Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058, India
(Autonomous College Affiliated to University of Mumbai)

End Semester Examination - Synoptic

Apr 2018

Max. Marks: 100
Class: M.Tech. (1st Year) **Duration: 180 Min**
Course Code: CE922 **Semester: II**
Name of the Course: High Performance Computing **Branch: Computer**

Instruction:

(1) All questions are compulsory
(2) Draw neat diagrams
(3) Assume suitable data if necessary

Q No.	Question	Max. Marks	CO
Q.1 (a)	List any five High Speed Network choices for High Performance Computing. **Answer:** Each High Speed Network choice for High Performance Computing carries 1 Mark. Five High Speed Network choices carry 5 Marks.	05	CO2
Q.1 (b)	Define the following terms in the context of Lightweight Messaging System: i) Latency, ii)End-to-end Asymptotic Bandwidth, iii) One-sided Asymptotic Bandwidth, v) Throughput and v) Message Delay. **Answer:** Definition of Latency - 1 Mark. Definition of End-to-end Asymptotic Bandwidth - 1 Mark. Definition of One-sided Asymptotic Bandwidth - 1 Mark. Definition of Throughput - 1 Mark. Definition of Message Delay - 1 Mark.	05	CO2
Q.1 (c)	Define the terms : i) MIPS rate and ii) FLOPS **Answer:** Definition of MIPS rate - 3 Mark. Definition of FLOPS - 2 Mark.	05	CO2
Q.1 (d)	List any five Kernel-level Lightweight Communications Systems. **Answer:** Each Kernel-level Lightweight Communications System carries 1 Mark. Five Kernel-level Lightweight Communications System carry 5 Marks.	05	CO2
Q.2 (a)	Discuss OpenCL Abstract Memory Model. **Answer:** Abstract OpenCL Memory Model with neat diagram carry 8 Marks. Example of Mapping Abstract OpenCL Memory Model to any actual Memory Model carry 2 Marks.	10	CO4

Q.2 (b)	Discuss the structure of *endpoint* communication port in *active messages*. **Answer:** List of all parts of *endpoint* communication port with neat diagram carry 5 Marks. Discussion of working of all parts of *endpoint* communication port carry 5 Marks.	10	CO3
Q.3 (a)	Exemplify the detection of parallelism using Bernstein's conditions. **Answer:** Bernstein's three conditions carry 3 Marks. Example of detection of parallelism using Bernstein's conditions carry 7 Marks.	10	CO3
	OR		
	Consider the following five statements labeled P_1, P_2, P_3, P_4 and P_5, in program order. Show the dependence graph for both data dependence and resource dependence of the five statements. $P_1 : C = D \times E$ $P_2 : M = G + C$ $P_3 : A = B + C$ $P_4 : C = L + M$ $P_5 : F = G \div E$ **Answer:** Valid Data Dependence Graph carry 5 Marks. Valid Resource Dependence Graph carry 5 Marks.	10	CO3
Q.3 (b)	Discuss the effect of fixing problem size (W) and fixing number of processing elements (p) on the efficiency (E) of parallel system. **Answer:** Discussion of the effect of fixing problem size (W) on the efficiency (E) of parallel system carry 5 Marks. Discussion of the effect of fixing number of processing elements (p) on the efficiency (E) of parallel system carry 5 Marks.	10	CO1
	OR		
	Consider a parallel system containing p processing elements solving a problem consisting of W units of work. Prove that if the isoefficiency function of the system is worse (greater) than $\Theta(p)$, then the problem cannot be solved cost-optimally with $p = (W)$. Also prove the converse that if the problem can be solved cost-optimally only for $p < \Theta(W)$, then the isoefficiency function of the parallel system is worse than linear. **Answer:** Proof that the problem cannot be solved cost-optimally with $p = (W)$ carry 5 Marks. Proof that the isoefficiency function of the parallel system is worse than linear carry 5 Marks.	10	CO1
Q.4 (a)	Suppose n pieces of work are allocated in cyclic fashion to p processes. i) Which pieces of work are assigned to process k, where $0 \leq k \leq p-1$?	10	CO3

	ii) Which process is responsible for piece of work j, where $0 \leq j \leq n-1$? iii) What are the most pieces of work assigned to any process? iv) Identify all processes having the most pieces of work? v) What are the fewest pieces of work assigned to any process? **Answer:** Answer of each sub-question carries 2 Marks. Answers of all five sub-questions carry 10 Marks. **OR** Write a parallel variant MPI program of the classic "Hello, world" program. Each process should print a message of the form : `Hello, world, from process <i>` where <i> is its rank. **Answer:** Inclusion of MPI headers in the program carries 2 Marks. Valid use of MPI Initialization function in the program carries 2 Marks. Valid use of MPI Finalization function in the program carries 2 Marks. Valid use of MPI communication rank function in the program carries 2 Marks. Valid use of printf function in the program carries 2 Marks.	10	CO3
Q.4 (b)	Two types of data decomposition strategies namely i) *Interleaved Data Decomposition* and ii) *Block Data Decomposition* assign n elements to p processes such that each process is assigned either $\lceil n/p \rceil$ or $\lfloor n/p \rfloor$ elements. For each pair of values of n and p, use a table or an illustration to show how these two schemes would assign array elements to processes: i) $n = 15$ and $p = 4$ ii) $n = 15$ and $p = 6$ iii) $n = 16$ and $p = 5$ iv) $n = 18$ and $p = 4$ v) $n = 20$ and $p = 6$ **Answer:** Answer of each sub-question for both Decomposition carries 2 Marks. Answers of all five sub-questions carry 10 Marks. **OR** Compare *Rowwise* and *Columnwise* Block-striped Decomposition of an $m \times n$ matrix for matrix-vector multiplication. **Answer:** Each comparative observation (with diagrams,if any) between *Rowwise* and *Columnwise* Block-striped Decomposition carries 2 Marks. Five such comparative observations carry 10 Marks.	10 10	CO1 CO1

Q.5 (a)	Discuss the recursive decomposition for sorting a sequence of 12 numbers using Quicksort and then show the task-dependency graph of the decomposed 12 numbers. The sequence of 12 numbers are : $5, 12, 11, 1, 10, 6, 8, 3, 7, 4, 9, 2$. **Answer:** Discussion of recursive decomposition (along with diagram) for sorting a sequence of 12 carry 5 Marks. Task-dependency graph of the decomposed 12 numbers carry 5 Marks.	10	CO4
Q.5 (b)	Exemplify One-to-All Broadcast and All-to-One Reduction operations for Mesh and Hypercube parallel algorithms. **Answer:** Example of One-to-All Broadcast and All-to-One Reduction operations for Mesh parallel algorithms carry 5 Marks. Example of One-to-All Broadcast and All-to-One Reduction operations for Hypercube parallel algorithms carry 5 Marks.	10	CO3