

2125  
M.E. (Computer Science and Engineering)  
First Semester  
Elective - II  
CS-8109: Advanced Computer Architecture  
(For UIET Only)

Time allowed: 3 Hours

Max. Marks: 50

*NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Unit.*

**x-x-x**

I. Answer any five of the following briefly:-

- a) Define Amdahl's Law and explain its significance in parallel processing.
- b) Differentiate between SIMD and MIMD architectures with suitable examples.
- c) What are the main properties of an ideal interconnection network?
- d) Explain the concept of program parallelism and its types.
- e) Distinguish between CISC and RISC processors.
- f) What is cache coherence? Mention two hardware mechanisms to maintain it.
- g) Define vector instruction and give an example. (5x2)

**UNIT - I**

- II. a) Consider a vector computer which can operate in one of the two execution modes at a time: one is the vector mode with an execution rate of  $R_v = 10$  Mflops, and the other is the scalar mode with an execution rate of  $R_s = 1$  Mflops. Let  $\alpha$  be the percentage code that is vectorizable in a typical program mix for this computer.
- i) Derive an expression for the average rate  $R_a$  for this computer.
  - ii) Plot  $R_a$  as a function of  $\alpha$  in the range (0,1)
  - iii) Determine the vectorization ratio  $\alpha$  needed in order to achieve an average execution rate of  $R_a = 7.5$  M flops
  - iv) Suppose  $R_s = 1$  Mflops and  $\alpha = 0.7$ . What value of  $R_v$  is needed to achieve  $R_a = 2$  Mflops?
- b) A parallel program runs on 8 processors and achieves  $5.6 \times$  speedup over serial execution.
- i) Calculate the parallel efficiency.
  - ii) Find the serial fraction ( $f$ ) using Amdahl's Law.
  - iii) What will be the maximum speed up if 32 processors are used? (2x5)

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- III. a) What are the conditions of parallelism in programs? Explain data and resource dependencies.  
b) Discuss grain packing and scheduling with examples. (2x5)

- IV. a) Derive and explain Amdahl's Law and Gustafson's Law.  
b) Define efficiency and utilization in parallel systems and describe how they are measured. (2x5)

### UNIT - II

- V. a) Explain the hierarchical bus system and crossbar switch interconnection with neat diagrams.  
b) A program consists of 40% sequential and 60% parallel code. Calculate the speedup and efficiency when executed on 2, 4, 8, and 16 processors. (2x5)

- VI. a) A program has  $IC = 2.0 \times 10^9$  instructions,  $CPI = 2.0$ . It must finish in 1.0 s. What clock frequency (in GHz) is needed?  
b) Explain Routing in Omega Network.  
c) Explain the CM-2 architecture.  
d) Explain any one vector access Memory scheme in detail.  
e) Bernstein Conditions. (2x5)

- VII. a) Explain principles of various synchronous mechanisms for inter-process communications.  
b) Describe performance metrics such as throughput, latency, utilization, and harmonic mean performance. (2x5)