



Universidad de Puerto Rico
Recinto Universitario de Mayagüez
SENADO ACADEMICO

CERTIFICACION NUMERO 03-22

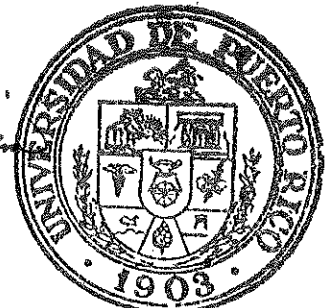
La que suscribe, Secretaria del Senado Académico del Recinto Universitario de Mayagüez de la Universidad de Puerto Rico, **CERTIFICA** que en reunión ordinaria celebrada el martes, 29 de abril de 2003, este organismo **APROBO** el **INFORME DEL COMITÉ DE ASUNTOS CURRICULARES RELACIONADO CON LAS PROPUESTAS PARA EL ESTABLECIMIENTO DE UN PROGRAMA DE BACHILLERATO EN CIENCIAS DE LA COMPUTACIÓN, DEL DEPARTAMENTO DE MATEMATICAS Y UN PROGRAMA DE BACHILLERATO EN CIENCIA E INGENIERIA DE COMPUTACION E INGENIERIA DE SOFTWARE DEL COLEGIO DE INGENIERIA.**

El informe contiene los siguientes acuerdos:

1. Los programas de bachillerato propuestos son substantivamente diferentes, el enfoque académico de cada programa es diferente y ambas propuestas tienen sus propios méritos.
2. Recomendar que se aprueben las propuestas para el establecimiento de los Bachilleratos en Ciencias de la Computación del Departamento de Matemáticas y Ciencias de Computación en Ingeniería de Software de la Facultad de Ingeniería.
3. Recomendar que si, ambas propuestas son aprobadas por las autoridades universitarias correspondientes, los Departamentos de Matemáticas e Ingeniería Eléctrica y de Computadoras colaboren y compartan recursos durante el ofrecimiento de sus respectivos bachilleratos.
4. Recomendar que a largo plazo, se tomen medidas correspondientes para establecer una estructura académica y administrativa en el Recinto Universitario de Mayagüez donde se puedan ofrecer programas de esta naturaleza.

Y para que así conste, expido y remito la presente certificación a las autoridades universitarias correspondientes, bajo el Sello de la Universidad de Puerto Rico a los dos días del mes de mayo del año dos mil tres, en Mayagüez, Puerto Rico.


Joanne R. Savino
Secretaria



Propuesta para el
Establecimiento de un
Programa de Bachillerato en
Ciencia e Ingeniería de
Computación e Ingeniería de
Software en el Colegio de
Ingeniería del Recinto
Universitario de Mayaguez
de la Universidad de Puerto
Rico

Propuesta formulada por el Comité de Sistemas de Computación del Departamento de Ingeniería Eléctrica y de Computadoras del Recinto Universitario de Mayaguez.

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1. INTRODUCCIÓN

1.1 Nombre del Programa y Grados Académicos a Otorgarse

El nombre del programa es **Programa de Bachillerato en Ciencia e Ingeniería de Computación e Ingeniería de Software**. Los grados académicos a otorgarse son:

- a. **Bachillerato en Ciencias en Ingeniería de Software (*B.S. in Software Engineering*)**
- b. **Bachillerato en Ciencias en Ciencia e Ingeniería de Computación (*B.S. in Computer Science and Engineering*)**

1.2 Descripción del Programa

El Programa de Bachillerato en Ciencia e Ingeniería de Computación e Ingeniería de Software se estructura sobre la base de un total de ciento veinticuatro (124) créditos en cursos de formación socio-humanística, fundamentos de ingeniería, ciencias, matemáticas y fundamentos de computación y doce (12) créditos en cursos electivos libres, para un total de ciento treinta y seis (136) créditos comunes a ambos grados. Sobre esta base común el programa otorga dos grados académicos. Cada uno de estos grados añade veintisiete (27) créditos en cursos de concentración en sus respectivas áreas enfoque.

En términos generales, el programa sigue el modelo curricular del Colegio de Ingeniería del Recinto de Mayagüez de la Universidad de Puerto Rico, el cual ofrece una base de fundamentos de ingeniería común a todos los estudiantes del área junto a una gama de posibilidades para la profundización y especialización profesional.

El grado en Ciencia e Ingeniería de Computación ofrece una formación amplia y flexible en diversos aspectos asociados al análisis y diseño de sistemas de computación, incluyendo entre estos los sistemas de computación en redes, la inteligencia artificial, los sistemas de bases de datos, la computación gráfica, el diseño e implantación de lenguajes de programación y la arquitectura de computadoras. La clasificación sugerida para este grado dentro del Sistema de Clasificación de Programas Instruccionales del Departamento de Educación de los EEUU (Código IPEDS) es 11.0701 – *Computer Science*.

De acuerdo al *Institute of Electrical and Electronic Engineers* (IEEE), la Ingeniería de Software (IS) es la aplicación de una metodología disciplinada, sistemática y cuantificable en el desarrollo, operación y mantenimiento de programas de computación. Consistentemente, el grado en Ingeniería de Software descrito en este documento ofrece una formación especializada en aspectos relacionados al análisis de requisitos, especificación, diseño, prueba, validación, implantación y mantenimiento de sistemas de software. Frecuentemente, la instrucción en Ingeniería de Software es ofrecida como una especialización dentro de programas de Ciencia de Computación y no como un grado independiente. Sin embargo, la conveniencia de contar con Ingenieros de Software se manifiesta constantemente en sectores de la industria, el gobierno y los servicios. Los avances en la investigación y la práctica de la Ingeniería de Software son, por otro lado, lo suficientemente significativos como para establecerla como

una rama de concentración con características curriculares y mercado ocupacional propios. En dicho mercado, el ingeniero de software tiene a su cargo no solo las tareas técnicas antes detalladas, sino que también tareas gerenciales tales como control de calidad, medición de procesos y administración de proyectos. El grado en Ingeniería de Software descrito en este documento ha sido diseñado para responder a las demandas del mercado laboral y para dotar a los estudiantes con una amplia gama de rasgos profesionales que han llegado a distinguir a la Ingeniería de Software como una disciplina. La clasificación sugerida para este grado dentro del Sistema de Clasificación de Programas Instruccionales del Departamento de Educación de los EEUU (Código IPEDS) es 14.0903– *Computer Software Engineer*.

En resumen, el Programa de Bachillerato en Ciencia e Ingeniería de Computación e Ingeniería de Software está diseñado para preparar profesionales especializados en la conceptualización, análisis, diseño, evaluación, mantenimiento y renovación de toda una amplia gama de sistemas informáticos, incluyendo entre estos, sistemas de computación industrial, comercial, científico, tecnológico y de informática médica. Los egresados del programa estarán también preparados para continuar estudios superiores en computación o participar en proyectos de investigación y desarrollo en equipos multidisciplinarios. En particular, los egresados de ingeniería de software estarán especializados en el desarrollo de proyectos de software de gran envergadura, que por su complejidad y uso potencial, envuelvan un alto riesgo y responsabilidad social.

1.3 Modalidades No Convencionales

No se contempla ofrecer más del cincuenta (50) por ciento del programa en una modalidad de enseñanza aprendizaje no convencional.

1.4 Fecha de Comienzo

El programa comenzará a ofrecerse tan pronto el Consejo de Educación Superior de Puerto Rico lo apruebe y enmiende Licencia de la Universidad de Puerto Rico. La fecha estimada para el comienzo de este ofrecimiento es el primer semestre del año académico 2011-2012.

1.5 Duración del Programa en Años para Estudiantes a Tiempo Completo

El Programa de Bachillerato en Ciencia e Ingeniería de Computación e Ingeniería de Software tiene una duración de cinco años. El tiempo máximo para completar el grado es de diez años.

2. ACREDITACIÓN PROFESIONAL Y REQUISITOS PARA LA PRÁCTICA PROFESIONAL

2.1 Acreditación Profesional

Los programas de Ciencia de Computación son acreditados por el *Accreditation Board of Engineering and Technology* (ABET). El Departamento de Ingeniería Eléctrica y de Computadoras, o el Departamento de Ciencia e Ingeniería de Computación de ser este creado, solicitará la acreditación de los programas de Bachillerato en Ciencia e Ingeniería de Computación, y de Bachillerato en Ingeniería de Software a ABET. De acuerdo a las reglas establecidas por ABET, pueden solicitar acreditación solamente los

programas que han producido al menos un graduado que haya sido aceptado desde la escuela superior. Puesto que ambos programas tienen una duración mínima de cinco años, la acreditación solo podrá solicitarse a partir del sexto año después de la implantación de los mismos. De este modo, si los programas de Bachillerato en Ciencia e Ingeniería de Computación y Bachillerato en Ingeniería de Software comenzaran a ofrecerse en Agosto de 2011, la primera clase se graduaría en el año 2016. Por lo tanto, la solicitud de acreditación estaría alineada con la visita de ABET al RUM programada para el año 2020; fecha para la cual se espera solicitar a ABET la acreditación de estos programas.

En preparación a esta solicitud de acreditación, se ha elaborado un plan que contempla actividades semestrales destinadas a recopilar la información requerida, efectuar auto evaluaciones formativas, e implantar los ajustes derivados de estas últimas. En estas actividades se pondrá especial énfasis en la documentación y logro de los criterios de acreditación relacionados a

- (i) Objetivos Educativos (*Educational Objectives*) y
- (ii) Evaluación de Resultados (*Outcomes Assessment*),

reconocidos como los más críticos dentro de los ocho criterios de acreditación establecidos por ABET. El Departamento de Ingeniería Eléctrica y de Computadoras (INEL/ICOM) del Recinto Universitario de Mayaguez ha obtenido y mantenido consistentemente la acreditación de ABET para todos sus programas. Las actividades y acciones destinadas a satisfacer los criterios (i) y (ii) de ABET para la acreditación de los programas de Ciencia e Ingeniería de Computación y de Ingeniería de Software se basan en la experiencia acumulada por INEL/ICOM en el ejercicio de acreditación de sus programas. Los ítems (i) e (ii) resumen estas acciones.

- i. **Objetivos Educativos.** Los Objetivos Educativos, por su parte, se refieren a conductas y atributos generales que se espera que los graduados de los programas exhiban después de tres a cinco años de ejercicio profesional. Los objetivos educativos de este programa son, en términos generales, similares a los de los programas de bachillerato en Ingeniería Eléctrica y bachillerato en Ingeniería de Computadoras. Dichos objetivos son:
 - a. *Become educated citizens who, as computer scientists/software engineers, contribute by applying, ethically, their specialized knowledge to the educational, cultural, social, technological and economic development of their societies.*
 - b. *Demonstrate a combination of analytical, computational, and experimental knowledge and skills to make them competitive within the electrical/computer engineering practice.*
 - c. *Demonstrate communication skills in Spanish and English that enable them to effectively participate and contribute in both linguistic environments.*
 - d. *Value the importance of lifelong learning as demonstrated by pursuing graduate studies, being involved in professional societies, or pursuing professional advancement and success.*

Los Objetivos Educativos serán evaluados en base a encuestas a graduados del programa, sus empleadores y/o las escuelas graduadas en las cuales hayan estudiado, o se encuentren estudiando. Dichas encuestas se conducirán tres años después de la primera graduación de cada programa. Con el objeto de conducir estas encuestas, el Departamento a cargo de estos programas mantendrá una base de datos con los egresados de cada programa.

