  Textbook 1:Sec: 4.8 pages:313-324  Textbook 1:Sec: 4.10 pages:333-339  Textbook 1:Sec: 4.11 pages:340-353  Textbook 1:Sec: 3.1 & 3.2 pages:190-192  Textbook 1:Sec: 3.3 pages Multiplication	48		Building a Datapath				
Dages:269-281   an overview of pipelining	49		Building a Datapath				
Sample   Pages: 269-281   an overview of pipelining	EO	1 0	A Simple Implementation Scheme,				
1)Write an ALP to check whether the given string is a palindrome (Using stack operations)   2)Write an ALP to search a given number in an array	50	pages:269-281	an overview of pipelining				
LAB-6   palindrome (Using stack operations)	51	AHP-6	Programming examples				
S4   Section					string is a		
Textbook 1:Sec: 4.4 pages:269-281 an overview of pipelining  Textbook 1:Sec: 4.7 pages:296-312 Pipelined Datapath and Controlpages:296-312 Part 1  Textbook 1:Sec: 4.7 pipelined Datapath and Controlpages:296-312 Part 2  Textbook 1:Sec: 4.8 pages:313-324 Data Hazards  Textbook 1:Sec: 4.8 pages:313-324 Data Hazards  Textbook 1:Sec: 4.8 pages:313-324 Data Hazards  1)To check register a0 is divisible by a given number.  2) RISC-V program to perform the following for (i = 0; i < 10; i = i+1) c[i] = a[i] x b[i] + c[i-1];  1SA-1 WEEK FOR UNITS 1 AND 2  UNIT 3: Arithmetic for Computer  Textbook 1:Sec: 4.10 pages:333-339 Exceptions  Textbook 1:Sec: 4.11 pages:340-353 Introduction, Addition, and Subtraction  Textbook 1:Sec: 3.1 & 3.2 pages pi193-199 Multiplication  Multiplication	53	LAB-6					
pages:269-281 an overview of pipelining Textbook 1:Sec: 4.7 pages:296-312 Pipelined Datapath and Control-pages:296-312 Part 1  Textbook 1:Sec: 4.7 pages:296-312 Part 2  Textbook 1:Sec: 4.8 pages:313-324 Data Hazards  Textbook 1:Sec: 4.8 pages:313-324 Data Hazards  Textbook 1:Sec: 4.8 pages:313-324 Data Hazards  LAB-7 Data Hazards  1)To check register a0 is divisible by a given number. 2) RISC-V program to perform the following for (i = 0; i < 10; i = i+1) c[i] = a[i] x b[i] + c[i-1];  ISA-1 WEEK FOR UNITS 1 AND 2  UNIT 3: Arithmetic for Computer  Textbook 1:Sec: 4.10 pages:333-339 Exceptions  Textbook 1:Sec: 4.11 pages:340-353 Introduction, Addition, and Subtraction  Textbook 1:Sec: 3.1 & 3.2 pages:190-192 Multiplication  Multiplication  Multiplication	54		2)Write an ALP to search a given number in an array				
Textbook 1:Sec: 4.7 pages:296-312  Textbook 1:Sec: 4.7 pages:296-312  Textbook 1:Sec: 4.7 pages:296-312  Textbook 1:Sec: 4.8 pages:313-324  Textbook 1:Sec: 4.8 pages:313-324  Data Hazards  Textbook 1:Sec: 4.8 pages:313-324  Data Hazards  Data Hazards  Data Hazards  Data Hazards  LAB-7  Textbook 1:Sec: 4.8 pages:313-324  Data Hazards  Textbook 1:Sec: 4.8 pages:313-324  Data Hazards  Data Haza	55		1 1				
Pages:296-312   Part 1		1 0					
Pages: 296-312   Part 1	56						
Part 2   P		1 0					
