هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification
(Bachelor)

Course Title:	Parallel and Distributed Computing
Course Code: :	CS 439
Program:	Computer Science
Department:	Computer Science
College:	College of Computer and Information Sciences
Institution:	Majmaah University
Version:	1
Last Revision Date:	11 September 2023

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: 3(3,0,1)					
2. Course type					
A.	☐University	☐College	☐Department	☐Track	☒ Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 11/Year 3)					
4. Course general Description:					
This course introduces the techniques of designing efficient parallel algorithms and their implementation. This course gives a broad look on how parallel computers work and their importance in solving practical problems.					
5. Pre-requirements for this course (if any)**:**					
CS 312-Computer Organization					
6. Pre-requirements for this course (if any)**:**					
7. Course Main Objective(s):					
This course introduces students to Parallel and Distributed Processing concepts including concurrency and its management. Introduction to Multiprocessor & Multicomputer, Interconnection networks, models of parallel computation, Load balancing, distributed termination detection and synchronous and asynchronous parallelism.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	15
5.	**Others (specify)**	
Total		60

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1				
1.2				
...				
2.0	**Skills**			
2.1	CLO1-Appreciate and understand the importance of parallel computation in solving practical problems in Science and Engineering	S1	Classroom Teaching	Quiz, Assignment, Mid Exam, Final Exam
2.2	CLO2-Be able to select the proper parallel processing strategy that is expected to work best for solving a practical problem	S2	Classroom Teaching	Quiz, Assignment, Mid Exam, Final Exam
2.3	CLO3-Be able to develop a parallelization strategy for numerical and other algorithms for science and engineering problems such as difficult integral, performing monte carlo simulation	S2	Classroom Teaching	Quiz, Assignment, Mid Exam, Final Exam

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
2.4	CLO4-Be able to develop, test and debug intermediate level message passing programs using C/MPI in a PC Cluster and write a Data Parallel Program for GPU	S4	Classroom Teaching, Classroom demonstration	Quiz, Assignment, Mid Exam, Final Exam, Lab Exercises
2.5	CLO5-Be able to compare the performance of alternative parallel processing strategies for a given problem in a PC cluster and GPU	S4	Classroom Teaching	Quiz, Assignment, Mid Exam, Final Exam
2.6	CLO6-Be able to evaluate how the performance is affected as the problem size increases (Scalability analysis)	S1	Classroom Teaching	Quiz, Assignment, Mid Exam, Final Exam
3.0	**Values, autonomy, and responsibility**			
3.1				
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	Fundamentals of Parallel Processing : Motivating Parallelism, Scope of Parallel Computing, Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Physical Organization of Parallel Platforms Parallel machines and computation models, shared Address space	6
2.	Introduction to Multiprocessor & Multicomputer : Introduction to multi-core architectures, issues involved into writing code for multi-core architectures, Development of programs for these architectures, program optimizations techniques. Multiprocessors and Thread-Level Parallelism Introduction ,Symmetric Shared-Memory Architectures ,Performance of Symmetric Shared-Memory Multiprocessors, Distributed Shared Memory and Directory-Based Coherence , Synchronization, Multiprocessors vs. Message passing	8

3.	Interconnection networks: Routing Mechanisms for Interconnection Networks Impact of Process-Processor Mapping and Mapping Techniques, Performance estimation methods	4
4.	Graphics Processing Units and other parallel devices: Data-Stream-Based Architectures, GPU Programming Model, Dataflow, Vector Operations ,Matrix Vector Product, Graphics Pipeline	4
5.	Message Passing methods and tools : Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Overlapping Communication with Computation Groups and Communicators	8
6.	Partitioning, divide-and-conquer strategies :Introduction, numerical integration and bucket sort case studies	6
7.	Data Parallel & synchronous computing: Introduction, PRAM models, The Bulk Synchronous Parallel Model, BSP algorithm, Data-parallel programming on MIMD computers	6
8.	Load balancing, distributed termination detection: Introduction, Static and Dynamic load balancing, Dynamic Load Balancing of Unbalanced Computations Using Message Passing, Algorithms for distributed termination detection	6
9.	Parallel Numerical and Image Processing Algorithms	6
10.	Languages and language extensions, including Pthreads, OpenCL and CUDA	6
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes	Week 4, 8	15%
2.	Assignments	Week 5, 9	15%
3.	Midterm Exam	Week 7	20 %
4.	Exercise	Every Week	10 %
5.	Final Exam	Week 11	40 %

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Introduction to Parallel Computing, (Second Edition) Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar. Addison-Wesley, 2003. ISBN 0-201-64865-2
Supportive References	
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classroom
Technology equipment (projector, smart board, software)	PC with Windows/Linux, LCD Projector, Smart Board
Other equipment (depending on the nature of the specialty)	Internet Connection

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Student Survey
Effectiveness of Students assessment	Students	Peer Review
Quality of learning resources	Students	Student Survey
The extent to which CLOs have been achieved	Instructor/Students	Direct/Indirect
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**CS COUNCIL**
REFERENCE NO.	
DATE	