El plan de evaluación se articulará en un documento similar al que usa el Departamento de Ingeniería Eléctrica y de Computadoras para estos efectos. Dicho documento incluye la misión y visión de los programas junto con la relación entre los resultados del program (“program outcomes”) y los objetivos educativos, además de un cronograma detallado para la ejecución de las distintas acciones de evaluación.

ii. **Evaluación de Resultados.** La Evaluación de Resultados es descrita por ABET como declaraciones explícitas de lo que se espera que los estudiantes sepan y sean capaces de hacer en el momento de su graduación. Los criterios para la Evaluación de Resultados son:

- a. *Ability to apply knowledge of mathematics, science, and engineering necessary to carry out analysis and design appropriate to computer engineering problems.*
- b. *Ability to design and conduct experiments as well as analyze and interpret data.*
- c. *Ability to design a computer system to meet desired needs.*
- d. *Ability to function on multidisciplinary teams.*
- e. *Ability to identify, formulate and solve engineering problems.*
- f. *Understanding of professional and ethical responsibility.*
- g. *Ability to communicate effectively.*
- h. *Broad education necessary to understand impact of engineering solutions in a global/societal context.*
- i. *Recognition of the need for and ability to engage in lifelong learning.*
- j. *Knowledge of contemporary issues.*
- k. *Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.*

Siguiendo el modelo adoptado por el Departamento de Ingeniería Eléctrica y de Computadoras se ha definido un plan para la evaluación de resultados. Este plan está orientado a recopilar información pertinente a las materias aprendidas, habilidades y experiencias adquiridas, en cada uno de los cursos de los programas en cuestión. Como parte de este plan, se generará para cada curso una tabla con objetivos medibles específicos, y se establecerá una relación directa, uno a uno si es posible, con los resultados (a) al (k) (*outcomes (a) to (k)*) establecidos por ABET. Cada semestre, se seleccionará un subconjunto de resultados (*outcomes*) y sus correspondientes cursos para evaluación. Dicha selección se hará de modo tal que, al final de un período de

cuatro años, se hayan evaluado todos los cursos del programa. Cada semestre, el Departamento encargado de la administración del programa discutirá los resultados de estas evaluaciones y recomendará y supervisará la implantación de los ajustes que se estimen necesarios. Estos ajustes pueden ir desde modificaciones menores en los prontuarios o cambios de estrategias de enseñanza, hasta modificaciones curriculares mayores, todas destinadas a asegurar el logro de los estándares de calidad esperados.

2.2 Requisitos para la práctica profesional

Los dos grados otorgados en este programa son grados de la práctica profesional de la Ingeniería. En el Estado Libre Asociado de Puerto Rico dicha práctica esta regulada por el Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR). Por lo tanto, los egresados de ambos programas deberán aprobar el examen de reválida fundamental y los exámenes correspondientes a sus especialidades, tales como el examen de Ingeniero de Computadoras, el de Ingeniero de Software, o aquel de la especialidad definida por ley para este tipo de profesional.

3. JUSTIFICACIÓN

3.1 Razones de tipo académico para el establecimiento de programa

3.1.1 El carácter actual de la ciencia e ingeniería de computación

La denominación usual de Ciencia de Computación (*Computer Science*) que domina en la academia en los Estados Unidos y Canada es un legado histórico que, como ampliamente se reconoce, tiende a obscurecer los rasgos tecnológicos inherentes y frecuentemente dominantes tanto en la disciplina como en su práctica profesional. Lo que hoy se entiende por Ciencia de Computación es en realidad, un conjunto de conocimientos y prácticas de ingeniería orientadas hacia el análisis, diseño e implantación de sistemas para el procesamiento automático de la información. Dichas prácticas y conocimientos incluyen elementos de lógica matemática y estadística los cuales, aunque fundamentales, ni definen el carácter de la disciplina, ni resultan suficientes para formar profesionales en el área. Más allá de los fundamentos estadísticos, lógicos y matemáticos, el diseño de sistemas informáticos requiere de una experimentación bien organizada y un amplio y variado acervo de mejores prácticas de la ingeniería. Esta naturaleza científico tecnológica de la Ciencia de Computación es un hecho mundialmente reconocido. El comité acreditador de programas académicos en computación, *Computing Accreditation Commission* (CAC) de ABET, el cual está formado por las organizaciones de profesionales del área de mayor influencia y prestigio en Estados Unidos y el mundo, incluyendo la *Association for Computing Machinery* y la *IEEE Computer Society*, define Ciencia de Computación como sigue:

Computer science is a discipline that involves the understanding and design of computers and computational processes ... The discipline ranges from theoretical studies of algorithms to practical problems of implementation in terms of computational hardware and software... Thus, the discipline spans both advancing the fundamental understanding of algorithms and information processes in general as well as the practical design of efficient reliable software and hardware to meet given specifications.

En el siguiente párrafo del mismo documento refuerza la naturaleza científica y tecnológica de la Ciencia de Computación, al expresar:

Computer science is a young discipline that is evolving rapidly from its beginnings in the 1940's. As such it includes theoretical studies, experimental methods, and engineering design all in one discipline. This differs radically from most physical sciences that separate the understanding and advancement of the science from the applications of the science in fields of engineering design and implementation. In computer science there is an inherent intermingling of the theoretical concepts of computability and algorithmic efficiency with the modern practical advancements in electronics that continue to stimulate advances in the discipline.

W. A. Wulf, un miembro distinguido del panel de ACM para el estudio de la posible otorgación de una licencia profesional de ingeniería de software, ha expresado por su parte:

"...my discipline spans a multidimensional spectrum from deep and elegant mathematics to crafty programming, from abstraction to solder joints, from deep truth to elusive human factors, from scholars motivated purely by the desire for knowledge to practitioners making my everyday life better. It embraces the ethos of the scholar as well as that of the professional"

La denominación de Ciencia e Ingeniería de Computación (*Computer Science and Engineering*) ha sido adoptada en universidades de los Estados Unidos y Canadá, en un esfuerzo destinado a destacar y reforzar este carácter dual, tecnológico y científico, de su currículo y sus egresados. El programa descrito en este documento está alineado a esas experiencias académicas, particularmente con el objetivo de integrar los aspectos tecnológicos y científicos de la computación en un programa de bachillerato. Una detallada revisión y análisis de currículos e informes sobre la evolución y estado actual de la Ciencia de Computación arrojó, entre otros, los siguientes puntos de consenso entre los proponentes:

1. La tecnología de la información tiene un carácter universal, en el sentido de que sirve tanto para propósitos científicos, humanísticos, comerciales y tecnológicos. Por lo tanto, el profesional de la computación debe tener el beneficio de una formación lo más amplia y abarcadora posible, incluyendo ciencias, ingeniería, economía, ciencias sociales y humanidades.
2. La generación, validación y control de calidad del software, esto es la Ingeniería de Software, desempeña un rol especial dentro de la tecnología informática. Las características especiales de la industria informática y la extrema dependencia de nuestra sociedad en sistemas basados en extensos y complejos programas de computación generan la necesidad de especialistas en el diseño, test y mantenimiento de sistemas de software. Estos especialistas, los ingenieros de software, tienen un mercado ocupacional definido e incluso, potencialmente, una licencia profesional independiente. Estas consideraciones ameritan el que el programa otorgue un grado específico en ingeniería de software

3. Los currículos de Ciencia e Ingeniería de Computación y de Ingeniería de Software comparten un número significativo de contenidos. En particular, el ingeniero de software necesita conocimientos de ciencia de computación lo suficientemente amplios como para aplicar los mismos crítica y creativamente en su ejercicio profesional. Estos conocimientos son la base del entendimiento, renovación y adecuada aplicación de técnicas y métodos de análisis, para la especificación, diseño, prueba, verificación y validación de programas de computación. Los aspectos éticos, sociales, humanísticos y las destrezas de comunicación y trabajo en equipo son también comunes a ambas profesiones. Por sobre esta base común, el ingeniero de software necesita conocimientos específicos de técnicas, metodologías de gerencia industrial y alguna concentración en un área técnica que sea consistente con su misión profesional. Los proponentes estiman que desarrollar programas separados de Ciencia e Ingeniería de Computación e Ingeniería de Software conllevaría una duplicación y desperdicio de recursos, e iría en detrimento de la visión global de la disciplina de la computación que se pretende lograr para ambos profesionales. Sin embargo, la concentración en Ingeniería de Software amerita *per se*, un grado profesional aparte.
4. Los proponentes concuerdan en que título académico de Ciencia e Ingeniería de Computación representa los atributos del profesional que se busca formar más fielmente que el de Ciencia de Computación, y que el modelo más adecuado para alcanzar el objetivo de una formación equilibrada entre tecnologías y ciencias de computación es el de desarrollo del programa al amparo de una Facultad de Ingeniería. Este último modelo ha sido adoptado por la mayoría de las universidades líderes en computación en los Estados Unidos, independientemente del nombre del título profesional que otorgan. En el año 2001, de las dieciocho universidades que, según el informe anual de *US News & World Report*, ofrecen los programas en Ciencia de Computación más relevantes de los Estados Unidos, trece (13) los ofrecen dentro de Facultades equivalentes al Colegio de Ingeniería del Recinto Universitario de Mayaguez. En seis de los primeros diez programas listados, la administración de los programas de Ciencia de Computación es compartida con la de los programas de Ingeniería Eléctrica y/o de Ingeniería de Computadoras. Los ejemplos más sobresalientes de administración conjunta son MIT, UC Berkeley y Stanford. La consolidación de las agencias de acreditación académica para programas de Ciencia de Computación y programas tradicionales de Ingeniería refuerza las bondades de este modelo.

3.1.2 El desarrollo de programas de bachillerato en Ingeniería de Software

Los programas de bachillerato en Ingeniería de Software comienzan a desarrollarse varios años después de la consolidación de Ciencia de Computación como disciplina académica. En el año 2000 existían trece programas en Inglaterra, tres programas en Australia, y dos programas en Canadá. En Estados Unidos hay tres programas: el de Rochester Institute of Technology, el de Fort Monmouth University y el de Southern Polytechnic State University. Existen además cerca de cuarenta programas de maestría en ingeniería de software en Estados Unidos.

En noviembre de 1999, el *Software Engineering Institute* (SEI) de la Universidad Carnegie Mellon publicó un documento pionero titulado *Guidelines for Software Engineering Education*, el cual establece guías y criterios para el desarrollo de programas de bachillerato en ingeniería de software. Dichas guías sirvieron de marco de referencia para el diseño del grado de Ingeniería de Software descrito en este documento.

3.1.3 El establecimiento de Ingeniería de Software como una profesión independiente

Entidades tales como el *IEEE Software Engineering Standards Committee*, el Departamento de Defensa de los Estados Unidos y el *Software Engineering Institute* han establecido estándares para la especificación de requerimientos y diseño, prácticas administrativas, pruebas y validación de programas computacionales. En base a dichos estándares, el *Texas Board of Professional Engineering* otorga desde hace ya varios años, licencias profesionales a ingenieros de software que cumplan con criterios de acreditación. Las asociaciones profesionales *IEEE Computer Society* y *Association for Computer Machinery* mantienen el grupo de trabajo conjunto *Joint Steering Committee for the Establishment of Software Engineering as a Profession*, con el propósito de definir estándares de ética, gama de conocimientos requeridos, prácticas recomendadas y currículos necesarios para establecer ingeniería de software como una profesión. Este comité ha hecho público un documento de referencia titulado *Guide to the Software Engineering Body of Knowledge*. Este comité revisa además los requisitos para el examen *Principles of Practice Examination* (PE) para ponerlos ante la consideración del *National Council of Examiners for Engineers and Surveyors* (NCEES). Cabe destacar que esta última organización ya ha incluido un cinco por ciento de contenido de ingeniería de software en su examen de ingeniería eléctrica.

