Reg. No.															

B.Tech/ M.Tech (Integrated) DEGREE EXAMINATION, MAY 2024
Fourth Semester

21CSE309J – GPU POWERED COMPUTING
(For the candidates admitted from the academic year 2022-2023 onwards)

Note:
(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
(ii) **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours Max. Marks: 75

PART – A (20 × 1 = 20Marks)
Answer **ALL** Questions

	Marks	BL	CO	PO
1. _____ is a common parallel programming paradigm used in scientific computing to distribute computation among multiple processors. (A) Object-oriented programming (B) Functional programming (C) Message passing interface (D) Procedural programming	1	2	1	1
2. What is the primary motivation for parallelizing scientific computing tasks? (A) Reducing the complexity of algorithms (B) Decreasing the need for computational resources (C) Improving performance by utilizing multiple processors (D) Simplifying the implementation of numerical methods	1	2	1	1
3. In OpenMP programming, which directive is used to parallelize loops and distribute iterations among threads? (A) #pragma omp for (B) #pragma omp critical (C) #pragma omp task (D) #pragma omp parallel	1	1	1	1
4. _____ is the best describes the scope of variables declared within a parallel region in OpenMP? (A) The variables are accessible only within the parallel region where they are declared (B) The variables are accessible globally by all threads (C) The variables are accessible only by the master thread (D) The scope of variables is determined by the thread that declares them	1	3	1	2
5. In MPI parallel computing model, how is data typically shared between processes? (A) Through shared memory (B) By passing messages between processes (C) By broadcasting data to all processes simultaneously (D) Through centralized storage accessible by all processes	1	2	2	1
6. _____ is a characteristic of the local memory in MPI parallel computing. (A) It is shared among all parallel processes (B) Each parallel process has its own local memory (C) It is dynamically allocated and deallocated during runtime (D) It is accessed using global pointers	1	2	2	1

7. In parallel computing, what is the term used to refer to multiple computers or multiple processor cores within the same computer? 1 1 2 2

(A) Segments (B) Sectors
(C) Clusters (D) Nodes

8. _____ MPI datatype is used to create custom datatypes for non-contiguous data structures. 1 3 2 2

(A) MPI_INT (B) MPI_CHAR
(C) MPI_DOUBLE (D) MPI_Datatype_Create_Struct

9. _____ parallel programming model is commonly used for implementing shared-memory parallelism in numerical methods on multicore CPUs? 1 2 3 1

(A) MPI-Message Passing Interface (B) OpenMP-Open Multi-Processing
(C) CUDA-Compute Unified Device Architecture (D) OpenACC-Open Accelerator

10. A large system of linear equations needs to be solved in parallel using both MPI and OpenMP. Which approach would be most suitable for distributing the rows of the coefficient matrix among MPI processes and parallelizing the solution within each process using OpenMP? 12 3 2

(A) Row-wise partitioning (B) Column-wise partitioning
(C) Domain decomposition (D) Shared-memory parallelism

11. In parallel numerical integration using MPI, which strategy involves dividing the integration domain into equal segments and assigning each segment to a different MPI process? 1 1 3 2

(A) Trapezoidal rule (B) Simpson's rule
(C) Monte Carlo Method (D) Midpoint rule

12. A parallel finite-difference solver is used to simulate the behavior of a vibrating membrane. Each MPI process is responsible for updating a portion of the mesh, while OpenMP threads within each process handle the computations. What is a key challenged that needs to be addressed in this parallelization strategy? 1 3 3 1

(A) Load balancing among MPI processes (B) Minimizing communication overhead between MPI processes
(C) Synchronization of threads within each MPI process (D) Memory management for large-scale simulations

13. Data dependence is _____. 1 2 4 1

(A) Involves only those tasks executing a communication operation (B) It exists between program statements when the order of statement execution affects the results of the program
(C) It refers to the practice of distributing work among task, so that all tasks are kept busy all of the time (D) It can be considered as minimization of task idle time

14. _____ programming framework is associated with NVIDIA GPUs for general-purpose computing? 1 2 4 2

(A) DirectX (B) OpenCL
(C) CUDA (D) OpenGL

		Marks	BL	CO	PO
23. a.	Differentiate between MPI and OpenMP with sample program.	8	3	3	1
	(OR)				
b.	Explain blocking communication with diagram.	8	3	3	1
24. a.	What is OpenACC? Write simple compiler directive program model.	2+6	3	4	2
	(OR)				
b.	Draw OpenACC development cycle and define each stage.	8	3	4	2
25. a.	Illustrate GPU programming models with diagram.	8	2	5	2
	(OR)				
b.	How can parallel computation help expedite the analysis of large datasets compared to traditional sequential processing methods? Briefly explain with diagram.	8	2	5	2

PART – C (1 × 15 = 15 Marks)

Answer **ANY ONE** Question

		Marks	BL	CO	PO
26.	A software developer working on a project that involves heavy computational tasks, and exploring the use of GPU acceleration to improve performance. His team is implementing CUDA programming for this purpose. During a team meeting, one of his colleagues raises concerns about the compatibility of CUDA with different GPU models and the potential limitations in may pose. How would he address these concerns and explain the benefits of using CUDA for GPU acceleration in this scenario?	15	4	5	2
27.	Describe collection communication operations for the following scenario:		4	3	2
(i)	To compute prefix-sums	5			
(ii)	If the result of the reduction operation is needed by all processes	5			
(iii)	The corresponding scatter operations	5			

* * * * *

15. The purpose of a compiler in programming is _____. | 1 | 1 | 4 | 1

(A) Executes the program
(B) Translates source code to machine code
(C) Interprets code in real time
(D) Optimizes code for better performance

16. _____ is unified virtual machine. | 1 | 2 | 4 | 2

(A) It is a technique that allow both CPU and GPU to read from single virtual machine simultaneously
(B) It is a technique for managing separate host and device memory spaces
(C) It is a technique for executing device code on host and host code on device
(D) It is a technique for executing general purpose programs on device instead of host

17. Both the CISC and RISC architectures have been developed to reduce the ____. | 1 | 3 | 5 | 1

(A) Cost
(B) Time delay
(C) Semantic gap
(D) Capacity

18. Two processors A and B have clock frequencies of 700 MHz and 900 MHz respectively. Suppose A can execute an instruction with an average of 3 steps and B can execute with an average of 5 steps. For the execution of the same instruction which processor is faster? | 1 | 2 | 5 | 2

(A) A
(B) B
(C) Both take the same time
(D) Insufficient information

19. Which metric provides a more comprehensive measure of the overall performance of a parallel program, including idle time spent waiting for communication operations? | 1 | 3 | 5 | 2

(A) CPU time
(B) Wall clock time
(C) Processor speed
(D) Memory utilization

20. Which function is used for free the memory in CUDA? | 1 | 2 | 5 | 3

(A) CudaFree ( )
(B) Free ( )
(C) cudaFree ( )
(D) Cudafree ( )

PART – B (5 × 8 = 40 Marks)

Answer **ALL** Questions

	Marks	BL	CO	PO

21. a. Define OpenMP. How it is a standard for Directive Based Parallel Programming? Elaborate parallel directive in OpenMP. | 2+6 | 3 | 1 | 1

(OR)

b. Define the thread. List out thread basics. Illustrate the logical machine model of a thread-based programming paradigm. | 2+6 | 3 | 1 | 1

22. a. Write the purpose of MPI_Comm_rank function and demonstrate how is it used in the MPI environment with example.. | 8 | 3 | 2 | 2

(OR)

b. Describe the concept of MPI data types and how MPI supports parallel I/O operations. | 8 | 3 | 2 | 2