

CE1-R3: ADVANCED COMPUTER ARCHITECTURE

NOTE:

1. Answer question 1 and any FOUR questions from 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

Time: 3 Hours

Total Marks: 100

1.
 - a) How many data dependent hazards are there? Which particular hazard may occur for branch type of instructions?
 - b) Compare between Dependency Graph, Signal Flow Graph and Data Flow Graph.
 - c) Compare Daisy chaining, Polling and Independent request system interconnect structures.
 - d) Discuss the four machine organizations, according to Flynn's classification.
 - e) How does internal forwarding enhance the performance of computers?
 - f) Which of coupling systems is better for higher degree of interactions between tasks? Differentiate between Loosely Coupled System (LCS) and Tightly Coupled System (TCS).
 - g) What do you mean by pipelining? How does it differ from parallel processing?
(7x4)

2.
 - a) Write down an $O(n^2)$ algorithm for SIMD matrix multiplication. Establish the correctness of the complexity. Explain the underlined architecture.
 - b) Sketch an $O(n \log_2 n)$ algorithm for matrix multiplication.
(12+6)

3.
 - a) Define systolic array. Discuss the various properties of systolic array.
 - b) Draw a systolic array corresponding to bubble-sorter.
 - c) Using systolic arrays multiply two full matrices.
(5+4+9)

4.
 - a) Draw the DG for Warshall-Floyd algorithm.
for k from 1 to N
for i from 1 to N
for j from 1 to N
 $X_{ij}^k \leftarrow X_{ij}^{k-1} + X_{ik}^{k-1} \times X_{kj}^{k-1}$.
 - b) Describe the procedure of mapping DGs and SFGs to systolic arrays.
(10+8)

5.
 - a) What do you mean by network topology? Write short notes on the following topologies and relatively compare them in terms of degree of a processor and longest distance between two processors: i) Mesh of Trees, ii) Pyramid, iii) Shuffle-Exchange, and iv) Hypercube.
 - b) Write a short note on Star interconnection network and draw such a network for the number of processors $N = 4!$.
([1+12]+5)

6.

- a) Explain single-stage and multistage dynamic interconnect networks, with necessary figures.
- b) Corresponding to the reservation table below, draw the state diagram. Clearly indicate the cross collision vectors and collision matrices.

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s	0	1	2	3	4
1	A	B		A	B
2		A		B	
3	B		AB		A

(10+8)

7.

- a) What is pipeline bubble? Explain with an example.
- b) Assume that the times required for the five functional units, which operate in each of the five cycles, are as follows: 10 ns, 8 ns, 10 ns, 10 ns, and 7 ns. Assume that pipelining adds 4 ns of overhead. Find the speedup versus the single-cycle data path.
- c) Discuss about control hazards.
- d) Assuming an ideal CPI of 1, compute the effective pipeline speedup with branch penalties.

(4+6+5+3)