Uno de los objetivos del programa de Ingeniería de Software descrito en este documento es el de preparar a sus graduados para una eventual certificación como ingenieros profesionales de software. El logro de este objetivo depende, sin embargo, de la acción mancomunada de la industria, el gobierno y el Colegio de Ingenieros de Puerto Rico. Los graduados del programa propuesto estarán en posición de obtener dicha certificación

3.1.4 Ciencia e Ingeniería de Computación como actividad académica mundial

El concepto popular de que la ingeniería es el uso de conocimientos científicos para el desarrollo de productos y servicios, es errado. En la práctica la ingeniería y el conocimiento básico marchan frecuentemente a la par. Las necesidades de diseño ingenieril suelen estimular la actividad creativa y la reflexión, abriendo nuevos campos de investigación, o incentivando el desarrollo y renovación en campos de investigación científica ya existentes. Ciertos inventos, como el automóvil, antecedieron y de hecho despertaron un mayor interés científico en los fundamentos de la energía, la transmisión del movimiento, y la ciencia de materiales, entre otros. Así, frecuentemente, los desafíos del diseño ingenieril conllevan la proposición e investigación de nuevos problemas científicos. La Ciencia e Ingeniería de Computación es un perfecto ejemplo de la simbiosis ingenieril entre ciencia y diseño. Los fundamentos de la Ciencia e Ingeniería de Computación comienzan a bosquejarse con el advenimiento de las computadoras digitales, y se han desarrollado y consolidado desde entonces, paso a paso y a la par con los progresos y dificultades que ha enfrentado el desarrollo de tecnologías de la información. A

través de aproximadamente ochenta años de evolución científica y tecnológica, la Ciencia e Ingeniería de la Computación ha alcanzado un cuerpo sólido y bien definido de conceptos y metodologías de diseño que le otorgan hoy el carácter de disciplina independiente. Dicha evolución, sin embargo, está lejos de haber culminado, toda vez que la presión continua del mercado que demanda sistemas cada vez más poderosos, portátiles y fáciles de usar, pone constantemente nuevos desafíos de diseño. Es esta dinámica lo que hace que la disciplina mantenga un rol vibrante y central en el comercio, los servicios, la industria, la ciencia y la tecnología. Y es en base a este rol central para la calidad de vida que la infraestructura informática suele constituirse en una medida estándar para el estatus y el potencial de crecimiento de una nación. La carencia de programas académicos en Ciencia e Ingeniería de Computación es una clara desventaja en la formación del capital humano de una nación, desventaja que más temprano que tarde se refleja en la capacidad de desarrollo e inserción de una sociedad en una economía y culturas globalizadas.

3.1.5 Ingeniería de Software como actividad académica mundial

Dentro del concepto general de Ciencia e Ingeniería de Computación, la Ingeniería de Software se destaca como una de las más robustas y distintivas de sus concentraciones. No hay duda de que uno de los problemas centrales en esta era informática es el de la producción de software de alta calidad, a costos accesibles. De esta calidad y accesibilidad dependen al fin y al cabo, la capacidad real de desarrollo cultural y comercial de una comunidad o nación. Por otro lado, la fuerte dependencia de la vida actual en tecnologías informáticas hace del ingeniero de software un profesional vital en la protección de las operaciones diarias de una sociedad, en su seguridad e incluso, en su supervivencia. En el informe del comité especial *President's Information Technology Advisory Committee* (PITAC-report) emitido el año 1999, se señalaba:

Software - The demand for software has grown far faster than our ability to produce it. Furthermore, the Nation needs software that is far more usable, reliable, and powerful than what is being produced today. We have become dangerously dependent on large software systems whose behavior is not well understood and which often fail in unpredictable ways. Therefore, increases in research on software should be given a high priority. Special emphasis should be placed on developing software for managing large amounts of information, for making computers easier to use, for making software easier to create and maintain, and for improving the ways humans interact with computers.

La tecnología informática ha evolucionado desde entonces, reemplazando una parte significativa de sistemas de computación personal por redes de computación y sistemas de información compartidos. Esta transformación hace que el usuario pierda en parte el control directo sobre los medios informáticos que utiliza, con lo cual, el problema originalmente señalado en PITAC se hace aún más complejo y crucial para el progreso y la seguridad social. La ingeniería de software se concentra en la búsqueda de soluciones para ese tipo de problemas y, por lo tanto, ocupa un rol fundamental en la confiabilidad y eficiencia con que el usuario accede a la tecnología informática.

3.2 Necesidad del Nuevo Programa

La necesidad del Programa en Ciencia e Ingeniería de Computación y Ingeniería de Software puede dividirse en tres grandes categorías:

- a. Necesidad de **completar el portafolio de ofertas académicas** en el Colegio de Ingeniería del Recinto Universitario de Mayaguez. El Recinto Universitario de Mayaguez es el primer centro para el estudio, la investigación y la difusión de la ingeniería en Puerto Rico. El hecho de que el Recinto ofrezca solo un programa del espectro básico de programas de bachillerato en tecnologías informáticas, a saber, el programa en Ingeniería de Computadoras, constituye una limitación importante en su oferta que además lo pone en clara desventaja con la mayoría de las facultades de ingeniería de los Estados Unidos y Canadá.
- b. Necesidad de satisfacer **una alta demanda estudiantil por programas enfocados al diseño de sistemas de software**. El alto número de solicitudes de admisión que año a año se presentan al programa en Ingeniería de Computadoras, las cuales corresponden a estudiantes de mayor índice académico entre los solicitantes a la Universidad de Puerto Rico, provee una medida indirecta de esta demanda. Dichas solicitudes corresponden tradicionalmente a los estudiantes de mayor índice académico del sistema de la UPR. Debido a limitaciones en recursos, el departamento de Ingeniería Eléctrica y Computadoras ha mantenido el número de admisiones constante en 75 estudiantes por año. De acuerdo a la encuesta realizada el año 1998 por el Dr. Manuel Pérez indica que treinta y dos (32) de una muestra de cuarenta (40) estudiantes entonces matriculados en el programa de Ingeniería de Computadoras, respondió haber estado/a interesado/a en estudiar Ciencia e Ingeniería de Computación o Ingeniería de Software. La percepción de los profesores de Ingeniería de Computadoras es que la tendencia captada en la encuesta del Dr. Pérez, se ha mantenido y quizás aumentado, en los últimos años. Una simple proyección de esta encuesta permite conjeturar que aproximadamente el 80% de los estudiantes que solicitan admisión al programa de Ingeniería de Computadoras – esto es, alrededor de 600 – solicitarían admisión al programa de Ciencia e Ingeniería de Computación o al de Ingeniería de Software.
- c. Necesidad de **satisfacer en parte las demandas de la industria, el gobierno y el comercio**. El Programa en Ciencia e Ingeniería de Computación e Ingeniería de Software responderá también a una alta demanda de la industria por ingenieros especialistas en sistemas de computación e ingenieros de software. Dicha demanda es un hecho reconocido en Estados Unidos, donde se observa con preocupación el creciente distanciamiento entre una demanda cada vez mayor por profesionales informáticos versus una producción decreciente de bachilleratos en ciencia de computación en los Estados Unidos. En el pasado, en Puerto Rico, diferentes comités asesores y compañías de consultores contratados por el gobierno coincidieron en señalar a la tecnología de la información, la computación y la comunicación como los ejes fundamentales de una política de desarrollo de ciencia y tecnología para el país. Entre estos informes se destacó el estudio sobre Tecnologías de Comunicaciones e Información de la empresa consultora Arthur D. Little. Este planteaba la creación de un *Centro para el Desarrollo de Software*, destinado a convertirse en el primer centro de América Latina, como uno de los hitos fundamentales en

dicha política. Este estudio destacaba que tal centro posibilitaría la conducción de proyectos de desarrollo de alta tecnología en colaboración con la industria y reconocía un rol protagónico para el Recinto Universitario de Mayagüez en el desarrollo de recursos humanos capaces de llevar a cabo este tipo de empresas. El programa que propone en este documento está directamente relacionado con el logro de objetivos de este tipo.

3.3 Oportunidades de Empleo para los Egresados del Programa

La demanda de profesionales de la computación en Puerto Rico, Estados Unidos y el mundo está en constante crecimiento. Una evidencia clara de esta demanda en Puerto Rico es el alto número de reclutadores de compañías que visitan el Recinto Universitario de Mayagüez, en busca de candidatos a posiciones profesionales en la industria informática. En particular, grandes compañías tales como IBM, Microsoft, Oracle, Google, AT&T Research, Xerox Corporation y Raytheon anualmente reclutan estudiantes egresados de ingeniería de computadoras. Muchos de estos egresados asumen posiciones más propias de un egresado de ciencia e ingeniería de computación o de un ingeniero de software, lo cual conlleva eventualmente un periodo de adaptación y especialización en el lugar de trabajo, después de la contratación. Aunque un bachiller en ingeniería de computadoras conoce los fundamentos de la ciencia e ingeniería de computación, adolece de una preparación integral en la disciplina y de entrenamiento especializado en el proceso de diseño y desarrollo de software; un rasgo altamente esperado por este tipo de reclutadores. El programa propuesto dota al perfil profesional de las destrezas, habilidades y conocimientos necesarios para satisfacer precisamente este tipo de demanda, haciendo que sus egresados sean más atractivos y competitivos en ese mercado laboral.

4. RELACIÓN DEL PROGRAMA CON LA MISIÓN Y PLANIFICACIÓN INSTITUCIONAL

4.1 Relación con la misión y el Plan de Desarrollo de la UPR, la misión y planificación de la unidad

Los objetivos del programa propuesto están alineados con los de DIEZ PARA LA DECADA: AGENDA PARA LA PLANIFICACION EN LA UNIVERSIDAD DE PUERTO RICO (2005 – 2015). En particular, el programa guarda una estrecha relación con las siguientes directrices:

- a. Vinculo Sostenido con el Estudiantado. Como meta de esta directriz se propone: *“Dispensar al estudiante, desde el momento de su ingreso hasta su conversión en egresado, la mejor calidad de servicios, programas académicos y ambientes para su desarrollo integral”*. El programa propuesto provee un perfil profesional en alta demanda y largamente reclamado por estudiantes puertorriqueños: el perfil del experto en la ingeniería de sistemas de software, capaz de diseñar sistemas sobre la base de principios fundamentales en teoría de sistemas de computación y las mejores prácticas de ingeniería. La ausencia de un programa académico de estas características hace que un número significativo de estudiantes interesados en proseguir carreras en Ciencia e Ingeniería de Computación y en Ingeniería de Software, busque la mejor aproximación posible dentro de la limitada oferta actualmente existente, o emigre a los Estados Unidos.

- b. Culturas Académicas de Actualización, Experimentación y Renovación. Esta segunda directriz conlleva una meta descrita como: *“El sistema y las unidades fomentarán culturas académicas que atemperen sus ofertas curriculares, modalidades de enseñanza – aprendizaje e investigación a los mejores desarrollos en los diferentes campos del conocimiento [...]”*. Los sistemas de software constituyen la base de la revolución informática. Dicha transformación en la sociedad, la política, la economía y la cultura no se produce por la mera concepción de una Ciencia de Computación, sino más bien por la capacidad técnica de diseñar e implantar complejos y sofisticados sistemas de hardware y software, los cuales han resultado capaces de realizar y superar con creces, las mejores proyecciones científicas y conceptuales. La ingeniería de estos sistemas está en constante evolución. Mientras la Ciencia de Computación ha alcanzado lo que puede distinguirse como un modo distintivo de pensar, esto es, un pensar en términos de procesos en lugar de formulas, y un cuerpo estable de principios básicos y conocimientos; la ingeniería de los sistemas de software continúa evolucionando y generando una cantidad exponencialmente creciente de nuevas áreas de especialidad y nuevos desafíos de diseño. Desde la escala individual de los sistemas de micro – chip hasta la escala mundial de sistemas de redes de información, los diseñadores e implantadores de sistemas de software se enfrentan a problemas de diseño restringidos a asuntos de usabilidad, confiabilidad, seguridad, costo, respuesta en tiempo real, coordinación de operaciones, organización y selección de componentes, reducción y distribución de espacios de memoria, entre muchos otros más. Los sistemas de software son, al igual que todos los campos de la ingeniería, un constante ciclo de aprendizaje y experimentación entre la tecnología y la ciencia. La ciencia de la computación intenta develar los principios que modelan estos sistemas, y la creación de nuevos sistemas, la experimentación de nuevas posibilidades en tecnología de software, brinda a su vez, nuevos problemas a la ciencia de la computación. El currículo de ambos grados, el de Ciencia e Ingeniería de Computación y el de Ingeniería de Software propuestos en este programa, están dotados de experiencias educacionales destinadas a entrenar estudiantes en esta continua interacción entre principios y observaciones científicas, y el diseño de sistemas de software. De este modo ambas líneas de especialización profesional, y el tronco común que comparten en los tres primeros años del currículo propuesto, constituyen una robusta respuesta a la necesidad de fomentar nuevas culturas académicas para atemperar las ofertas curriculares de la Universidad de Puerto Rico a las demandas y necesidades de la industria, la educación, la economía del conocimiento y la cultura, en general.

