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	Lecture 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#

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

Class No.	Chapter Title / Reference Literature	Topics to be covered	% of Portions covered	
			Reference chapter	Cumulative
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	LAB -1 (Manual)	Introduction to Assembler Directives and Register Transfer Program		
9				
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 pages:95-97	Logical operations		
15	**AHP 2**			
16				
17	LAB -2 (Manual)	C program and -Abstraction		
18				
19	Textbook 1:Sec: 2.6 pages:95-97	Logical operations	25	25
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		
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 –**			
25				
26	LAB -3 (Manual)	Programs on 1) Little Endian to Big Endian 2) Array 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		
UNIT 2: Data Flow Model - RISC-V				
31	Textbook 1:Sec: 2.11 pages:128-130	Parallelism and Instructions: Synchronization		
32	Textbook 1:Sec: 2.11 pages:128-130	Parallelism and Instructions: Synchronization		
33	**AHP-4** Programming Examples			
34		1) Write an ALP to add 'N' a) 32 bit numbers b) 16 bit numbers c) 8 bit numbers 2) Write RISC-V program for the following X=(Y+M) – (L-D) +(Z+C) – D		
35	LAB -4 (Manual)			
36				
37	Textbook 1:Sec: 2.12 pages:131-139	Translating and Starting Programs		
38	Textbook 1:Sec: 2.13 pages:140-147	A C Sort Example to put it All 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		

41	Textbook 1:Sec: 2.15 pages:151	Compiling C		
42	**AHP-5**	Programming examples		
43		Logical Operations: a) 2 out of 5 code		
44	LAB -5 (Manual)	b) Hamming code encoding		
45				
46	Textbook 1:Sec: 2.20 pages p:167-168	The Rest of RISC-V Instructions – Part 1		
47	Textbook 1:Sec: 4.2 pages:258-261	Basic RISC-V Implementation Part-2,Logic Design Conventions		
48	Textbook 1:Sec: 4.3 pages:261-268	Building a Datapath		
49	Textbook 1:Sec: 4.3 pages:261-268	Building a Datapath		
50	Textbook 1:Sec: 4.4 pages:269-281	A Simple Implementation Scheme, an overview of pipelining		
51	**AHP-6**	Programming examples		
52		1)Write an ALP to check whether the given string is a palindrome (Using stack operations)		
53	LAB-6			
54		2)Write an ALP to search a given number in an array		
55	Textbook 1:Sec: 4.4 pages:269-281	A Simple Implementation Scheme, an overview of pipelining		
56	Textbook 1:Sec: 4.7 pages:296-312	Pipelined Datapath and Control-Part 1		
57	Textbook 1:Sec: 4.7 pages:296-312	Pipelined Datapath and Control-Part 2	25	50
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		
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		
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 that sorts a n-element array called sort array from smallest to largest. The array starts at address 0x400.		
71	LAB -8 (Manual)			
72				
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 observe CPI/IPC and total cycles in a C program		
89		Write a program to find the Factorial of a number with and without recursion		
80	LAB -9 (Manual)			
81				
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	25	75
84	Textbook 1:Sec: 3.5 pages:208-232	Floating Point – Part 3, Parallelism 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				
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		
93	RISC-V manual	Introduction to the RISC-V Vector Extension		
94		Parallelism, and Computer Arithmetic.		
Unit 4: Computer Abstractions and Technology				
95	Textbook 1:Sec: 1.1 pages:3-10	Introduction		
96	**AHP-11 -** MEM /EX hazard Datapath simulation			
97	LAB -11 (Manual)	5-stage Pipeline Processor with and without Forwarding /		

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98		Hazard detection		
99				
100	Textbook 1:Sec: 1.2 pages:10-12	Seven Great Ideas in Computer Architecture		
101	Textbook 1:Sec: 1.2 pages:10-12	Seven Great Ideas in Computer Architecture		
102	Textbook1:Sec: 1.3 , pages:13-16	Seven Great Ideas in Computer Architecture		
103	Textbook 1:Sec: 1.5 pages:25-28	Seven Great Ideas in Computer Architecture & Below Your Program		
104	Textbook 1:Sec: 1.6 pages:29-35	Technologies for building processors and Memory		
105	**AHP 12**	Programming examples using ecall, interrupts		
106		5-stage Pipeline Processor with and without Forwarding / Hazard detection		
107	LAB -12 (Manual)			
108				
109	Textbook 1:Sec: 1.6 pages:36-39	Performance		
110	Textbook 1:Sec: 1.7 pages:40-42	Performance		
111	Textbook 1:Sec: 1.7 pages:40-42	Performance		
112	Textbook 1:Sec: 1.8 pages:43-45	The Power Wall		
113	Textbook 1:Sec: 1.8 pages:43-45	The Switching from uniprocessor 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	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		
121	Textbook 1:Sec: 1.11&1.12 pages:50-52	Fallacies and Pitfalls and concluding remarks		
122		Amdahl's Law		
123	**AHP-14**	**Course Project Demo**		
124	LAB -14	Lab assessment, Course Project Demo		
125				

126		

Book Type	Author & Title	Edition	Publisher	Year
Textbook	David A. Patterson, John L. Hennessy, "Computer Organization and Design- The Hardware/Software Interface: RISC-V Edition",	Second	Elsevier	2018
Reference book	Sarah Harris, David Harris, "Digital Design and Computer Architecture, RISC-V Edition"	RISC V	Elsevier	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 30	**Hybrid mode**
ISA 2	Units 3 and 4	40		**Hybrid mode**
Total ISA		**50**		
ESA – Theory	Units 1, 2, 3, 4	100	Scaled to 50	**Hybrid mode**
ESA – Lab	Lab assessments	20		**Quiz and Open-ended experiments**
Total ESA		**50**		
Total ISA + ESA		**100**		