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| <b>Course Title</b>                    | <b>Parallel &amp; Distributed Computing</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |            |
| <b>Course Code</b>                     | <b>DC-328</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |            |
| <b>Credit Hours</b>                    | 3 (2,1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |            |
| <b>Category</b>                        | Computer Science Core                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |            |
| <b>Prerequisite</b>                    | CC-311 Operating Systems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |            |
| <b>Co-Requisite</b>                    | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |            |
| <b>Follow-up</b>                       | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |            |
| <b>Course Introduction</b>             | The demand of huge computation and storage resources has been increasing exponentially. The course provides the methods for dealing with the emerging challenges of enhancing the power of the computational resources. This course will introduce topics related to parallel and distributed computing and also expose students to the latest tools and technologies.                                                                                                                                                                                                                                                                                                                                    |                     |            |
| <b>Course Learning Outcomes (CLOs)</b> | At the end of the course, the students will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>BT</b>           | <b>PLO</b> |
|                                        | CLO1: Learn about parallel and distributed computers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | C1 (Know)           | 1          |
|                                        | CLO2: Write portable programs for parallel or distributed architectures using Message-Passing Interface (MPI) library.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | C3<br>(Demonstrate) | 3.4.5      |
|                                        | CLO3: Analyze complex problems with shared memory programming with openMP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | C4 (Analyze)        | 3          |
| <b>Course Description</b>              | Asynchronous/synchronous computation/communication, concurrency control, fault tolerance, GPU architecture and programming, heterogeneity, interconnection topologies, load balancing, memory consistency model, memory hierarchies, Message passing interface (MPI), MIMD/SIMD, multithreaded programming, parallel algorithms & architectures, parallel I/O, performance analysis and tuning, power, programming models (data parallel, task parallel, process-centric, shared/distributed memory), scalability and performance studies, scheduling, storage systems, synchronization, and tools (Cuda, Swift, Globus, Condor, Amazon AWS, OpenStack, Cilk, gdb, threads, MPICH, OpenMP, Hadoop, FUSE). |                     |            |
| <b>Text Book(s)</b>                    | 1. Distributed Systems: Principles and Paradigms, A. S. Tanenbaum and M. V. Steen, Prentice Hall, 2nd Edition, 2007                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |            |
| <b>Reference Material</b>              | 1. Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet, KHwang, J Dongarra and GC. C. Fox, Elsevier, 1st Ed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |            |