Relacion con el Plan Estrategico del Recinto Universitario de Mayaguez

El programa propuesto responde también a directrices estratégicas trazadas en el documento *Strategic Plan University of Puerto Rico at Mayaguez*. El programa se alinea especialmente con las áreas críticas de *Leadership* y *Curriculum, Learning and Teaching*. Con respecto a la primera, el plan estratégico del RUM propone las siguientes orientaciones:

- *Identify present and future needs of our society*
- *Create programs and services which will truly meet the needs of our beneficiaries*

La necesidad de desarrollar el capital intelectual y proveer profesionales en Ciencia e Ingeniería de Computación y en Ingeniería de Software es ampliamente reconocido por la industria, el gobierno y la sociedad en general. El programa propuesto está diseñado con el objetivo de satisfacer estas demandas. En el área crítica *Curriculum, Learning and Teaching*, por otro lado, se destaca la dirección estratégica señalada como *Provide updated academic offerings*. El programa propuesto está diseñado en base a los más altos estándares de educación en Ciencias e Ingeniería de Computación y Ingeniería de Software en Facultades de Ingeniería en los Estados Unidos y Canadá, y por lo tanto, responde también a este objetivo y dirección estratégica trazado por la administración del Recinto Universitario de Mayagüez.

4.2 Relación con la oferta académica vigente, dentro y fuera de la UPR

Existe en la actualidad un amplio portafolio de programas de educación en ciencia de computación, tecnologías, y sistemas de información en universidades a través de todo el mundo. En términos muy generales, este portafolio se divide entre programas orientados hacia la formación de expertos en computación y programas dedicados a la capacitación en el uso de la computación en otras áreas profesionales. Más aun, dentro de los programas enfocados en la formación de expertos en computación algunos enfatizan aspectos teóricos de Ciencia de Computación, mientras otros, como el programa descrito en este documento, buscan una formación equilibrada de ciencia y tecnología informática y orientan esos conocimientos y habilidades hacia el análisis y diseño de sistemas de software. Aunque estos últimos programas han llegado a dominar en la oferta académica en los Estados Unidos, nuestro análisis indica a-priori, que ese podría no ser el caso en Puerto Rico, donde dominan los programas académicos orientados hacia la capacitación en el uso de sistemas informáticos en negocios, ciencia y tecnología. El lento desarrollo de programas académicos orientados hacia el diseño se debe a más de un factor. Entre ellos quizás el más importante sea la falta de académicos con doctorado en Ciencia de Computación. Dicha falta conlleva a una concepción errada de la naturaleza de Ciencia de Computación en los estudiantes y el público en general; una concepción que los sitúa mucho más en la posición de usuarios que de creadores o innovadores. Conteos recientes indican que en todo Puerto Rico no hay más doctores en áreas de Computación que las que hay en un solo departamento académico de una universidad promedio en países como Brasil, México, Chile o Costa Rica. Otro resultado de esta deficiencia fue el hecho de que las facultades de ingeniería de las universidades en Puerto Rico, hasta hace muy poco tiempo, no se sentían inclinadas o no encontraban propio de su quehacer el desarrollar y albergar este tipo de programas. El resultado es la antes observada falta de enfoque en diseño de sistemas computacionales en la mayoría de los programas actuales, pues es en las facultades de Ingeniería donde naturalmente se cultiva la ciencia y el arte del diseño de sistemas. Por esto no resulta extraño que la mayoría de los programas de Ciencia de Computación se ofrecen actualmente en Facultades de Ingeniería o Facultades de Computación, en los Estados Unidos.

El siguiente análisis compara el programa descrito en este documento con programas en Puerto Rico que estén dedicados a la formación de expertos en computación, a nivel de bachillerato.

4.2.1 En el Recinto Universitario de Mayagüez

El programa que se propone está íntimamente relacionado con el programa de bachillerato en Ingeniería de Computadoras (ICOM) del Departamento de Ingeniería Eléctrica y Computadoras. De hecho, el programa que se propone en este documento es la evolución del componente de Ciencia e Ingeniería de Computación e Ingeniería de Software de ICOM hacia un programa formal. Ambos programas compartirán un número significativo de cursos tanto en ciencia e ingeniería de computación como en ingeniería de software. La diferencia entre ingeniería de computadoras y ciencia e ingeniería de computación e ingeniería de software está marcada por los campos de especialización de cada disciplina y un énfasis ya sea en el aspecto software o hardware en el currículo. Tradicionalmente corresponden a ingeniería de computadoras áreas de especialización tales como percepción remota, procesamiento digital de señales, diseño de hardware, VLSI, y en general, el diseño de equipo computadorizado y “firmware”, es decir, software de carácter relativamente permanente.

La Opción o “*Major*” en Ciencias de Computación del programa bachillerato en Matemáticas del Departamento de Matemáticas del Recinto Universitario de Mayagüez ofrece algunos cursos en Ciencia de Computación similares a los contemplados en esta propuesta. Este programa no cubre suficientes materias, especialmente en las áreas antes mencionadas de diseño de sistemas, como para ser catalogado como programa en ciencia e ingeniería de computación.

El programa que se propone guarda una leve relación con el programa en Sistemas de Información que ofrece el Colegio de Administración de Empresas del Recinto Universitario de Mayagüez. Los programas en sistemas de información no son considerados programas en ciencia e ingeniería de computación ni en ingeniería de software y, de hecho, tienen un conjunto de criterios de acreditación independiente.

4.2.2 En Otras Unidades del Sistema Universitario de la U.P.R.

El programa propuesto está relacionado con los programas de bachillerato de Ciencias de Computadoras del Recinto de Río Piedras, Ciencias de Computadoras del Colegio Universitario Tecnológico de Bayamón, Ciencias de Computadoras del Colegio Universitario Tecnológico de Arecibo, y Matemáticas Computacionales del Colegio Universitario de Humacao. Todos estos son programas de bachillerato en Ciencia de Computación o contienen secuencias estructuradas de cursos en Ciencia e Ingeniería de Computación a nivel de bachillerato. La diferencia principal entre estos programas y el que se propone en este documento está en la capacidad de este último para integrar aspectos científicos y de ingeniería efectivamente tanto dentro del currículo como en la experiencia de aprendizaje del estudiante y una mayor oferta de posibilidades de especialización profesional.

La Concentración en Sistemas Computadorizados de Información del programa de Bachillerato en Administración de Empresas del Recinto de Río Piedras contiene temas en Ciencia de Computación, dentro de un currículo orientado a la administración. Nuevamente, este tipo de programas no es normalmente clasificado ni acreditado con los mismos parámetros de un programa en ciencia e ingeniería de computación ni de ingeniería de software.

4.2.3 En Otras Instituciones del País

El programa propuesto está relacionado con el programa de bachillerato en Ciencias de Cómputos de la Universidad Metropolitana y programas similares ofrecidos por otras instituciones privadas del país incluyendo la Universidad Politécnica, Universidad Interamericana y la Universidad del Sagrado Corazón. Estos programas están enfocados en la capacitación de profesionales en el desarrollo de aplicaciones de software para el mundo empresarial. El programa propuesto es más amplio y a la vez más profundo en su cobertura de las áreas tradicionales de la computación y pretende formar profesionales con una preparación matemática, científica y de ingeniería de primer orden.

5. MARCO CONCEPTUAL DEL PROGRAMA

La filosofía fundamental del Programa de Bachillerato en Ciencia e Ingeniería de Computación e Ingeniería de Software es la de una visión integrada de la disciplina de la computación como un campo del conocimiento y la practica profesional donde lo científico, lo tecnológico y lo social se conjugan de un modo unico. El programa persigue transmitir esta visión a sus estudiantes y otorgarles los conceptos y habilidades profesionales que de ella se derivan. Tal visión es especialmente apropiada para una disciplina emergente, llena de posibilidades de expansión y con una influencia decisiva en el desarrollo social y económico de la nación.

5.1 Misión del Programa del Programa

La misión central del programa en Ciencia e Ingeniería de Computacion y en Ingeniería de Software es la formación de profesionales de la ingeniería dotados de sólidos conocimientos de los principios y fundamentos teóricos de la computación; y capacitados técnica, cultural y éticamente para diseñar, evaluar, mantener y modificar sistemas de procesamiento automatico de la información. Los graduados del programa servirán demandas de sistemas de software generadas por la industria, el comercio, la educación, el gobierno y la sociedad, en general; y estarán además capacitados para seguir estudios de post grado en universidades de renombre. El programa se distinguirá por la búsqueda constante de una formación equilibrada entre los aspectos científicos y tecnológicos del diseño de sistemas informaticos, al día con los avances de la disciplina, contribuyendo de esta manera al desarrollo y evolución de programas similares que se ofrecen en facultades de ingeniería en los Estados Unidos y Canada. De este modo, a nivel curricular, el programa tiene la misión de liderar en la implantación de un modelo de educación en Ciencia e Ingeniería de Computación, y en Ingeniería de Software en Puerto Rico. Este liderazgo se reflejará en:

- a. el desarrollo y mejoramiento continuo del currículo de acuerdo a las nuevas tendencias en Ciencia e Ingeniería de Computación, y de Ingeniería de Software,
- b. el mantenimiento de equipos y recursos de enseñanza actualizados,
- c. el mantenimiento y expansión de una facultad de excelencia,
- d. la capacidad para atraer a un número significativo de estudiantes sobresalientes al programa.

5.2 Metas del Programa

La metas del programa se dividen en dos grandes grupos, a saber:

1. Formar profesionales en Ciencia e Ingeniería de Computación y en Ingeniería de Software dotados de:
 - a. una visión global de la disciplina de la computación y un área de especialización claramente definida,
 - b. aprecio tanto por los aspectos teóricos como los aspectos prácticos de la disciplina, y una clara capacidad para usar la interrelación entre ellos en problemas de diseño de sistemas informáticos,
 - c. capacidad para evolucionar de acuerdo a los cambios en la disciplina,
 - d. capacidad de comunicación técnica y profesional en español e inglés,
 - e. conciencia de los asuntos éticos y sociales relacionados a la práctica profesional e interacción social,
 - f. conocimientos básicos de ciencia y economía.
2. Establecer relaciones con la industria, el comercio, el gobierno destinadas a atemperar el perfil profesional del egresado del programa a demandas y necesidades específicas de ese mercado laboral. En particular, se buscará establecer:
 - a. proyectos de investigación y desarrollo en colaboración con organismos del gobierno o la industria que involucren estudiantes y facultad del programa,
 - b. el establecimiento de relaciones formales con estas entidades y otros organismos profesionales como el Colegio de Ingenieros y Agrimensores

5.3 Objetivos del Programa

Los objetivos asociados a la meta 1 del programa son:

- a. Al completar la secuencia de cursos en Ciencias y Matemáticas el estudiante tendrá conocimientos y habilidades suficientes para operar con, y analizar correctamente expresiones lógicas, estadísticas y matemáticas.
- b. Al completar la secuencia de cursos en Ciencias y Matemáticas el estudiante tendrá además los conocimientos generales sobre ciencias físicas y químicas suficientes como para entender el lenguaje de pares en estas disciplinas, capacitándolo para participar en proyectos multidisciplinarios.
- c. Al completar la secuencia de cursos en Ciencias y Matemáticas el estudiante tendrá además conocimientos generales sobre ciencias físicas y químicas suficientes como para entender

ciertos aspectos físicos y químicos pertinentes al diseño del hardware de un sistema de computación.

