Reg No.									

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FIRST SEMESTER M.TECH (CSE) DEGREE END SEMESTER EXAMINATION DEC-2013
HIGH PERFORMANCE COMPUTER SYSTEMS (CSE 507)
DATE: 03-12-2013

TIME : 3 HOURS MAX.MARKS : 50

Instructions to Candidates
- Answer **ANY FIVE** full questions.

1A. How do you achieve parallel processing mechanisms in following categories in a uniprocessor system:
i) Overlapped CPU and I/O operations
ii) Multiprogramming **(2+2)**

1B. Starting from basic principles derive the expression for the clock period τ, speed up S_k, throughput W, efficiency η of linear pipeline. This pipeline has a processor with clock frequency of 50 MHz executing a program with 15000 instructions. An assumption is done such that 5 stages of instruction pipelining are done for this linear pipeline and one instruction is issued per clock cycle. Calculate the above derived parameters for this linear pipeline. **(1 × 6=6)**

2A. It is required to multiply matrix A with matrix B to give the product matrix C each of size 3 × 3 using SIMD computer. The initial allocation is such that the each row vector of matrix is stored across the PEMs and each column vectors within the same PEM in this SIMD system. This memory allocation allows parallel access to all the elements in each row vector of the matrices. Write a parallel algorithm that satisfies the above requirement. Demonstrate the iterative analysis in the form of a table to show how your parallel algorithm generates the each element of the product matrix C. **(3 + 3)**

2B. Explain the following bus arbitration algorithms with their advantages and disadvantages:
i) Dynamic priority
ii) Rotating daisy chain algorithm **(2 + 2)**

3A. It is required to design and analyze the data parallel implementation of prime finding algorithm that explore the method to parallelize the Sieve of Eratosthenes with minimum number of processors for integer value n=50. See that the root process contains all the primes less than √n as well as the first prime greater than √n. **(5)**

3B. Availability of a parallel computer system is 2-D MESH SIMD. There are N elements in an array to be partitioned among p number of processers in mesh SIMD where $p < N$. After partitioning, the respective processors perform the summation of the numbers allocated to them simultaneously. Write a parallel algorithm to perform summation by the respective processors after partitioning the numbers and also obtain the final sum. **(5)**

4A. Draw a general bitonic sorting network using building block $\oplus$BM[k] and ΘBM[k] of input size k to sort 8 random numbers. Taking this as reference construct a bitonic sorting network using symbolic representation of increasing $\oplus$ and decreasing Θ comparators. It is expected to sort these numbers in descending order. **(2 + 3 + 1)**

4B. Identify and write the appropriate MPI function to meet the following requirement with suitable examples:

(i) All the processes collect data to all the other processes in the same communicator, and perform an operation on the data.

(ii) One process (root) sends data to all the other processes in the same communicator. **(2 + 2)**

5A.Write an MPI program to read a number N through a root process. Now see that this number communicated to rest of all the processes created. Further each process (including root process) calculate the intermediate sum up to N and then all processes send it to root to calculate the final sum and to display it by the root process. **(6)**

5B. What is GPU computing? Describe the abstract memory model defined by OpenCL with supporting diagram. **(1 + 3)**

6A. Define kernel for a OpenCL program. Write a kernel program to find the square of each element of an array and add the respective elements of the original array. Also write an equivalent code for multithreaded version for the same**.** **(½ + 2 + 1 ½)**

6B. Give the CUDA program structure and also discuss with appropriate diagram the overview of the CUDA device memory model. **(3 + 1 + 2)**