Course Code	UDS21202J	Course Name	ADVANCED COMPUTING WITH DISTRIBUTED DATA PROCESSING	Course Category	C	Professional Core Course	L	T	P	C
							4	0	2	5

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Applications		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Understand the concept of advanced computing in recent times
CLR-2 :	Learn the basics of cloud computing and serverless computing
CLR-3 :	Understand the concept of Real Time Computing
CLR-4 :	Identify the concept of Microservice and its Architecture
CLR-5 :	Impart the knowledge of Numerical and Scientific Computing with Scala
CLR-6 :	Appreciate the applications of advanced computing

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Learn the basics of Traditional Computing	3	80	70
CLO-2 :	Classify different types of Cloud Computing	3	85	75
CLO-3 :	Recognize Web Services and its Architecture	3	75	70
CLO-4 :	Understanding about Python and Scala Programming for AI implementstion	3	85	80
CLO-5 :	Grasp the concept of Google Cloud Platform	3	85	75
CLO-6 :	Apply Advanced Computing in Google Cloud Platform	3	80	70

	Program Learning Outcomes (PLO)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLO-1 :	H	H	M	-	-	-	-	-	H	H	-	-	M	H	H
CLO-2 :	H	H	H	H	H	-	M	-	H	H	-	-	M	H	H
CLO-3 :	H	H	M	H	H	-	M	-	H	H	-	-	M	H	H
CLO-4 :	H	H	H	-	-	-	-	-	H	M	-	-	M	H	H
CLO-5 :	H	M	M	M	M	M	M	-	H	H	-	M	M	H	H
CLO-6 :	H	H	M	-	-	-	-	-	H	H	-	-	M	H	H

Note: All our curriculum, study materials, assignments, quizzes, lab works, and learning resources are personalized and dynamically generated using machine learning models based on the learner's learning ability. Users can review our learning curriculum only through our intelligent learning management platform (iLMSP), and our learning resources and lab infrastructures are available only in the digital form on our cloud infrastructures.

Duration (hour)		18	18	18	18	18
S-1	SLO-1	**Unit 1: Working and Architecture of Cluster Computing Grid Computing and Cloud Computing**	Infrastructure -as-a-service	Apache Spark Resilient Distributed Datasets	Typical Application Life Cycle	Overview of Compute Engine
	SLO-2	Overview of Grid Computing	Benefits of Infrastructure -as-a-service	Progamming with Resilient Distributed Datasets	Application Life Cycle with Dynamic Load Balancing	Overview of Kubernetes Engine
S-2	SLO-1	Technology	**Unit 4: High Performance Computing**	Interactive Spark using PySpark	Use of Dynamic Load Balancing	Overview of Google Cloud Strage