- d. Al completar la secuencia de cursos en Fundamentos de Computación, el estudiante entenderá el uso de fundamentos lógicos, matemáticos y estadísticos en el modelaje de sistemas para el procesamiento automático de la información.
- e. Al completar la secuencia de cursos en Fundamentos de Computación, el estudiante tendrá además las habilidades necesarias para cuantificar el comportamiento de un sistema de software, especialmente en términos del tiempo de ejecución de procesos, y las necesidades de memoria y energía.
- f. Al completar la secuencia de cursos en Fundamentos de Computación, el estudiante tendrá además la capacidad de proponer fundamentadamente, nuevos diseños de sistemas informáticos o la adaptación de diseños existentes a nuevas necesidades.
- g. Al completar la secuencia de cursos en Fundamentos de Computación, el estudiante estará además capacitado para leer informes técnicos y literatura sobre sistemas de computación.
- h. Al completar la secuencia de cursos en Fundamentos de la Ingeniería el estudiante tendrá conocimientos generales sobre los fundamentos de la ingeniería, incluyendo entre estos asuntos específicos sobre la ingeniería de sistemas electrónicos, eléctricos y de telecomunicaciones.
- i. Al completar la secuencia de cursos en Fundamentos de la Ingeniería el estudiante tendrá además información y conocimientos sobre los pasos fundamentales que componen el diseño de un sistema de ingeniería.
- j. Al completar la secuencia de cursos de Formación General el estudiante tendrá dominio del idioma inglés suficiente para entender, expresarse y redactar informes técnicos en esa lengua.
- k. Al completar la secuencia de cursos de Formación General el estudiante tendrá además conocimientos generales sobre los sistemas sociales, la economía y la ética.
- l. El estudiante deberá en su debido momento, tomar una decisión racional e informada sobre la concentración de su preferencia, dentro del grado de su elección.
- m. El estudiante deberá además culminar su experiencia educativa con conocimientos específicos y del nivel de profundidad adecuados, en el área de concentración de su elección.

Los objetivos asociados a la meta 2 del programa son:

- a. Alcanzar y mantener un mínimo de un ochenta y cinco por ciento (85%) de participación de los estudiantes en el programa COOP, o en internados de verano.
- b. Lograr una participación suficiente de los estudiantes del programa en investigación subgraduada como para ofrecer al menos una sección de ese curso electivo en cada año académico.

5.4 Filosofía educativa

En el informe *The Engineer of 2020: Visions of Engineering in the New Century*, emitido en el año 2004 por el *National Academy of Engineering*, se destaca *“Engineering is a profoundly creative process. A most elegant description is that engineering is about design under constraint. The engineer designs devices, components, subsystems, and systems and, to create a successful design, in the sense that it leads directly or indirectly to an improvement in our quality of life, must work within the constraints provided by technical, economic, business, political, social, and ethical issues.”* El ingeniero es, en gran medida, un innovador y por lo tanto, su educación debe junto con dotarlo de conocimientos científicos y tecnológicos, cultivar la creatividad intelectual, el ingenio, como un valor y una característica distintiva de su ser profesional. Los proponentes adhieren al postulado que hace del cultivo de la razón y la intuición la esencia de la educación. La educación en sí, no es una réplica de la vida profesional sino un ambiente en el cual el estudiante desarrolla sus potenciales intelectuales y se prepara para usarlos en una amplia gama de situaciones, en el futuro. El ambiente educativo debe, por lo tanto, estimular el crecimiento organizado y metódico de la creatividad, el pensamiento crítico y la individualidad; y no debe pretender ajustar y restringir al individuo a los métodos y concepciones dominantes. La educación debe, en suma, proveer un cuerpo de conocimientos fundamentales a partir de los cuales nuevas observaciones, modelos y conceptos puedan descubrirse en base al ejercicio intelectual del individuo. La responsabilidad primaria de la educación es siempre, el desarrollo de la unicidad del individuo.

El aprendizaje ocurre a veces mediante la participación del estudiante en proyectos a través de los cuales este transita de asuntos o problemas prácticos a principios teóricos, esto es de lo concreto a lo abstracto; mientras que en otras circunstancias, el aprendizaje ocurre a través de la lectura o exposición de principios y modelos básicos que el estudiante puede aplicar a asuntos o problemas prácticos, esto es, de lo abstracto a lo concreto. En el programa descrito en esta propuesta se espera que en los cursos de Fundamentos de Computación y Ciencia y Matemáticas domine el segundo estilo de instrucción, esto es, el tránsito de lo abstracto a lo práctico, mientras que en los cursos de Concentración se espera que ocurra lo contrario, esto es que el estudiante transite de asuntos y problemas prácticos a principios teóricos.

5.5 Perfil del Egresado

5.5.1. Rasgos comunes a ambos grados

- a. Conocimiento amplio de los fundamentos teóricos de Ciencia de Computación. Esto es, familiaridad con el lenguaje, los temas y problemas básicos de la disciplina. Dominio de temas tales como algoritmos, programación, estructuras de datos, lenguajes de programación, sistemas de computación, bases de datos y arquitecturas de computadoras.
- b. Conocimientos de los fundamentos de ingeniería lo suficientemente extensos y profundos como para capacitar al graduado para desarrollar exitosamente las diversas soluciones que le demande su práctica profesional.

- c. Conocimiento de los fundamentos de electrónica suficientes para el entendimiento de los aparatos físicos controlados por la programación y de los mecanismos internos de un sistema de computación.
- d. Capacidad para aplicar creativa e integradamente estos conocimientos en la solución de problemas y en el diseño, evaluación y mantenimiento de sistemas informáticos.
- e. Capacidad de analizar y determinar las especificaciones apropiadas a un problema específico y proponer estrategias de solución. Capacidad para determinar en que medida un sistema de computación satisface los criterios definidos para su uso actual y desarrollo futuro.
- f. Habilidad de comunicación oral y escrita en los idiomas inglés y español.
- g. Capacidad de formular claramente sus objetivos a corto, mediano y largo plazo y de hacer sus ideas y resultados comprensibles para sus compañeros de trabajo. Capacidad para comunicar efectivamente los aspectos esenciales de un determinado problema y su solución, a una audiencia general.
- h. Capacidad de aprender de sus experiencias y realizar trabajo en equipo. Capacidad para evolucionar de acuerdo a la naturaleza cambiante de la disciplina.
- i. Conciencia del impacto de su trabajo en la calidad de vida de la sociedad, incluyendo un claro entendimiento y respeto por los asuntos legales, éticos, sociales y culturales pertinentes a la práctica de su profesión. Capacidad para identificar los riesgos potenciales asociados al uso u operación de sistemas de computación.
- j. Visión global de los sistemas de computación. El egresado del programa debe entender la estructura de los sistemas de computación y los procesos involucrados en su construcción y análisis, más allá de los detalles asociados a una implantación en particular.
- k. Apreciación de la relación entre teoría y práctica. El egresado debe apreciar tanto el valor de un buen diseño de ingeniería como el del marco teórico que lo sustenta. Esto es, debe entender el valor de la interrelación entre teoría, experimento y resultado y ser capaz usarla efectivamente en su práctica profesional.

5.5.2. Rasgos específicos del egresado del bachillerato en Ingeniería de Software

- a. Conocimientos vastos en técnicas y metodologías para el desarrollo de software a gran escala, tales como interacción humano-computadora, especificación, diseño, codificación y prueba, y aquellos relacionados a la gerencia, tales como administración de proyectos y control de calidad.
- b. Capacidad para integrar y aplicar conocimientos de ciencia e ingeniería en el desarrollo de proyectos innovadores de software.

- c. Habilidad gerencial, capacidad para la organización de trabajo en equipo, administración de proyectos y manejo de personal especializado.
- d. Capacidad para aplicar los principios de la Ingeniería de Software en la solución de una amplia gama de problemas informáticos.

5.5.3 Rasgos específicos del egresado de bachillerato en Ciencia e Ingeniería de Computación

- a. Conocimiento profundo de técnicas y metodologías para el análisis y diseño de sistemas de software de alta complejidad.
- b. Capacidad para integrar y aplicar conocimientos fundamentales de la ciencia y la ingeniería en el diseño de sistemas de software, en al menos un área de concentración. Ejemplos de estas áreas son: computación en redes, inteligencia artificial, sistemas computacionales, bases de datos, computación gráfica, diseño e implantación de lenguajes de programación, arquitectura de computadoras, entre otras.
- c. Conocimientos básicos de la ingeniería de los sistemas de software.
- d. Capacidad para aplicar los principios fundamentales de la Ciencia e Ingeniería de Computación en la solución de una amplia gama de problemas computacionales e informáticos.

5.6 COHERENCIA Y SUFICIENCIA DEL MARCO CONCEPTUAL

La misión principal de este programa, esto es, la formación de ingenieros en Ciencia de Computación y en Ingeniería de Software dotados de conocimientos y habilidades científicas y tecnológicas y una equilibrada visión y capacidad para usar las mismas en el diseño de sistemas informáticos está reflejada en la meta 1 de las metas del programa, y en los objetivos que se detallan para esta meta, en la sección correspondiente. La misión asociada al impacto real de estos profesionales, esto es, la capacidad de los mismos para satisfacer necesidades de diseño e implantación de sistemas informáticos requeridos por la industria, el gobierno, el comercio y la sociedad en general, se refleja a su vez, en la meta 2 de las metas del programa. Los objetivos del programa han sido diseñados para alcanzar estas metas y, de hecho, han sido cuidadosamente alineados también con el currículo que se discute en la sección siguiente. El perfil del egresado es, por otro lado, una descripción detallada de los atributos que debe tener un profesional capaz de alcanzar las metas del programa. Como se expresó antes, en la confección del marco conceptual para este programa se revisaron programas en Ciencia e Ingeniería de Computación y programas en Ciencia de Computación de facultades de ingeniería, todos ellos acreditados por ABET. Además, los contenidos programáticos de cada uno de los grados, esto es Ciencia e Ingeniería de Computación e Ingeniería de Software, han sido revisados a la luz del informe *Computing Curricula 2005*, emitido por un comité conjunto de la IEEE y la ACM.

6. DISEÑO CURRICULAR

6.1 Esquema y balance curricular

Ambos grados del Programa de Bachillerato en Ciencia e Ingeniería de Computación e Ingeniería de Software constan de un mínimo de 163 créditos. Estos se distribuyen del modo siguiente:

Resumen: 163 créditos	
Formación General	35
Fundamentos de Ingeniería	21
Ciencias y Matemáticas	32
Fundamentos de Computación	36
Especialidad (Computación/Software)	27
Electivas libres	12

Tabla 1: Desglose de cursos por áreas

- **Cursos nuevos** – cursos regulares de nueva creación en el Recinto Universitario de Mayagüez.
- **Cursos existentes** – cursos regulares ya activos en el Recinto Universitario de Mayagüez.
- **Cursos reclasificados** – cursos regulares que ya existen bajo el programa de Ingeniería de Computadoras pero que requieren de una nueva codificación.

A continuación se presenta el desglose de los cursos requeridos por área:

Formación general: 32 créditos					
Curso	Nombre	Créditos	Tipo de Curso		
			Nuevo	Existente	Reclasificado
ESPA 3101	Español Básico I	3		X	
ESPA 3102	Español Básico II	3		X	
*INGL 3---	Inglés de Primer Año I	3		X	
*INGL 3---	Inglés de Primer Año II	3		X	
*INGL 3---	Inglés de Segundo Año I	3		X	
*INGL 3---	Inglés de Segundo Año II	3		X	
INGL 3191 o INGL3250	Inglés para Oratoria	3		X	
EDIF ----	Electiva Educación Física I	1		X	
EDIF ----	Electiva Educación Física II	1		X	
---- ----	Electiva Socio-humanístico	3		X	
---- ----	Electiva Socio-humanístico	3		X	
---- ----	Electiva Socio-humanístico	3		X	
---- ----	Electiva Socio-humanístico	3		X	

Tabla 2: Desglose de cursos de formación general.