58         Textbook 1:Sec: 4.8 pages:313-324         Data Hazards           59         Textbook 1:Sec: 4.8 pages:313-324         Data Hazards           60         Textbook 1:Sec: 4.8 pages:313-324         Data Hazards           61         1)To check register a0 is divisible by a given number.           62         LAB-7         2) RISC-V program to perform the following for (i = 0; i < 10; i = i+1) c[i] = a[i] x b[i] + c[i-1];	57		=	25	50		
58         pages:313-324         Data Hazards           59         Textbook 1:Sec: 4.8 pages:313-324         Data Hazards           60         Textbook 1:Sec: 4.8 pages:313-324         Data Hazards           61         1)To check register a0 is divisible by a given number.           62         LAB-7         2) RISC-V program to perform the following for (i = 0; i < 10; i = i+1) c[i] = a[i] x b[i] + c[i-1];			Part 2				
Data Hazards   Data Hazards	58	pages:313-324	Data Hazards				
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62 LAB-7 2) RISC-V program to perform the following for (i = 0; i < 10; i = i+1) c[i] = a[i] x b[i] + c[i-1];  ISA-1 WEEK FOR UNITS 1 AND 2  UNIT 3: Arithmetic for Computer  64 Textbook 1:Sec: 4.10 pages:333-339 Textbook 1:Sec: 4.11 pages:340-353 Parallelism via Instructions  65 Textbook 1:Sec: 3.1 & 3.2 pages:190-192 Introduction, Addition, and Subtraction  67 Textbook 1:Sec: 3.3 pages p:193-199 Multiplication	60		Data Hazards				
63         for (i = 0; i < 10; i = i+1) c[i] = a[i] x b[i] + c[i-1];           ISA-1 WEEK FOR UNITS 1 AND 2           UNIT 3: Arithmetic for Computer           64         Textbook 1:Sec: 4.10 pages:333-339         Exceptions           65         Textbook 1:Sec: 4.11 pages:340-353         Parallelism via Instructions           66         Textbook 1:Sec: 3.1 & 3.2 pages:190-192         Introduction, Addition, and Subtraction           67         Textbook 1:Sec: 3.3 pages p:193-199         Multiplication	<b>———</b>	_	, ,		ber.		
ISA-1 WEEK FOR UNITS 1 AND 2 UNIT 3: Arithmetic for Computer  Textbook 1:Sec: 4.10 pages:333-339  Textbook 1:Sec: 4.11 pages:340-353  Textbook 1:Sec: 3.1 & 3.2 pages:190-192  Textbook 1:Sec: 3.3 pages p:193-199  Multiplication		LAB-7	, , ,				
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pages:333-339  Textbook 1:Sec: 4.11 pages:340-353  Textbook 1:Sec: 3.1 & 3.2 pages:190-192  Textbook 1:Sec: 3.3 pages p:193-199  Exceptions  Parallelism via Instructions  Introduction, Addition, and Subtraction  Multiplication			UNIT 3: Arithmetic for Comput	er			
pages:340-353 Parallelism via Instructions  Textbook 1:Sec: 3.1 & 3.2 pages:190-192  Textbook 1:Sec: 3.3 pages p:193-199  Multiplication  Parallelism via Instructions  Introduction, Addition, and Subtraction  Multiplication	64	pages:333-339	Exceptions				
pages:190-192 Subtraction  67 Textbook 1:Sec: 3.3 pages p:193-199 Multiplication	65		Parallelism via Instructions				
67 p:193-199 Multiplication	66						
68 Textbook 1:Sec: 3.3 pages Faster Multiplication, Multiply in	67	p:193-199	Multiplication				
	68	Textbook 1:Sec: 3.3 pages	Faster Multiplication , Multiply in				