	SLO-2	History of Grid Computing	Introduction to High Performance Computing	Writing Spark Applications	Working of Dynamic Load Balancing	Overview of Cloud SQL and Big Query ML
S-3	SLO-1	Overview of Cloud Computing	Peer to Peer Computing	**Unit 7: OpenMP programming**	**Unit 10: Parallel Meshing and Remeshing**	Overview of Cloud Storage
	SLO-2	History of Cloud Computing	Internet Computing	Getting Started with Memory Programming	Getting Started with Parallel Meshing and Remeshing	Overview of Networking Services
S-4	SLO-1	**Unit 2: Role of Cloud Computing in An AI Implementation**	Grid Computing	Fundamentals of Shared Memory Programming	Large Deformation and Adaptive Remeshing	**Unit 13: Advanced Computing in Google Cloud Platform**
	SLO-2	Cloud Service for AI	Types of Grids	Basic OpenMP Conecpts	Partitioning and Parallel Meshing Technique	Working with Google Cloud GPU
S-5 to S-6	SLO-1	**Lab 1: Study of Cloud Computing & Architecture**	**Lab 4: Case Study on Amazon Web Services**	**Lab 7: Perform a Simple Vector Addition using OpenMP Progreamming**	**Lab 10: Perform a study on Parallel Meshing**	**Lab 13: Perform a study on Google GPU and TPU Options**
	SLO-2					
S-7	SLO-1	Cloud Computing for Improved Productivity	Applications and Architectures of High Performance Grids	Parallel Directive	Parallel Mesh	Connecting Cloud GPU to custom machine types
	SLO-2	Cognitive Computing API's	High Performance Application Development Environment.	Data Scoping Rules	Parallel Mesh Generation	Preemptible Cloud GPU
S-8	SLO-1	Merging AI and Cloud Computing	**Unit 5: High Performance Computing Building Blocks**	Basic Open MP Constructs	**Unit 11: Networking and Storage Options for Advanced Computing**	Machine Learning Performance with Cloud GPU
	SLO-2	Machine Learning Cloud Services	Introduction to High Performance Computing Building Blocks	Open MP Directives		Working with Google Cloud TPU
S-9	SLO-1	Cloud AI Platforms	Models and Protocols	Open MP Calls	Language of Storage	Connecting Cloud TPU to custom machine types
	SLO-2	Types of Cloud Application Development	Components of High Performance Computing	Parallelizing an Existing Code with OpenMP	Understandng the Hard-Dsk Drive	Preemptible Cloud TPU
S-10	SLO-1	Infrastructure-as-a-service	High Performance Computing – Compute	**Unit 8: Message Passing interface (MPI) parallel programming**	Understandng the NAND Flash Drive	**Unit 14: Google Cloud Platform Compute, Kubernetes, App Engine**
	SLO-2	Platform-as-a-service	High Performance Computing – Network		Data Center Storage Configurations	
S-11 to S-12	SLO-1	**Lab 2: Virtualization in Cloud by using KVM and VMware**	**Lab 5: Case Study on Microsoft Azure**	**Lab 8: Write a MPI Program to send data across all processes**	**Lab 11: Perform a study on Networking and Storage Service**	**Lab 14: Perform a study on Google App, Compute, Kubernetes Engine**
	SLO-2					
S-17	SLO-1	**Unit 3: Cloud Computing Buliding Blocks**	High Performance Computing – Storage	Introduction to Messsge Passing Inteface	Modern Storage Technologies	Virtual Machine Instances
	SLO-2	Getting Started with Cloud Computing Building Blocks	High Performance Computing – User Scheduler	Messsge Passing Model	Convergence and Composability	Machine Types
S-13	SLO-1	Cloud Software Building Blocks	High Performance Computing – Compute Cluster	Types of Parallel Computing Model	Cloud Storage	Custom Machine Types

	SLO-2	Cloud Hardware Building Blocks	High Performance Computing – Data Storage	MPI Sources	Data Security and Privacy	Disks and Persistent Disks
S-14	SLO-1	Software-as-a-service	**Unit 6: In memory and Real Time Computing with Scala**	Need for MPI Programming	**Unit 12: Google Cloud Platform Core Infrastructure and Services**	Introduction to Containers
	SLO-2	Benefits of Software-as-a-service	Getting Started with In-memory and Real Time Computing with Scala	Running a MPI Program		Introduction to Kubernetes
S-15	SLO-1	Platform-as-a-service	In-memory computing with Apache Spark	**Unit 9: Dynamic Load Balancing**	Getting Started with Google Cloud Platform	Introduction to App Engine
	SLO-2	Benefits of Platform-as-a-service	Apache Spark Basics	Introduction to Dynamic Load Balancing	Overview of Google App Engine	Key Features of App Engine
S-17 to S-18	SLO-1	**Lab 3: Case study: PaaS (Face Book, Google App Engine**	**Lab 6: Create an Application using Apache Spark. (Ex.: Similarity word count during searching)**	**Lab 9: Perform a study on Asynchronous Dynamic Load Balancer**	**Lab 12: Perform a study on Google Core Infrastructure Services**	**Lab 15: Create a Simple Virtual Machine on Google Compute Service**
	SLO-2					

Learning Resources	.1. https://deepsphereai.litmos.com/ 2. Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems - Principles and Paradigms", Second Edition, Pearson, 2006. 3. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", John Wiley& Sons, 2011.	4. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012. 5. .John W.Rittinghouse, James F.Ransome, "Cloud Computing: Implementation "Management, and Security", CRC Press, 2010.

Learning Assessment

Level	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%) #			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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