Ciencias y Matemáticas: 32 créditos

Curso	Nombre	Créditos	Tipo de Curso		
			Nuevo	Existente	Reclasificado
MATE 3031	Cálculo I	4		X	
MATE 3032	Cálculo II	4		X	
MATE 3063	Cálculo III	3		X	
MATE 4009	Ecuaciones Diferenciales Ordinarias	3		X	
QUIM 3131	Química General I	3		X	
QUIM 3133	Laboratorio de Química General I	1		X	
QUIM 3132	Química General II	3		X	
QUIM 3134	Laboratorio de Química General II	1		X	
FISI 3171	Física I	4		X	
FISI 3173	Laboratorio de Física I	1		X	
FISI 3172	Física II	4		X	
FISI 3174	Laboratorio de Física II	3		X	

Tabla 3: Desglose de cursos de Ciencias y Matemáticas.

Fundamentos de Ingeniería: 21 créditos

Curso	Nombre	Créditos	Tipo de Curso		
			Nuevo	Existente	Reclasificado
INGE 3011	Gráficos de Ingeniería	2		X	
INGE 3035	Mecánica para Ingeniería	3		X	
INME 4045	Termodinámica	3		X	
ININ 4010	Probabilidad y Estadística para Ingenieros	3		X	
ININ 4015	Economía para Ingenieros	3		X	
INGE 3045	Materiales para Ingenieros Electricistas	3		X	
INEL 3105	Análisis de Sistemas Eléctricos I	3		X	
INEL 4115	Laboratorio de Medidas Eléctricas	1		X	

Tabla 4: Desglose de cursos de Fundamentos de Ingeniería.

Electivas Libres: 12 créditos

Tabla 5: Total de Créditos en Electivas Libres.

Fundamentos de Computación: 36 créditos					
Curso	Nombre	Créditos	Tipo de Curso		
			Nuevo	Existente	Reclasificado
CIIC 3XXX o COMP 3010	Intro. a la Programación de Computadoras I	3			X
CIIC 4XXX	Programación Avanzada	4			X
CIIC 4XXX	Estructuras de Datos	4			X
CIIC 3XXX	Fundamentos de Computación	3			X
CIIC 4XXX	Análisis y Diseño de Algoritmos	3	X		
CIIC 4XXX	Lenguajes de Programación	3			X
CIIC 4XXX	Redes de Computadoras	3			X
CIIC 4XXX	Sistemas Operativos	4			X
CIIC 4XXX	Sistemas de Bases de Datos	3			X
CIIC 3XXX	Arquitectura de Computadoras I	3	X		
CIIC 4XXX	Arquitectura de Computadoras II	3	X		

Tabla 6: Desglose de cursos de Fundamentos de Computación.

Grado en Ciencia e Ingeniería de Computación: 27 créditos

Curso	Nombre	Créditos	Tipo de Curso		
			Nuevo	Existente	Reclasificado
CIIC 5XXX o COMP 5045	Lenguajes Formales y Autómata	3	X		
INSO 4XXX	Introducción a la Ingeniería de Software	3			X
CIIC 4XXX	Computación de Alto Rendimiento	3	X		
CIIC 5XXX	Inteligencia Artificial	18			X
CIIC 5XXX	Desarrollo de Compiladores				X
INSO 4XXX	Introducción a la Interacción Humano- Computadora		X		
INSO 4XXX	Administración de Proyectos de Software		X		
CIIC 5XXX	Administración y Seguridad de Sistemas y Redes				X
CIIC 5XXX	Criptografía y Seguridad de Redes				X
CIIC 5XXX	Temas Selectos		X		
CIIC 4XXX	Investigación subgraduada		X		

Tabla 7: Desglose de cursos específicos para el grado en Ciencia e Ingeniería de Computación

Grado en Ingeniería de Software 27 créditos

Curso	Nombre	Créditos	Tipo de Curso		
			Nuevo	Existente	Reclasificado
INSO 4XXX	Introducción a la Ingeniería de Software	3			X
INSO 4XXX	Introducción a la Interacción Humano-Computadora	3	X		
INSO 4XXX	Requisitos de Ingeniería de Software	3	X		
INSO 4XXX	Diseño de Software	3	X		
INSO 4XXX	Pruebas de Confiabilidad de Software	3	X		
INSO 4XXX	Proyecto de Ingeniería de Software I	3	X		
INSO 4XXX	Proyecto de Ingeniería de Software II	3	X		
INSO 4XXX	Administración de Proyectos de Software	6	X		
CIIC 5XXX	Inteligencia Artificial				X
CIIC 5XXX	Administración y Seguridad de Sistemas y Redes				X
CIIC 5XXX	Criptografía y Seguridad de Redes				X
CIIC 5XXX	Desarrollo de Compiladores				X
INSO 4XXX	Investigación subgraduada en Software Engineering			X	

Tabla 8: Desglose de cursos específicos para el grado en Ingeniería de Software

6.2 Cursos que componen el currículo

6.2.1 Cursos requeridos para ambos grados (medulares)

En esta sección se presenta la descripción de los cursos de Ciencia de Computación requeridos por ambos grados. Se propone una codificación común **CIIC** (ciencia e ingeniería de la computación) para los cursos comunes a ambos grados y una codificación **INSO** (ingeniería de software) para los cursos específicos al grado de ingeniería de software. De ser necesarias la codificación en inglés correspondiente a **CIIC** deben ser **CISE** mientras que la codificación en inglés correspondiente a **INSO** debe ser **SENG**.

Cursos Requeridos Nuevos¹

CIIC 3XXX. FUNDAMENTOS DE COMPUTACIÓN. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: COMP 3010 o CIIC 3XXX (*Introducción a la Programación de Computadoras I*). Estructuras discretas en ciencias e ingeniería de computación con énfasis en destrezas de solución de problemas y algoritmos. Los temas incluyen: teoría de conjuntos, lógica y técnicas de demostración, teoría de grafos, computabilidad y probabilidad discreta aplicada a problemas de computación.

CIIC 4XXX. ANÁLISIS Y DISEÑO DE ALGORITMOS. Tres horas crédito. Tres horas de conferencia semanales. Requisitos previos: [ICOM 4035 o CIIC 4XXX (*Estructuras de Datos*)] y CIIC 3XXX (*Fundamentos de Computación*). Estudio de métodos y técnicas para el análisis de la complejidad de algoritmos computacionales. Diseño de nuevos algoritmos capaces de minimizar el tiempo de ejecución y optimizar el uso de recursos computacionales. Los temas incluyen: análisis asintótico, estrategias ambiciosas, división y conquista, programación dinámica, “backtracking” y algoritmos de grafos, búsqueda y ordenamiento.

CIIC 4XXX. REDES DE COMPUTADORAS. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: ICOM 5007 o CIIC 4XXX (Sistemas Operativos). Estudio y desarrollo de destrezas para el diseño de protocolos y aplicaciones orientadas a redes computacionales, con énfasis en protocolos utilizados en la Internet. Los temas incluyen: el modelo estratificado ISO, TCP/IP, establecimiento de rutas, modelo cliente-servidor, World Wide Web y “Web Services”. Práctica con problemas de análisis y programación.

CIIC 3XXX. INTRODUCCIÓN A LA PROGRAMACIÓN DE COMPUTADORAS I. 3 créditos. Curso con codificación dual a COMP 3010.

¹ Algunos de estos cursos son recodificaciones de cursos previamente existentes como ICOM o INGE

CIIC 4XXX. PROGRAMACIÓN AVANZADA. Cuatro horas crédito. Tres horas de conferencia y un laboratorio de dos horas semanales. Requisito previo: COMP 3010 o CIIC 3XXX (Introducción a la Programación de Computadoras I). Técnicas avanzadas de programación aplicadas a la solución de problemas de ingeniería; uso amplio de subprogramas y expresiones lógicas y de especificación. Principios de multiprogramación, multiprocesamiento y sistemas de tiempo real.

CIIC 3XXX. ARQUITECTURA DE COMPUTADORAS I. Tres horas crédito. Tres horas de conferencia semanales. Estudio de conceptos fundamentales para el análisis y diseño de circuitos lógicos con el objetivo de entender y diseñar los componentes principales de un procesador moderno. Los temas incluyen: álgebra Booleana, compuertas lógicas, circuitos combinatorios y secuenciales, unidades lógicas aritméticas (ALU), memoria y dispositivos lógicos programables, vías de datos y unidades de control. Práctica con problemas de diseño de componentes lógicos.

CIIC 4XXX. ARQUITECTURA DE COMPUTADORAS II. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: CIIC 3XXX (Arquitectura de Computadoras I). Estudio de conceptos fundamentales de arquitectura de computadoras con el objetivo de diseñar procesadores y sistemas computacionales eficientes para apoyar sistemas operativos y lenguajes de programación de alto nivel. Los temas incluyen: subrutinas, excepciones, entrada/salida, "pipelining" y memorias jerárquicas. Práctica con problemas de análisis, diseño y programación.

CIIC 4XXX. ESTRUCTURAS DE DATOS. Cuatro horas crédito. Tres horas de conferencia y un laboratorio de dos horas semanales. Requisito previo: CIIC 4XXX (Programación Avanzada). Estructuras de datos en lenguajes de programación; representación de información en forma de datos; listas de forma lineal, ortogonal, en sucesión y en arreglo; estructuras tipo árbol; técnicas para el almacenamiento, la distribución, la recolección y el ordenamiento de datos.

CIIC 4XXX. LENGUAJES DE PROGRAMACIÓN. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: ICOM 4035 o CIIC 4XXX (Estructuras de Datos). Estudio comparativo de paradigmas de programación que incluye programación imperativa, de objetos, funcional, lógica y concurrente; encapsulación de datos y herencia; especificación formal de la estructura sintáctica de un lenguaje; gramáticas de contexto libre y árboles sintácticos.

CIIC 4XXX. SISTEMAS OPERATIVOS. Cuatro horas crédito. Tres horas de conferencia y un laboratorio de dos horas semanales. Requisitos previos: [ICOM 4035 o CIIC 4XXX (Estructuras de Datos)] y CIIC 4XXX (Arquitectura de Computadoras II). Estudio de sistemas operativos, multiprogramación, multiprocesamiento, procesamiento por lotes, por tiempo compartido y por tiempo real; organización y manejo de sistemas de archivo; teoría de colas y control de flujo de información.

CIIC 4XXX. SISTEMAS DE BASES DE DATOS. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: CIIC 4XXX (Sistemas Operativos). Estudio de arquitecturas de sistemas de bases de datos; diseño e implantación de aplicaciones de bases de datos; modelos conceptuales y representacionales; SQL y el modelo relacional; dependencias funcionales y normalización; procesamiento de transacciones.

6.2.2 Cursos requeridos y electivas técnicas para ingeniería de software

Cursos Requeridos Nuevos

INSO 4XXX. INTRODUCCIÓN A LA INGENIERÍA DE SOFTWARE. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: ICOM 4035 o CIIC 4XXX (Estructuras de Datos). Introducción a las actividades del ciclo de desarrollo de software. Modelos de procesos de desarrollo de software y métricas relacionadas. Aspectos éticos en la ingeniería de software.

INSO 4XXX. ADMINISTRACIÓN DE PROYECTOS DE SOFTWARE. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: ICOM 4009 o INSO 4XXX (Introducción a la Ingeniería de Software). Discusión de técnicas y herramientas de estimación, planificación, verificación, documentación, evaluación, refinamiento y control de calidad de software. Desarrollo de destrezas para la administración efectiva de proyectos complejos de ingeniería de software. Práctica en la administración de proyectos.

INSO 4XXX. INTRODUCCIÓN A LA INTERACCIÓN HUMANO-COMPUTADORA. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: ICOM 4009 o INSO 4XXX (Introducción a la Ingeniería de Software). Introducción a los principios de interacción entre los seres humanos y las computadoras con el objetivo de desarrollar las habilidades necesarias para el diseño e implantación de interfaces gráficas (GUI). Los temas incluyen: psicología cognoscitiva, factores humanos y estilos de interacción. Práctica en el diseño y evaluación de uso de varias interfaces gráficas.

