هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	Parallel and Distributed Computing
Course Code:	CS432
Program:	Computer Science
Department:	Computer Science
College:	College of Computer and Information Sciences
Institution:	Majmaah University

Table of Contents

A. Course Identification

1. Credit hours:	**3(3,0,1)**
2. Course type	
a.	University ☐ College ☐ Department ☐ Others ☒
b.	Required ☒ Elective ☐
3. Level/year at which this course is offered:	**Level 12/Year 4**
4. Pre-requisites for this course (if any)**:**	**CS 322-Computer Organization**
5. Co-requisites for this course (if any)**:**	

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	44	100%
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	33
2	**Laboratory/Studio**	
3	**Tutorial**	11
4	**Others** (specify)	
	Total	44

B. Course Objectives and Learning Outcomes

1. Course 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.

2. Course Main Objective

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.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1		
1.2		
1.3		
1...		
2	**Skills :**	
2.1	CLO1-Appreciate and understand the importance of parallel computation in solving practical problems in Science and Engineering	S1
2.2	CLO2-Be able to select the proper parallel processing architecture based on performance requirements	S4
2.3	CLO3-Be able to develop a parallelization strategy for divide and conquer problems	S2
2.4	CLO4-Be able to develop, test and debug intermediate level message passing programs using C/MPI and OpenMP in a PC Cluster	S4
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
2.6		
3	**Values:**	
3.1		
3.2		
3.3		
3...		

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.	**8**
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	**4**
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	**8**
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	**4**
7	Data Parallel & synchronous computing: Introduction, PRAM models, The Bulk Synchronous Parallel Model, BSP algorithm, Data-parallel programming on MIMD computers	**8**
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	**8**
9	Parallel Numerical and Image Processing Algorithms	**4**
10	Languages and language extensions, including Pthreads, OpenCL and CUDA	**4**
Total		60

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	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	Classroom Teaching	Quiz, Mid Exam, Final Exam, Assignment
2.2	CLO2-Be able to select the proper parallel processing strategy that is expected to work best for solving a practical problem	Classroom Teaching	Quiz, 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	Classroom Teaching	Quiz, Mid Exam, Final Exam

Code	Course Learning Outcomes	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	Lab Exercises and Demonstration of experiments	Quiz and Homework
2.5	CLO5-Be able to compare the performance of alternative parallel processing strategies for a given problem in a PC cluster and GPU	Classroom Teaching	Quiz, Mid Exam, Final Exam, Assignment
2.6	CLO6-Be able to evaluate how the performance is affected as the problem size increases (Scalability analysis)	Classroom Teaching	Quiz, Mid Exam, Final Exam, Assignment
3.0	**Values**		
3.1			
3.2			
…			

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Quizzes	Week 3, Week 8	10%
2	Assignments	Week 4, Week 9	20%
3	Mid Term Exam	Week 6	20%
4	Homework	Week 10	5%
5	Exercise	Every Week	5%
6	Final Exam	Week 12	40%
7			
8			

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

- Each student is allotted to an academic advisor for guidance and counselling.
- Available for a minimum of 4 hours per week/course, as communicated to the students.
- Student also contacts through social networking websites / Blackboard/ Email for advice and consultations

F. Learning Resources and Facilities

1.Learning Resources

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

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Class Room, PC**
Technology Resources (AV, data show, Smart Board, software, etc.)	**LCD Projector, Dev C++/Visual studio C++**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Final Examination, Midterm Exam & Quizzes	Instructor	Direct
Survey	Students	Indirect
Final Examination Marks	Peers	Verification of Marks
Course Report	Quality Unit	Checklist quality reports

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	
Reference No.	
Date	