Sample Quiz questions:

1. State the main characteristics of the four generation of computers
   (i) Name the essential processing component used in each generation of machines
   (ii) Compare the machines in terms of speed, size, heat and any other factors.
2. State the main classifications of computers and give an example each. (Describe using Flynn's classification, Memory classification, and Interconnection network classification)
3. What is a Von Neumann bottleneck in sequential architectures?
4. A parallel program is written in an MIMD environment so that the program can be broken into pieces and each piece of the program can be run on a parallel processor. This speeds up the execution of a parallel program. However, certain portion of the parallel program may be inherently sequential and cannot be parallelized. If a program requires 500 milliseconds to run sequentially, calculate the parallel execution time and speed up for the following:
   (i) 5 processors and 100% of the program can be parallelized.
   (ii) 5 processors and70 % of the program can be parallelized
5. Consider a Von Neumann machine with a clock rate of 10 GHz (Trillion Cycles/Second). The average floating point instruction execution requires 8 cycles. Express the computation power of the machine in FLOPS (Floating Point Operations/Second).
6. How do processes exchange information in shared-memory architectures and distributed-memory architectures.
7. Classify Illiac IV, Hypercube, Oscar-Cluster, Sun architectures as : (i) SIMD/MISD/MIMD (ii)shared/distributed memory
8. Consider an MISD architecture with 6 processing segments and each processing segment requires 5 microseconds of processing time. (Note that one higher level instruction requires processing by all the segments)
   (i) Show the pipeline diagram for processing 5 operations in the pipeline on a time axis.
   (ii) What is the execution time for: 1 operation, 2 operations, 3 operations, 4 operations, 5 operations.
   (iii) What would be the execution time for 500 such operations?
   (iv) What would be the speedup?
9. Consider the following loop: for (i=0; i<500; i++) {job(i)}. This is executed on an SIMD architecture with 15 processors and each job(i) requires 2 microseconds of processing time. What is the net speed up attained?
10. Consider the following loop: for (i=0; i<500; i++) {job(i)}. This is executed on an MISD architecture with 4 processing segments and each segment requires 2 microseconds of processing time. What is the net speed up attained?
11. Indicate all the outputs that are possible after executing the code below:

```
int shared;
int id,p=2;
shared=1;
// fork 2 processes
If (id == 0)
    shared=shared * 2;
else
```

```
        shared=shared + 2;
    //process join
    cout<< shared;
```

12. What is a semaphore? Why is it needed in asynchronous parallel programming?
13. What happens (specify any output generated) when the following program code is compiled and executed on a cluster of 4 nodes.

```
    int size, node;
    MPI_Init(&argc, &argv);
    MPI_Comm_rank(MPI_COMM_WORLD, &node);
    MPI_Comm_size(MPI_COMM_WORLD, &size);
    int a=0; b=0;
    if(node == 1)
         MPI_Recv(&b, 1, MPI_INT, node-1, 0, MPI_COMM_WORLD, &status);
    else
      if(node == 0)
      {
         a=3;
         MPI_Send(&a, 1, MPI_INT, node+1, 0, MPI_COMM_WORLD);
      }
      cout<<node<<" " <<a<<" "<<b<<endl;

      MPI_Finalize();
```

14. Write the necessary code to implement
    MPI_Bcast(&value, 1, MPI_FLOAT, 9, MPI_COMM_WORLD);
    using only MPI_Send and MPI_Recieve commands on a 10 node cluster.
    (Note that node #9 is to broadcast the "value" to all the nodes)
15. Similar to the above problem, implement MPI_Reduce function using MPI_Send and MPI_Recieve functions
16. What happens (specify any output generated) when the following program code is executed on a cluster of 4 nodes.

```
   MPI_Comm_rank(MPI_COMM_WORLD, &node);
    MPI_Comm_size(MPI_COMM_WORLD, &size);
    int a=3
     MPI_Bcast(&a, 1, MPI_INT, 0, MPI_COMM_WORLD);
    cout<<node<<" " <<a<<" <<endl;
```

17. What happens (specify any output generated) when the following program code is executed on a cluster of 4 nodes. (Note the difference with the above problem)

```
   MPI_Comm_rank(MPI_COMM_WORLD, &node);
    MPI_Comm_size(MPI_COMM_WORLD, &size);
    int a=0; ;
```

```
if(node == 0)
{
    a=3;
 MPI_Bcast(&a, 1, MPI_INT, 0, MPI_COMM_WORLD);
}
cout<<node<<"  " <<a<<"  <<endl;
```

18. What happens (specify any output generated) when the following program code is executed on a cluster of 4 nodes.

```
int size, node;
MPI_Init(&argc, &argv);
MPI_Comm_rank(MPI_COMM_WORLD, &node);
MPI_Comm_size(MPI_COMM_WORLD, &size);
  if(node == 0)
  {
      a=1; b=2;
      MPI_Recv(&a, 1, MPI_INT, 1, 0, MPI_COMM_WORLD, &status);
      MPI_Send(&b, 1, MPI_INT, 1, 0, MPI_COMM_WORLD);
  }
  else
  {
       a=101; b=102;
       MPI_Recv(&a, 1, MPI_INT, 0, 0, MPI_COMM_WORLD, &status);
      MPI_Send(&b, 1, MPI_INT, 0, 0, MPI_COMM_WORLD);
  }
  cout<<node<<"  " <<a<<"  "<<b<<endl;
  MPI_Finalize();
```

19. If the intent is to generate the output as in Problem #15, write the complete program to be executed in an MPI environment..
20. Write program asked for in Problem #24, #25 to be executed in an MPI environment.
21. Write the sequential Rank Sort algorithm.

    Write the necessary outline to implement it on oscar.calstatela.edu

22. Compute $\sum$ $(1/(1+x^2)$

    starting with x=0 and intervals of 0.02 until x=1 (use loop splitting with n processes)