	p:193-199	RISC-V			
69	AHP-8	Programming Examples			
70		Write a bubble sorting algorithm tha	t sorts a n-ele	ment array	
71	LAB -8 (Manual)	called sort array from smallest to lar			
72		address 0x400.			
73	Textbook 1:Sec: 3.3 pages p:193-199	Textbook 1:Sec: 3.3 pages p:193-199			
74	Textbook 1:Sec: 3.4 pages:199-207	Division			
75	Textbook 1:Sec: 3.4 pages:199-207	Division			
76	Textbook 1:Sec: 3.5 pages:208-232	Floating Point – Part 1			
77	Textbook 1:Sec: 3.5 pages:208-232	Floating Point – Part 1			
78	AHP-9	Optimization on Ripes simulator to c cycles in a C program	observe CPI/II	PC and total	
89			l of a numb	ruith and	
80	LAB -9 (Manual)	write a program to find the Factorial without recursion	Write a program to find the Factorial of a number with and		
81		without recursion			
82	Textbook 1:Sec: 3.5 pages:208-232	Floating Point – Part 2			
83	Textbook 1:Sec: 3.5 pages:208-232	Floating Point – Part 3, Parallelism and Computer Arithmetic			
_	Textbook 1:Sec: 3.5	Floating Point – Part 3, Parallelism	25	75	
84	pages:208-232	and Computer Arithmetic			
85	RISC-V manual	Interrupt -Overview, Trap			
86	RISC-V manual	Environment Call, Exception Handling Registers			
87	AHP-10	Programming examples			
88		3 3 1			
89	LAB -10 (Manual)	Matrix multiplication			
90		•			
91	RISC-V manual	External Interrupts, Software Interrupts			
92	RISC-V manual	Introduction to the RISC-V Vector Extension			
		Introduction to the RISC-V Vector			
93	RISC-V manual	Extension			
94		Parallelism, and Computer Arithmetic.			
Unit 4: Computer Abstractions and Technology					
	Textbook 1:Sec: 1.1				
95	pages:3-10	Introduction			
96		AHP-11 - MEM /EX hazard Datapath simulation			
97	LAB -11 (Manual)	5-stage Pipeline Processor with and	without Forwa	arding /	
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Textbook 1:Sec: 1.2   Seven Great Ideas in Computer   Architecture	98		Hannel data street		
Pages: 10-12	99		Hazard detection		
Pages: 10-12	100		<u> </u>		
Textbook 1:Sec: 1.5   Seven Great Ideas in Computer   Architecture & Below Your   Program	101		_		
103 Pages:25-28   Architecture & Below Your Program   104	102	-	<u> </u>		
104   pages:29-35   processors and Memory     105   AHP 12   Programming examples using ecall, interrupts     106   107   LAB -12 (Manual)   S-stage Pipeline Processor with and without Forwarding / Hazard detection     109	103		Architecture & Below Your		
105	104				
107	105	AHP 12			
108			5-stage Pineline Processor with a	and without I	Forwarding /
Textbook 1:Sec: 1.6   Performance   Perfor		LAB -12 (Manual)		ma williout I	orwarumg /
110	108			T	
Textbook 1:Sec: 1.8	109		Performance		
Textbook 1:Sec: 1.8   The Power Wall	110		Performance		
Textbook 1:Sec: 1.8	111		Performance		
113 pages:43-45 to Multiprocessor – Part 2  114 AHP-13 Course Project Demo  115 116 LAB -13 Lab assessment/ Course Project Demo  117  118 Textbook 1:Sec: 1.8 pages:43-45 to Multiprocessor – Part 2  119 Textbook 1:Sec: 1.9 pages:46-48  120 Textbook 1:Sec: 1.9 pages:46-48  121 Textbook 1:Sec: 1.9 pages:46-48  122 Textbook 1:Sec: Fallacies and Pitfalls and concluding remarks  123 AHP-14  Lab assessment/ Course Project Demo  Lab assessment/ Course Project Demo	112		The Power Wall		
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116 117LAB -13Lab assessment/ Course Project Demo118Textbook 1:Sec: 1.8 pages:43-45The Switching from uniprocessor to Multiprocessor – Part 2119Textbook 1:Sec: 1.9 pages:46-48Benchmarking Intel i7 – Part 125120Textbook 1:Sec: 1.9 pages:46-48Benchmarking Intel i7 – Part 2121Textbook 1:Sec: 1.11&1.12 pages:50-52Fallacies and Pitfalls and concluding remarks122Amdahl's Law123AHP-14Course Project Demo124LAB -14Lab assessment, Course Project Demo	114	AHP-13	Course Project Demo		
117       Textbook 1:Sec: 1.8 pages:43-45       The Switching from uniprocessor to Multiprocessor – Part 2         119       Textbook 1:Sec: 1.9 pages:46-48       Benchmarking Intel i7 – Part 1       25       100         120       Textbook 1:Sec: 1.9 pages:46-48       Benchmarking Intel i7 – Part 2       25       100         121       Textbook 1:Sec: 1.9 pages:46-48       Fallacies and Pitfalls and concluding remarks       25       Amdahl's Law         122       Amdahl's Law       Course Project Demo         123       AHP-14       Lab assessment, Course Project Demo	115				
Textbook 1:Sec: 1.8 pages:43-45 Textbook 1:Sec: 1.9 pages:46-48  Textbook 1:Sec: Fallacies and Pitfalls and concluding remarks  121 AHP-14  Course Project Demo  Lab assessment, Course Project Demo	116	LAB -13	Lab assessment/ Course Project Den	10	
118       pages:43-45       to Multiprocessor – Part 2         119       Textbook 1:Sec: 1.9 pages:46-48       Benchmarking Intel i7 – Part 1       25         120       Textbook 1:Sec: 1.9 pages:46-48       Benchmarking Intel i7 – Part 2         121       Textbook 1:Sec: Fallacies and Pitfalls and concluding remarks         122       Amdahl's Law         123       AHP-14         124       LAB -14         Lab assessment, Course Project Demo	117				
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Textbook 1:Sec: Fallacies and Pitfalls and concluding remarks  122 AHP-14 Course Project Demo  LAB -14 Lab assessment, Course Project Demo	120	Textbook 1:Sec: 1.9	Benchmarking Intel i7 – Part 2		
122 Amdahl's Law  123 AHP-14 Course Project Demo  124 LAB -14 Lab assessment, Course Project Demo	121	Textbook 1:Sec:			
124 LAB -14 Lab assessment, Course Project Demo	122		-	]	
	123	AHP-14	Course Project Demo		
	124	LAB -14	Lab assessment, Course Project Den	10	!
	125				





