National Institute of Technology, Tiruchirappalli

Department of Computer Science and Engineering

CYCLE TEST – I

CSPC31 – Computer Architecture

Branch/Semester/ Section:	CSE/ V/ A	Time	: 10:00 to 11:00 am
Date	: 06.09.2021	Max Marks	: 15

Answer All Questions

1.
   a) In the context of processor performance compare absolute vs. relative measures of performance using program execution time and MIPS as parameters. **(2)**

   b) Discuss the factors that influence the optimal number of stages in the context of pipeline design. **(2)**

2. Your colleague at AMD suggests that, since the yield is so poor, you might make chips more cheaply if you released multiple versions of the same chip, just with different numbers of cores. For example, you could sell Phoenix8, Phoenix4, Phoenix2, and Phoenix1, which contain 8, 4, 2, and 1 cores on each chip, respectively. If all eight cores are defect-free, then it is sold as Phoenix8. Chips with four to seven defect-free cores are sold as Phoenix4, and those with two or three defect-free cores are sold as Phoenix2. For simplification, calculate the yield for a single core as the yield for a chip that is 1/8 the area of the original Phoenix chip. Then view that yield as an independent probability of a single core being defect free. Calculate the yield for each configuration as the probability of at the corresponding number of cores being defect free.

Chip	Die Size (mm^2)	Estimated defect rate (per cm^2)	*N*	Manufacturing size (nm)	Transistors (billion)	Cores
BlueDragon	180	0.03	12	10	7.5	4
RedDragon	120	0.04	14	7	7.5	4
Phoenix[8]	200	0.04	14	7	12	8

a) What is the yield for a single core being defect free as well as the yield for Phoenix4, Phoenix2 and Phoenix1? **(2)**

b) Using your results from part a, determine which chips you think it would be worthwhile to package and sell, and why? **(2)**

3. Assume that we are considering enhancing a quad-core machine by adding encryption hardware to it. When computing encryption operations, it is 15 times faster than the normal mode of execution. We will define percentage of encryption as the percentage of time in the original execution that is spent performing encryption operations. The specialized hardware increases power consumption by 3%. **(3)**

a) With what percentage of encryption will adding encryption hardware result in a speedup of 2?
b) What percentage of time in the new execution will be spent on encryption operations if a speedup of 2 is achieved?

4. When parallelizing an application, the ideal speedup is speeding up by the number of processors. This is limited by two things: percentage of the application that can be parallelized and the cost of communication. Amdahl's Law takes into account the former but not the latter. **(2)**
   a) What is the speedup with N processors if 65% of the application is parallelizable, ignoring the cost of communication?
   b) What is the speedup with six processors if, for every processor added, the communication overhead is 0.4% of the original execution time.
5. Assume that we make an enhancement to a computer that improves some mode of execution by a factor of 15. Enhanced mode is used 40% of the time, measured as a percentage of the execution time when the enhanced mode is in use. Recall that Amdahl's Law depends on the fraction of the original, unenhanced execution time that could make use of enhanced mode. **(2)**
   a) What is the speedup we have obtained from fast mode?
   b) What percentage of the original execution time has been converted to fast mode?