High Performance Computing Course Specifications

Faculty: Faculty of computer and informatics

Department: Scientific Computing

Program(s) on which the course is given : Bachelor in Computer & Information Sciences

Major or Minor element of programs : Scientific Computing

Department offering the program : Scientific Computing

Department offering the course : Scientific Computing

Academic year / Level : 4th Year/B.Sc.

Date of specification approval : 20/10/2009

A. Basic Information

Title: High Performance Computing **Code:** SCC 434

Lecture: 3 hrs/week **Tutorial:** 2 hrs/week **Practical:** ---

Credit Hours: --- **Total:** 5 hrs/week

B. Professional Information

1. Overall Aims of Course:

The aim of this course is to provide students with the knowledge of the ways that High Performance Computing (HPC) techniques can be used to address problems in Computational Science. The course aims also to introduce students to the major scientific applications areas and basic concepts of parallel computing, it outlines the hardware design of modern HPC platforms and the parallel programming models

that they support. The principal methods of measuring and characterizing serial and parallel performance are then covered.

2. Intended Learning Outcomes of Course (ILOs):

a. Knowledge and Understanding:

On completion of this course students should be able to:

a1- State and classify the most commonly used HPC platforms and parallel programming models.

a2- Explain and have an understanding of the different levels of abstraction in HPC modeling and of different parallel programming models

a3- Explain and have an understanding of parallel performance overheads and of techniques for reducing them

a4- State some parallel numerical algorithms

a5- Summarize the concepts of shared memory, and message passing programming constructs, and their utility in scientific programming applications.

b. Intellectual Skills:

b1- Formulate, implement, criticize and evaluate an appropriate high-performance computer algorithm to tackle a task in scientific research.

b2- Measure, analyze and assess the performance of HPC programs.

b3- Interpret overall performance characteristics in terms of the basic hardware and software design.

b4- Evaluate the suitability of different HPC solutions to standard problems in Computational Science.

b5- Conclude and implement a moderately complicated application in a parallel language

c. Professional and Practical Skills:

c1- Handle to write parallel programs to solve practical problems

d. General and Transferable Skills:

d1- Present and work effectively as a member of a group to develop parallel applications

e. Attitude

e1- A knowledge and respect of ethics and ethical standards in relation to a major area of study.

e2- Illustrate the use of example, analogy, and counter-analogy in ethical argument.

e3- Demonstrate an ethical behaviour toward software copyrights.

e4- Relationship Emphasis a successful with other students.

e5- Learn how to make relation with other, and the limit of this relation.

e6- Explain the nature of privacy and how it is protected by the Data Protection.

e7- Know the danger of viruses and how to protect yourself from it.

e8- Know the culture of other peoples.

e9- Discuss the legal background of copyright in national and international law.

3. Contents:

Topic	No. of Hours	Lecture	Tutorial/ Practical
The development of Supercomputers: A review of conventional machines, Hardware improvements, Software: improvements, clock cycle limitations, Hardware vs. software, Grand challenge problems(Part I)	٥	3	٢
The development of Supercomputers: A review of conventional machines, Hardware improvements, Software: improvements, clock cycle limitations, Hardware vs. software, Grand challenge problems(Part II)	٥	٣	٢
new architecture, parallel architecture, parallel algorithm, parallel language, parallel compiler, parallel operating systems, parallel programming..(Part I)	٥	٣	٢
new architecture, parallel architecture, parallel algorithm, parallel language, parallel compiler, parallel operating systems, parallel programming.(PartII).	٥	٣	٢
Introductory survey of supercomputers: Definition of a supercomputer, Number of processors, Peak speeds, Characteristics of supercomputers, Performance Evaluation, Flynn's Taxonomy and High-level taxonomy(Part I)	٥	٣	٢
Introductory survey of supercomputers: Definition of a supercomputer, Number of processors, Peak speeds, Characteristics of supercomputers, Performance Evaluation, Flynn's Taxonomy and High-level taxonomy(Part II)	٥	٣	٢
Introductory survey of supercomputers: Definition of a	٥	٣	٢

supercomputer, Number of processors, Peak speeds, Characteristics of supercomputers, Performance Evaluation, Flynn's Taxonomy and High-level taxonomy(Part III)			
Introduction to UNIX, Internet, telecommunication and Computer ethics.).(Part I)	٥	٣	٢
Introduction to UNIX, Internet, telecommunication and Computer ethics.). (Part II)	٥	٣	٢
Programming on Pipelined Vector machines. Programming on shared-memory machines (Multimax)(Part I)	٥	٣	٢
Programming on Pipelined Vector machines. Programming on shared-memory machines (Multimax)(Part II)	٥	٣	٢
Programming on Pipelined Vector machines. Programming on shared-memory machines (Multimax)(Part III)	٥	٣	٢
Programming on distributed-memory machines (iPSC/860 and nCUBE2). Parallel Algorithm Development.	٥	٣	٢
Programming on distributed-memory machines (iPSC/860 and nCUBE2). Parallel Algorithm Development.	٥	٣	٢