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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

Course Code: CS405

Course Name: COMPUTER SYSTEM ARCHITECTURE

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions, each carries 4 marks.

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| 1 | A 400MHz processor was used to execute a program with 150000 floating point instructions with clock cycle count of 1. Determine the execution time and MIPS rate for this program. | (4) |
| 2 | State Amdahl's law. Write an expression for the overall speed up. | (4) |
| 3 | Distinguish between scalar RISC and super-scalar RISC in terms of instruction issue, pipeline architecture and performance. | (4) |
| 4 | Discuss the schematic representation of a generalized multiprocessor system. | (4) |
| 5 | Explain chained cache coherence protocol. | (4) |
| 6 | Consider the execution of a program of 15,00,000 instructions by a linear pipeline processor with a clock rate of 1000 MHz. Assume that the instruction pipeline has five stages and that one instruction is issued per cycle. The penalties due to branch instruction and out-of-order execution are ignored. <ul style="list-style-type: none"> a) Calculate the speedup factor in using this pipeline to execute the program as compared with the use of an equivalent non-pipelined processor with an equal amount of flow-through delay. b) Find out the efficiency and throughput of this pipelined processor. | (4) |
| 7 | Write short notes on internal data forwarding. | (4) |
| 8 | Explain Goodman's write once protocol with transition diagram. | (4) |
| 9 | List any two advantages and disadvantages of Scalable Coherence Interface(SCI). | (4) |
| 10 | What are the four context switching policies adopted by multithreaded architectures? | (4) |

PART B

Answer any two full questions, each carries 9 marks.

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| 11 | a) Discuss the Bernstein's conditions for checking the parallelism among a set of processes. | (3) |
| | b) Analyze the data dependences among the following statements and construct a | (6) |

dependency graph. Also detect the parallelism embedded in them.

S1 : Load R1 , M(100) / R1 \leftarrow Memory(100) /

S2 : Move R2 , R1 / R2 \leftarrow (R1) /

S3 : Inc R1 / R1 \leftarrow (R1) + 1 /

S4 : Add R2 , R1 / R2 \leftarrow (R2) + (R1) /

S5 : Store M(100), R1 / Memory(100) \leftarrow (R1) /

- 12 a) Define the inclusion property of a memory hierarchy. Illustrate the data transfers between adjacent levels of a memory hierarchy. (5)
- b) Consider a two-level memory hierarchy, M1 and M2 of sizes 64Kbytes and 4Mbytes respectively, with access time $t_1 = 20\text{ns}$ and $t_2 = 200\text{ns}$ and costs c_1 and c_2 are \$0.01/byte, $c_2 = \$0.0005/\text{byte}$ respectively. The cache hit ratio $h_1 = 0.95$ at the first level. Find the effective access time and total cost of this memory system. (4)
- 13 Differentiate between the following with necessary diagrams:
- a) UMA and NUMA multiprocessor models. (4)
- b) RISC and CISC (5)

PART C

Answer any two full questions, each carries 9 marks.

- 14 a) Explain the different levels of hierarchy of bus systems. (4)
- b) Define the write-invalidate snoop bus protocol for maintaining cache coherence. Show the different possible state transitions for write-through and write-back cache using the write-invalidate protocol. (5)
- 15 Consider the five-stage pipelined processor specified by the following reservation table and answer the following: (S indicate the stages)

	1	2	3	4	5	6
S1	X					X
S2		X		X		
S3			X			
S4				X	X	

- (i) List the set of forbidden latencies and the collision vector. (2)
- (ii) Draw the state transition diagram showing all possible initial sequences without causing a collision in the pipeline. (3)

- (iii) List all the simple and greedy cycles from the state diagram. (2)
- (iv) Determine the minimal average latency (MAL). (2)
- 16 a) Explain the three major operational characteristics of a multiprocessor interconnection network. (3)
- b) Analyse and compare the communication latencies of Store-and Forward and Wormhole routing schemes. (3)
- c) Consider a 16-node hypercube network. Based on the E-cube routing algorithm, show how to route a message from node (0111) to node (1101). All intermediate nodes must be identified on the routing path. (3)

PART D

Answer any two full questions, each carries 12 marks.

- 17 a) Which are the three logic hazards possible in an instruction pipeline? Define each. Write the necessary conditions for each to occur. (6)
- b) Explain the in-order and out-of-order pipeline scheduling policies for a superscalar machine with an example. (6)
- 18 a) Explain the importance of Tomasulo's algorithm for dynamic instruction scheduling. (8)
- b) What do you mean by Release Consistency (RC) memory model? Give the conditions to ensure RC. (4)
- 19 a) Explain the effect of branching in instruction pipelining. Find the execution time and throughput of the pipeline for n instructions by considering the effect of branching. How branch penalty is reduced using delayed branch strategy. (6)
- b) Explain any two latency hiding techniques used in distributed shared memory multi computers. (6)