INSO 4XXX. REQUISITOS DE INGENIERIA DE SOFTWARE. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: ICOM 4009 o INSO 4XXX (Introducción a la Ingeniería de Software). Técnicas utilizadas para determinar los requisitos de un sistema complejo de software: estándares de especificación, lenguaje UML, validación, herramientas para manejo de especificaciones y métricas de calidad. Recopilación y desarrollo de requisitos de sistemas de software. Discusión de aspectos éticos que surgen durante la recopilación de requisitos.

INSO 4XXX. DISEÑO DE SOFTWARE. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: INSO 4XXX (Requisitos de Ingeniería de Software). Conceptos fundamentales y desarrollo de destrezas requeridas para el diseño efectivo de sistemas complejos de software. Los temas incluyen: métodos formales, estándares de especificaciones, patrones, validación y métricas de diseño. Uso de herramientas de diseño asistido por computadora (CASE).

INSO 4XXX. PRUEBAS DE CONFIABILIDAD DE SOFTWARE. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: INSO 4XXX (Diseño de Software). Técnicas de prueba y validación de software para desarrollar destrezas para el diseño de sistemas de software confiables y tolerantes a fallas. Los temas incluyen: pruebas de unidad, integración, desempeño, esfuerzo, uso y de tolerancia a fallas. Práctica con herramientas computarizadas de prueba y depuración.

INSO 4XXX. PROYECTO DE INGENIERÍA DE SOFTWARE I. Tres horas crédito. Tres horas de discusión semanales. Requisitos previos: INSO 4XXX (Pruebas de Confiabilidad de Software) e INSO 4XXX (Introducción a la Interacción Humano-Computadora). Proyecto en equipo con el propósito de diseñar un sistema que conlleve todos los aspectos del proceso de desarrollo de ingeniería de software para resolver un problema académico, gubernamental, comercial o industrial.

INSO 4XXX. PROYECTO DE INGENIERÍA DE SOFTWARE II. Tres horas crédito. Tres horas de discusión semanales. Requisito previo: INSO 4XXX (Proyecto de Ingeniería de Software I). Proyecto en equipo con el propósito de implantar un sistema previamente diseñado de desarrollo de ingeniería de software para resolver un problema académico, gubernamental, comercial o industrial. Presentación final y evaluación del proyecto.

INSO 49XX. INVESTIGACIÓN SUBGRADUADA EN INGENIERÍA DE SOFTWARE. De una a seis horas crédito. Tres horas de investigación semanales por crédito. Requisito previo: autorización del Director de Departamento. Desarrollo de un trabajo de investigación en ingeniería de software bajo la supervisión de un miembro de la facultad.

6.2.3 Cursos requeridos y electivos para ciencia e ingeniería de la computación

CIIC 5XXX. Lenguajes Formales y Autómata. 3 créditos. Curso con codificación dual a COMP 5045.

CIIC 4XXX. COMPUTACION DE ALTO RENDIMIENTO. Tres horas crédito. Tres horas de conferencias semanales. Requisito previo: ICOM 4035 o CIIC 4XXX (Estructuras de Datos). Estudio de conceptos fundamentales asociados al rendimiento de un sistema de computación. Discusión de técnicas para la reducción de operaciones con el objetivo de minimizar el tiempo de respuesta de un sistema a la solución de problemas de alta demanda computacional. Estudio de estrategias de paralelización y concurrencia y experiencias prácticas en el uso de sistemas y herramientas que las implantan.

CIIC 5XXX. INTELIGENCIA ARTIFICIAL. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: autorización del Director de Departamento. Introducción al campo de la inteligencia artificial. Los temas incluyen: el lenguaje LISP; técnicas de búsqueda; juegos; visión; representación del conocimiento; inferencia y el proceso de prueba de teoremas; entendimiento de lenguaje natural.

CIIC 5XXX. DESARROLLO DE COMPILADORES. Tres horas crédito. Dos horas de conferencia y un laboratorio de tres horas semanales. Requisito previo: autorización del Director de Departamento. Estudio y aplicación de técnicas asociadas al análisis de los lenguajes fuente y la generación de objetos de códigos eficientes con énfasis en los componentes de un compilador.

CIIC 5XXX. TEMAS SELECTOS. De una a tres horas crédito. De una a tres horas de conferencia semanales. Requisito previo: ICOM 4035 o CIIC 4XXX (Estructuras de Datos) o autorización del Director de Departamento. Temas selectos en ciencias e ingeniería de la computación.

CIIC 4XXX. INVESTIGACIÓN SUBGRADUADA. De una a seis horas crédito. Requisito previo: ICOM 4035 o CIIC 4XXX (Estructuras de Datos) y autorización del Director de Departamento. Desarrollo de un proyecto de investigación relacionado con ciencia e ingeniería de la computación bajo la supervisión de un miembro de la facultad.

CIIC 5XXX. CRIPTOGRAFÍA Y SEGURIDAD DE REDES. Tres horas crédito. Tres horas de conferencia semanales. Requisito previo: CIIC 4XXX (Redes de Computadoras) o autorización del Director de

Departamento. Aspectos teóricos y prácticos de seguridad en sistemas de computación y redes; modelos de amenazas; vulnerabilidad a ataques tales como: “hackers”, código malicioso, caballos de Troya, virus y gusanos; técnicas criptográficas para defender los sistemas de dichos ataques.

CIIC 5XXX. ADMINISTRACIÓN Y SEGURIDAD DE SISTEMAS OPERATIVOS Y REDES. Tres horas crédito. Dos horas de conferencia y un laboratorio de tres horas semanales. Requisito previo: CIIC 4XXX (Sistemas Operativos) o autorización del Director de Departamento. Experiencia práctica en la administración y seguridad de sistemas operativos y redes. Diseño y desarrollo de medidas de detección de y respuesta a ataques en estos sistemas.

6.3 Secuencia curricular

6.3.1 Secuencia curricular B.S. en Ciencia e Ingeniería de la Computación

El modelo está de acuerdo con la distribución de cursos mencionados en la sección 6.2

Primer Año			
Primer Semestre			
Curso	Descripción	Crédts	Prerrequisitos/Corequisitos
*MATE 3031	Cálculo I	4	MATE 3005 ó MATE 3143 ó MATE 3172 ó MATE 3174
QUIM 3131	Química General I	3	
QUIM 3133	Laboratorio de Química General I	1	
**INGL 3---	Inglés de Primer Año	3	
ESPA 3101	Español Básico I	3	
CIIC 3XXX ó COMP 3010	Introducción a la Programación de Computadoras I	3	MATE 3005 ó MATE 3173 ó MATE 3171
EDFI ----	Electiva en Educación Física	1	
	Total	18	

Segundo Semestre			
MATE 3032	Calculo II	4	MATE 3031
QUIM 3132	Química General II	3	QUIM 3131
QUIM 3134	Laboratorio de Química General II	1	QUIM 3133
**INGL 3---	Inglés de Primer Año	3	
ESPA 3102	Español Básico II	3	ESPA 3101
CIIC 3XXX	Fundamentos de Computación	3	COMP 3010 o CIIC 3XXX (<i>Introducción a la Programación de Computadoras I</i>)
EDFI ----	Electiva en Educación Física	1	
	Total	18	

Segundo Año			
Primer Semestre			
Curso	Descripción	Créds	Prerrequisitos/Corequisitos
MATE 3063	Calculo III	3	MATE 3032
FISI 3171	Física I	4	MATE 3031 ó MATE 3183
FISI 3173	Laboratorio de Física I	1	MATE 3171 (correquisito)
INGE 3011	Gráficos de Ingeniería	2	
CIIC 4XXX	Programación Avanzada	4	COMP 3010 o CIIC 3XXX (<i>Introducción a la Programación de Computadoras I</i>)
**INGL 3---	Inglés de Segundo Año	3	
	Total	17	
Segundo Semestre			
MATE 4009	Ecuaciones Diferenciales Ordinarias	3	MATE3063
FISI 3172	Física II	4	FISI3171
FISI 3174	Laboratorio de Física II	1	FISI3173

CIIC 4XXX	Estructuras de Datos	4	CIIC 4XXX (<i>Programación Avanzada</i>)
**INGL 3---	Inglés de Segundo Año	3	MATE3063
INEL 3105	Análisis de Sistemas Eléctricos I	3	MATE 3032 ó MATE 3184, y FISI 3172 (correquisito) y MATE 3063
INEL 4115	Laboratorio de Medidas Eléctricas	1	INEL 3105 (correquisito)
	Total	19	

Tercer Año

Primer Semestre

Curso	Descripción	Crédos	Prerrequisitos/Corequisitos
CIIC 4XXX	Análisis y Diseño de Algoritmos	3	[ICOM 4035 o CIIC 4XXX (<i>Estructuras de Datos</i>)] y CIIC 3XXX (<i>Fundamentos de Computación</i>)
INSO 4XXX	Introducción a la Ingeniería de Software	3	ICOM 4035 ó CIIC 4XXX Estructuras de Datos
CIIC 3XXX	Arquitectura de Computadoras I	3	
ININ 4010	Probabilidad y Estadística para Ing.	3	MATE 3032 ó MATE 3184 y CIIC 3XXX ó INGE 3016 (<i>Introducción a la Programación de Computadoras I</i>)
CIIC 4XXX	Lenguajes de Programación	3	ICOM 4035 o CIIC 4XXX (<i>Estructuras de Datos</i>).
	Total	15	

Segundo Semestre

CIIC 4XXX	Computación de Alto Rendimiento	3	ICOM 4035 o CIIC 4XXX (<i>Estructuras de Datos</i>)
CIIC 4XXX	Arquitectura de Computadoras II	3	CIIC 3XXX (<i>Arquitectura de Computadoras I</i>)
ININ 4015	Economía de Ingeniería	3	ININ 4010 ó INI 4011
INME 4045	Termodinámica	3	QUIM 3002, FISI 3172 ó FISI 3162 ó FISI 3012
CIIC ----	Electiva Técnica***	3	
	Total	15	

Cuarto Año			
Primer Semestre			
Curso	Descripción	Crédts	Prerrequisitos/Corequisitos
CIIC 4XXX	Sistemas Operativos	4	[ICOM 4035 o CIIC 4XXX (<i>Estructuras de Datos</i>)] y CIIC 4XXX (<i>Arquitectura de Computadoras II</i>)
CIIC 5XXX Ó COMP 5045	Leguajes Formales y Autómata	3	Autorización del Director
CIIC ----	Electiva Técnica***	3	
-----	Electiva libre	3	
-----	Electiva Socio-humanístico	3	
	Total	16	
Segundo Semestre			
CIIC 4XXX	Sistemas de Bases de Datos	3	CIIC 4XXX (<i>Sistemas Operativos</i>)
CIIC 4XXX	Redes de Computadoras	3	CIIC 4XXX ó ICOM 5007 (<i>Sistemas Operativos</i>)
CIIC ----	Electiva Técnica***	3	
-----	Electiva Socio-humanístico	3	
-----	Electiva Libre	3	
		15	

Quinto Año			
Primer Semestre			
Curso	Descripción	Crédts	Prerrequisitos/Corequisitos
CIIC ----	Electiva Técnica***	3	

CIIC ----	Electiva Técnica***	3	
-----	Electiva Socio-humanístico	3	
-----	Electiva Libre	3	
INGL 3191 ó INGL 3250	Curso de Inglés para Oratoria	3	INGL 3--- Inglés de Segundo Año
	Total	15	
Segundo Semestre			
CIIC ----	Electiva Técnica***	3	
INGE 3045	Ciencia de Materiales para Ingenieros Electricistas	3	QUIM 3002 y FISI 3162 ó FISI 3171
-----	Electiva Socio-humanística	3	
-----	Electiva Libre	3	
INGE 3035	Mecánica para Ingeniería	3	MATE 3031 ó MATE 3134 ó MATE 3183 y FISI 3161 ó FISI 3171
	Total	15	

Total de créditos: 163

* El estudiante debe haber aprobado precálculo previamente

** Hacer referencia a la sección de regulaciones Académicas para información relacionada con Nivel Avanzado (Advanced Placement)

*** Electiva técnica seleccionada según la tabla 7, sección 6.1

6.3.2 Secuencia curricular B.S. en Ingeniería de Software

El modelo está de acuerdo con la distribución de cursos mencionados en la sección 6.2.