126						
	ISA-2 WEEK FOR UNITS 3 AND 4					

Book	Author & Title	Edition	Publishe	Year
Type			r	
	David A. Patterson, John L. Hennessy, "Computer			
Textbook	Organization and Design- The Hardware/Software	Second	Elsevier	2018
	Interface: RISC-V Edition",			
Reference	Sarah Harris, David Harris, "Digital Design and	RISC V	Elsevier	2021
book	Computer Architecture, RISC-V Edition"	KISC V	Eisevier	2021

## Skills imparted by the course (NEP component):

NEP feature	Mapping
Experiential learning	Hands-on learning and project work
Conceptual understanding	Subjective questions, Hands-on learning
Creativity and Critical thinking	Solving, simulating, coding, and verifying results
Formative assessment/ Continuous assessment	Computer Based Test, A/H/P slots
Tools Usage/Skill Enhancement	RIPE Simulator, SPIKE
Project-based learning	Project work (A/H/P 10-12)
Problem-solving	Numerical problems, Project work, open-ended experiments (Lab 12-13)
Research	Project work (A/H/P 10-12) and open-ended experiments (Lab 12-13)
Soft skills	Presentation





## Assessment plan:

Event	Portion	Marks		Mode
A/H/P	Implementation of RISC-V using HDL	10		Simulation And Synthesis
ISA 1	Units 1 and 2	40	Scaled to	Hybrid mode
ISA 2	Units 3 and 4	40	30	Hybrid mode
Total ISA		50		
ESA – Theory	Units 1, 2, 3, 4	100	Scaled to	Hybrid mode
ESA – Lab	Lab assessments	20	50	Quiz and Open- ended experiments
Total ESA		50		
Total ISA + ESA		100	•	