SEMESTER S6

ADVANCED COMPUTING SYSTEMS

Course Code	PCCST602	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs 30 Min.
Prerequisites (if any)	GAEST203 PBCST404 PCCST403	Course Type	Theory

Course Objectives:

1. To introduce the computational models prevalent in modern distributed systems.
2. To provide the concepts of computer clusters, virtualization, cloud computing, microservices and containers.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Distributed System Models and Enabling Technologies:-** **The age of internet computing:-** – High performance and high throughput computing, Centralized, Parallel, Distributed and Cloud Computing. Design objectives of HPC and HTC. IoT and Cyber Physical systems. **Technologies for Network-Based systems:-** Multicore CPUs and Multithreading Technologies. GPU Computing. Virtual Machines. **System models for distributed and cloud computing:-** Clusters, Grids, P2P Systems, Clouds.	7
2	**Computer Clusters :-** **Clustering for massive parallelism:-** Design objectives, Design Issues – Ensuring high availability, Cluster families. Cluster Architecture. GPU Clusters – Components. **Computer Clusters** – Design principles – Single System Image features. High availability through redundancy. Fault tolerant cluster configurations, checkpoint and recovery techniques. **Cluster Job and Resource Management:-** – Job Scheduling methods, Job management system – administration, job types, migration schemes.	11

3	**Virtualization:-** Introduction, Virtualization at different levels and their comparison. VMM design requirements, OS level virtualization. Virtualization structures and mechanisms. CPU, Memory and I/O Virtualization. Virtual clusters and resource management. Live VM migration steps, migration of memory, files and network resources.	**9**
4	**Cloud Computing, Microservices and Containers:-** **Cloud Computing and Service models:-** Private, Public and Hybrid clouds. Cloud Design objectives and Cost Model. Infrastructure-as-a-Service, Platform-as-a-Service, Software-as-a-Service. **Microservices:-** – Introduction, advantages and disadvantages. Interprocess Communication – Types of interactions, Protocol, Standard and Message Format, Discovery Service, API Gateway, Service Registry **Containers** – Comparison of Virtual Machines and Containers. Introduction to Docker. Case Study - Docker Containers – Architecture, Components, Examples.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the key enabling technologies for network-based systems, including multicore CPUs, multithreading, GPU computing, and virtualization, and how these technologies contribute to the performance and efficiency of distributed systems.	**K3**
CO2	Use computer cluster architectures, ensuring high availability, fault tolerance, and massive parallelism. They will also learn to implement effective job and resource management strategies within cluster environments.	**K4**
CO3	Explain various levels of virtualization, including CPU, memory, and I/O virtualization, and understand the design requirements and mechanisms of Virtual Machine Monitors (VMMs).	**K2**
CO4	Articulate the differences between private, public, and hybrid cloud models, and understand the design objectives and cost considerations associated with different cloud models.	**K4**
CO5	Explain microservices architecture, its advantages and disadvantages, and the principles of interprocess communication. They will also learn about the role of containers in modern computing, with a specific focus on Docker, including its architecture, components, and practical applications through case studies.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3									3
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3									3
CO5	3	3	3		3							3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Distributed and Cloud Computing: From Parallel Processing to the Internet of Things	Kai Hwang,Geoffrey C. Fox, Jack Dongarra	Morgan Kaufmann	1/e, 2013
2	Microservices and Containers	Parminder Singh Kocher	Addison-Wesley	1/e, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Patterns of Distributed Systems	Unmesh Joshi	Pearson Education	1/e, 2024
2	Cluster Computing, Grid Computing, Cloud and Virtualization	Deepa Kalavikatte	DSK Publisher	1/e, 2020
3	Cloud and Distributed Computing: Algorithms and Systems	Rajiv Misra, Yashwant Singh Patel	Wiley	1/e, 2020

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_cs118/preview
2	https://onlinecourses.nptel.ac.in/noc24_cs131/preview