CIIC 5120 - Virtual Machines

1. General Information:

Alpha-numeric codification: CIIC 5120
Course title: Virtual Machines
Number of credits: 3
Contact period: 3 hours of lecture per week

2. Course Description:

English: Discussion of concepts related to the design and implementation of virtual computer monitors, including traditional computer virtualization techniques such as "trap-and-emulate", translation of binary files, "shadow page tables" and principles of emulation of devices. Discussion of classic publications in the area of virtualization and recent advances in the subject.

Spanish: Discusión de conceptos relacionados al diseño e implementación de monitores de computadoras virtuales, incluyendo técnicas tradicionales de virtualización de computadoras tales como "trap-and-emulate", traducción de archivos binarios, "shadow page tables" y principios de emulación de dispositivos. Se discuten publicaciones clásicas del área de virtualización y avances recientes en el tema.

3. Pre/Co-requisites and other requirements:

ICOM 5007 or CIIC 4050 or authorization of department chair.

4. Course Objectives:

The fundamentals on how virtual machines work will be explained along with the required hardware and software interfaces for implementing virtual machines.

5. Instructional Strategies:

☒conference ☐discussion ☐computation ☐laboratory

☐seminar with formal presentation ☐seminar without formal presentation ☐workshop

☐art workshop ☐practice ☐trip ☐thesis ☐special problems ☐tutoring

☐research ☐other, please specify:

6. Minimum or Required Resources Available:

Students will use the Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to virtualization and an overview of various virtualization techniques	3
CPU virtualization	3
Memory virtualization	3
Device virtualization	3
Network virtualization	3
Virtual Machine Management	5
Operating System and virtualization of software libraries	5
Software and hardware techniques for x86 virtualization	4
VM security	3
VM resource management	7
Exams	3
Total	45

8. **Grading System**

☒Quantifiable (letters) ☐ Not Quantifiable

9. **Evaluation Strategies**

Strategy	Quantity	Percent
☒ **Exams**	Up to 3	Up to 45
☒ **Final Exam**	1	Up to 45
☒ **Short Quizzes**	Up to 5	Up to 20
☐ **Oral Reports**		
☐ **Monographies**		
☐ **Portfolio**		
☒ **Projects**	Up to 2	Up to 50
☐ **Journals**		
☐ **Other, specify**		
Total		**100%**

10. Bibliography:

Textbook: *Hardware and Software Support for Virtualization* (Synthesis Lectures on Computer Architecture), Bugnion, Nieh, Tsafrir, Morgan and Claypool Publishers, 2017.

References:
- *Advanced Virtual Machine Design and Implementation,* Xiao-Feng Li , Jiu-Tao Nie, and Ligang Wang, CRC Press, Boca Raton, Fl, 2016.
- *Virtual Machines: Versatile Platforms for Systems and Processes*, Jim Smith and Ravi Nair, Morgan Kaufmann Publishers, San Francisco, CA, 2005.

Research papers in each research area to be selected from digital libraries available such as: IEEEXplore, ACM Digital Library, SPIE, SpringerLink.

11. Course Outcomes

After successfully completing this course, the student will be able to:	Program Student Outcomes Impacted
1. explain the functionality of a virtual machine monitor	1, 2
2. identify the required techniques to virtualize CPU, Memory, Disk and Network	2, 6
3. analyze different virtual machine configurations to support application execution	2, 6
4. identify the use of ISA virtualization extensions to improve virtual machine execution	2

12. According to Law 51

Students will identify themselves with the Institution and the instructor of the course for purposes of assessment (exams) accommodations. For more information please call the Student with Disabilities Office which is part of the Dean of Students office (Office #4) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

13. Academic Integrity

-The University of Puerto Rico promotes the highest standards of academic and scientific integrity. Article 6.2 of the UPR Students General Bylaws (Board of Trustees Certification 13, 2009-2010) states that academic dishonesty includes, but is not limited to: fraudulent actions; obtaining grades or academic degrees by false or fraudulent simulations; copying the whole or part of the academic work of another person; plagiarizing totally or partially the work of another person; copying all or part of another person answers to the questions of an oral or written exam by taking or getting someone else to take the exam on his/her behalf; as well as enabling and facilitating another person to perform the aforementioned

behavior. Any of these behaviors will be subject to disciplinary action in accordance with the disciplinary procedure laid down in the UPR Students General Bylaws.⸺