1	Course Name:	Distributed Systems and Parallel Computing				
	Course Code:	BMCS3003				
	Course Classification:	Major (core)				
2	Synopsis:	This course provides students with an understanding of distributed systems and parallel computing; considers the principles and the applications of parallel computing techniques.				
3	Name(s) of Academic Staff:	1	Refer to timetable			
		2				
		3				
4	Semester and Year offered:	Year Offered		Semester		*Remarks: Refer to Programme Structure*
5	Credit Value:	3				
6	Pre-requisite/ co-requisite (if any):	Nil				

7

Course Learning Outcomes (CLO)		
	CLO1	Demonstrate appropriate programming skills with regards to parallel and distributed computing. (P4, PLO3)
	CLO2	Analyse a given scenario with parallel and distributed computing techniques. (C4, PLO2)
	CLO3	Discuss the variety of parallel and distributed computing techniques. (C2, PLO1)

8 Mapping of the Course Learning Outcomes to the Programme Learning Outcomes, Teaching Methods and Assessment Methods

Course Learning Outcomes	Programme Learning Outcomes (PLO)												Teaching Methods	Assessment Methods
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11			
CLO1			√										L,P,NF2F	Assignment
CLO2		√											L,P,NF2F	Assignment, Test, Examination
CLO3	√												L,P,NF2F	Test, Examination
Mapping with MQF Cluster of Learning Outcomes	C1	C2	C3A											

Indicate the primary causal link between the CLO and PLO by ticking 'V' in the appropriate box.

C1 = Knowledge & Understanding, **C2** = Cognitive Skills, **C3A** = Practical Skills, **C3B** = Interpersonal Skills, **C3C** = Communication Skills, **C3D** = Digital Skills, **C3E =** Numeracy Skills**, C3F** = Leadership, Autonomy & Responsibility, **C4A** = Personal Skills, **C4B** = Entrepreneurial Skills, **C5** = Ethics & Professionalism

9 Transferable Skills (if applicable)

(Skills learned in the course of study which can be useful and utilized in other settings)

1	Cognitive skills
2	

3	

Open-ended response (if any)

4	

10 Distribution of Student Learning Time (SLT)

Note: This SLT calculation is designed for home grown programme only.

	Course Content Outline and Subtopics	CLO*	Learning and Teaching Activities**									Total SLT
			Face-to-Face (F2F)								NF2F Independent Learning (Asynchronous)	
			Physical				Online/ Technology-mediated (Synchronous)					
			L	T	P	O	L	T	P	O		
1	**Introduction to Distributed Systems** • What is a Distributed System? • What is a Real-Time System? • Operating Systems	1,2	2		2						4	
2	**Inter-process Communication** • Selection Factors • Message Passing • Pipes • Sockets • Remote Procedure Calls	1,2	2		2						4	
3	**Memory Management** • Review of Centralized Memory Management • Simple Memory Model • Shared Memory Model • Distributed Shared Memory • Memory Migration	1,2	2		2						4	
4	**Concurrency Control** • Mutual Exclusion and Critical Regions • Semaphores • Monitors • Locks • Software Lock Control • Token-Passing Mutual Exclusion • Deadlocks	1,2	4		4						4	
5	**Distributed Process Management** • Distributed Scheduling Algorithm Choices • Scheduling Algorithm Approaches • Coordinator Elections • Orphan Processes	2,3	2		2						2	
6	**Introduction to Parallel Computing – Part 1** • Parallel Computing • Components of Parallel Computing Systems • Multiprocessor vs. Multi-core Architecture • The needs of Parallelism	2,3	2		2						2	
7	**Introduction to Parallel Computing – Part 2** • Types of Parallel Computing • Concurrent Computing • Distributed Computing • Level of Parallelism • Writing parallel program	2,3	2		2						2	
8	**Parallel Architecture - I** • Von Neumann Architecture • Classification of Parallel Computers o Flynn's Classification o Handler's Classification) o Classification on the Basis of Structure	2,3	2		2						3	
9	**Parallel Architecture - II** • Dependency and its Types • Various types of dependency. • Bernstein Conditions for Detecting Parallelism	2,3	2		2						3	

10	**Parallel Algorithm** • Introduction to parallel algorithm • Models of parallel algorithm • Analyzing a Sequential Algorithm • Analyzing Parallel Algorithms • Amdahl's Law	2,3	4		4						4	
11	**Graph Algorithm** • Graph Terminology • Data Structure to Store Graph • Solving Problems with Graph	2,3	2		2						2	
12	**PRAM Model** • RAM Model of Computation • PRAM Model of Computation • PRAM Algorithms	2,3	2		2						2	
13												
14												
15												
16												
17												
18												
19												
20												
											SUB-TOTAL SLT:	**92**

	Continuous Assessment	%	Face-to-Face (F2F)		NF2F Independent Learning for Assessment (Asynchronous)	
			Physical	Online/ Technology-mediated (Synchronous)		
1	Test	28	1		2	
2	Assignment	42	-		15	
3						
4						
5						
					SUB-TOTAL SLT:	**18**

	Final Assessment	%	Face-to-Face (F2F)		NF2F Independent Learning for Assessment (Asynchronous)	
			Physical	Online/ Technology-mediated (Synchronous)		
1	Examination	30	2		8	
2						
3						
4						
5						
					SUB-TOTAL SLT:	**10**

	SLT for Assessment:	28
	GRAND TOTAL SLT:	120
A	% SLT for F2F Physical Component: *[Total F2F Physical /(Total F2F Physical + Total F2F Online + Total Independent Learning) x 100)]*	49.17
B	% SLT for Online & Independent Learning Component: *[(Total F2F Online + Total Independent Learning) /(Total F2F Physical + Total F2F Online + Total Independent Learning) x 100]*	**50.83**
C	% SLT for All Practical Component: *[% F2F Physical Practical + % F2F Online Practical]*	**23.33**
C1	% SLT for F2F Physical Practical Component *[Total F2F Physical Practical /(Total F2F Physical + Total F2F Online + Total Independent Learning) x 100)]*	**23.33**
C2	*% SLT for F2F Online Practical Component* *[Total F2F Online Practical / (Total F2F Physical + Total F2F Online + Total Independent Learning) x 100]*	**0.00**

	Please tick (V) if this course is **Industrial Training/ Clinical Placement/ Practicum** using 50% of Effective Learning Time (ELT) Note: * Indicate the CLO based on the CLO's numbering in Item 8 ** For ODL programme: Courses with mandatory practical requiremnets imposed by the programme standards or any related standards can be exempted from complying to the minimum 80% ODL delivery rule in the SLT.	
11	Identify special requirement or resources to deliver the course (e.g., software, nursery, computer lab, simulation room etc)	Nil
12	References (include required and further readings, and should be the most current)	**Main references supporting the course** 1. NVIDIA Corporation. (2023). *CUDA Toolkit Documentation 12.1* . https://docs.nvidia.com/cuda/ 2. OpenACC-standard.org. (2022). *Programming and Best practices guide* . https://www.openacc.org/sites/default/files/inline-files/openacc-guide.pdf 3. OpenMP Architecture Review Board. (2021). *OpenMP 5.2 API Syntax Reference Guide* . https://www.openmp.org/wp-content/uploads/OpenMPRefCard-5-2-web.pdf
13	Other additional information (if applicable)	Nil
	Note: Number of PLO indicated is purely for illustration purposes only and the number is subjected to the curriculum design.	