Primer Año			
Primer Semestre			
Curso	Descripción	Crédos	Prerrequisitos/Corequisitos
*MATE 3031	Cálculo I	4	MATE 3005 ó MATE 3143 ó MATE 3172 ó MATE 3174
QUIM 3131	Química General I	3	
QUIM 3133	Laboratorio de Química General I	1	
**INGL 3---	Inglés de Primer Año	3	
ESPA 3101	Español Básico I	3	
CIIC 3XXX Ó COMP 3010	Introducción a la Programación de Computadoras I	3	MATE 3005 ó MATE 3173 ó MATE 3171
EDFI ----	Electiva en Educación Física	1	
	Total	18	
Segundo Semestre			
MATE 3032	Calculo II	4	MATE 3031
QUIM 3132	Química General II	3	QUIM 3131
QUIM 3134	Laboratorio de Química General II	1	QUIM 3133
**INGL 3---	Inglés de Primer Año	3	
ESPA 3102	Español Básico II	3	ESPA 3101
CIIC 3XXX	Fundamentos de Computación	3	COMP 3010 o CIIC 3XXX (Introducción a la Programación de Computadoras I)
EDFI ----	Electiva en Educación Física	1	
	Total	18	

Segundo Año			
Primer Semestre			
Curso	Descripción	Crédts	Prerrequisitos/Corequisitos
MATE 3063	Calculo III	3	MATE 3032
FISI 3171	Física I	4	MATE 3031 ó MATE 3183
FISI 3173	Laboratorio de Física I	1	MATE 3171 (correquisito)
INGE 3011	Gráficos de Ingeniería	2	
CIIC 4XXX	Programación Avanzada	4	COMP 3010 o CIIC 3XXX (<i>Introducción a la Programación de Computadoras I</i>)
**INGL 3---	Inglés de Segundo Año	3	
	Total	17	
Segundo Semestre			
MATE 4009	Ecuaciones Diferenciales Ordinarias	3	MATE3063
FISI 3172	Física II	4	FISI3171
FISI 3174	Laboratorio de Física II	1	FISI3173
CIIC 4XXX	Estructuras de Datos	4	CIIC 4XXX (<i>Programación Avanzada</i>)
**INGL 3---	Inglés de Segundo Año	3	MATE3063
INEL 3105	Análisis de Sistemas Eléctricos I	3	MATE 3032 ó MATE 3184, y FISI 3172 (correquisito) y MATE 3063
INEL 4115	Laboratorio de Medidas Eléctricas	1	INEL 3105 (correquisito)
	Total	19	

Tercer Año			
Primer Semestre			
Curso	Descripción	Crédts	Prerrequisitos/Corequisitos

CIIC 4XXX	Análisis y Diseño de Algoritmos	3	[ICOM 4035 o CIIC 4XXX (<i>Estructuras de Datos</i>)] y CIIC 3XXX (<i>Fundamentos de Computación</i>)
INSO 4XXX	Introducción a la Ingeniería de Software	3	ICOM 4035 o CIIC 4XXX (<i>Estructuras de Datos</i>)
CIIC 3XXX	Arquitectura de Computadoras I	3	
ININ 4010	Probabilidad y Estadística para Ing.	3	MATE 3032 ó MATE 3184 y CIIC 3XXX ó INGE 3016 (<i>Introducción a la Programación de Computadoras I</i>)
CIIC 4XXX	Lenguajes de Programación	3	ICOM 4035 o CIIC 4XXX (<i>Estructuras de Datos</i>)
	Total	15	

Segundo Semestre

INSO 4XXX	Introducción a la Interacción Humano-Computadora	3	ICOM 4009 o INSO 4XXX (<i>Introducción a la Ingeniería de Software</i>)
INSO 4XXX	Requisitos de Ingeniería de Software	3	ICOM 4009 o INSO 4XXX (<i>Introducción a la Ingeniería de Software</i>)
CIIC 4XXX	Arquitectura Computadoras II	3	CIIC 3XXX (<i>Arquitectura de Computadoras I</i>)
ININ 4015	Economía de Ingeniería	3	ININ 4010 ó INI 4011
INME 4045	Termodinámica	3	QUIM 3002, FISI 3172 ó FISI 3162 ó FISI 3012
	Total	15	

Cuarto Año

Primer Semestre

Curso	Descripción	Crédos	Prerrequisitos/Corequisitos
CIIC 4XXX	Sistemas Operativos	4	[ICOM 4035 o CIIC 4XXX (<i>Estructuras de Datos</i>)] y CIIC 4XXX (<i>Arquitectura de Computadoras II</i>)
INGE 3035	Mecánica para Ingeniería	3	MATE 3031 ó MATE 3134 ó MATE 3183 y FISI 3161 ó FISI 3171
INSO 4XXX	Diseño de Software	3	INSO 4XXX (<i>Requisitos de Ingeniería de Software</i>)
-----	Electiva libre	3	

-----	Electiva Socio-humanístico	3	
	Total	16	
Segundo Semestre			
CIIC 4XXX	Sistemas de Bases de Datos	3	CIIC 4XXX (Sistemas Operativos)
CIIC 4XXX	Redes de Computadoras	3	ICOM 5007 o CIIC 4XXX (Sistemas Operativos)
INSO 4XXX	Pruebas de Confiabilidad de Software	3	INSO 4XXX (Diseño de Software)
-----	Electiva Socio-humanístico	3	
-----	Electiva Libre	3	
		15	

Quinto Año			
Primer Semestre			
Curso	Descripción	Crédos	Prerrequisitos/Corequisitos
INSO 4XXX	Proyecto de Ingeniería de Software I	3	INSO 4XXX (Pruebas de Confiabilidad de Software) e INSO 4XXX (Introducción a la Interacción Humano-Computadora)
CIIC ----	Electiva Técnica***	3	
-----	Electiva Socio-humanístico	3	
-----	Electiva Libre	3	
INGL 3191 ó INGL 3250	Curso de Inglés para Oratoria	3	INGL 3--- Inglés de Segundo Año
	Total	15	
Segundo Semestre			
INSO 4XXX	Proyecto de Ingeniería de Software II	3	INSO 4XXX (Proyecto de Ingeniería de Software I)
INGE 3045	Ciencia de Materiales para Ingenieros Electricistas	3	QUIM 3002 y FISI 3162 ó FISI 3171

-----	Electiva Socio-humanístico	3	
-----	Electiva Libre	3	
CIIC ----	Electiva Técnica***	3	
	Total	15	

Total de créditos: 163

* El estudiante debe haber aprobado precálculo previamente

** Hacer referencia a la sección de regulaciones Académicas para información relacionada con Nivel Avanzado (Advanced Placement)

*** Electiva técnica seleccionada según la tabla 8, sección 6.1

6.4 Coherencia y suficiencia curricular

Código Curso	Título	CIIC	INSO
CIIC 3XXX	Introducción a la Programación de Computadoras I	Medular	Medular
CIIC 4XXX	Programación Avanzada	Medular	Medular
CIIC 3XXX	Fundamentos de Computación	Medular	Medular
CIIC 4XXX	Estructuras de Datos	Medular	Medular
CIIC 4XXX	Análisis y Diseño de Algoritmos	Medular	Medular
CIIC 3XXX	Arquitectura de Computadoras I	Medular	Medular
CIIC 4XXX	Arquitectura de Computadoras II	Medular	Medular
CIIC 4XXX	Redes de Computadoras	Medular	Medular
CIIC 4XXX	Lenguajes de Programación	Medular	Medular
CIIC 4XXX	Sistemas de Bases de Datos	Medular	Medular
CIIC 4XXX	Sistemas Operativos	Medular	Medular
INSO 4XXX	Introducción a la Ingeniería de Software	Medular	Medular
CIIC 5XXX	Lenguajes Formales y Autómata	CIIC	Electivo
CIIC 4XXX	Computación de Alto Rendimiento	CIIC	Electivo
INSO 4XXX	Introducción a la Interacción Humano – Computadora	Electivo	INSO
INSO 4XXX	Requisitos de Ingeniería de Software	Electivo	INSO
INSO 4XXX	Diseño de Software	Electivo	INSO
INSO 4XXX	Pruebas de Confiabilidad de Software	Electivo	INSO
INSO 4XXX	Proyecto de Ingeniería de Software I	Electivo	INSO
INSO 4XXX	Proyecto de Ingeniería de Software II	Electivo	INSO
CIIC 5XXX.	Administración y Seguridad de Sistemas y Redes	Electivo	Electivo
CIIC 5XXX	Criptografía y Seguridad de Redes	Electivo	Electivo
INSO 4XXX	Administración de Proyectos de Software	Electivo	Electivo
INSO 4XXX	Investigación Subgraduada en Ingeniería de Software	Electivo	Electivo
CIIC 5XXX	Temas Selectos	Electivo	Electivo
CIIC 4XXX	Investigación Subgraduada	Electivo	Electivo
CIIC 5XXX	Inteligencia Artificial	Electivo	Electivo
CIIC 5XXX	Desarrollo de Compiladores	Electivo	Electivo

Tabla 9: Cursos incluyendo las electivas técnicas recomendadas

Leyenda:

Medular: Medular para ambos grados

CIIC: Medular para Ciencias e Ingeniería de la Computación

INSO: Medular para Ingeniería de Software

Electivo: Electivo para grado correspondiente

6.5 Metodologías educativas

La metodología educativa está alineada con la filosofía educativa del programa y dirigida específicamente a cumplir con los objetivos del programa propuesto. Se utilizarán conferencias regulares, trabajo independiente, aprendizaje en colaboración y trabajo en equipo. La capacidad de trabajo individual será estimulada mediante asignaciones y preparación de informes, en algunos cursos. La capacidad de trabajo en equipo y de aprendizaje en colaboración, será incentivada y evaluada a través de proyectos que, por su complejidad, demanden la efectiva colaboración entre varios estudiantes. En particular, se proveerán actividades de aprendizaje que simulen efectivamente procesos de producción industrial y amplíen la visión global del estudiante sobre el proceso de desarrollo de un producto. Se entrenará a los estudiantes en el uso de herramientas aplicadas al desarrollo de programación mediante sesiones de laboratorio conducidas por el profesor o un ayudante de cátedra cualificado.

6.6 Plan de avalúo del aprendizaje estudiantil

En términos generales, el estilo de enseñanza enfatizará el aprendizaje individual y activo por sobre la enseñanza pasiva. Los estudiantes serán continuamente incitados a pensar individualmente y criticar sus propias soluciones. Se promoverá el trabajo en equipo y el aprendizaje en grupo, incluyendo el uso efectivo de tecnologías de comunicación para la interacción entre los estudiantes y sus pares.

De manera periódica se medirá el desempeño de los estudiantes y se analizarán los resultados con el objeto de determinar el grado en que el currículo está satisfaciendo los objetivos del programa. El análisis crítico de estos datos nos permitirá determinar, entre otras cosas:

- a. Si los cursos incluyen los tópicos apropiados.
- b. Si las actividades académicas en cada curso son las adecuadas.
- c. Si las facilidades físicas con las que contamos para satisfacer las exigencias de cada curso son las adecuadas.
- d. Si los requerimientos de admisión vigentes son los adecuados.

Este análisis servirá para identificar deficiencias tanto en la modalidad de enseñanza, los contenidos, o en la infraestructura física en que se apoya el programa.

El desempeño de los graduados será también evaluado, con el objeto de determinar el impacto efectivo del programa en el mercado laboral. El análisis de estos resultados servirá para alinear los contenidos programáticos, estilos de enseñanza e infraestructura con las exigencias del mercado laboral. Resulta también de alta importancia para el programa que sus administradores conozcan la opinión de todas aquellas agencias, compañías u organizaciones con la que los estudiantes hayan tenido alguna relación de trabajo o académica, tales como internados de verano, programas COOP, programas de intercambio, entre otros.

Tanto la recopilación de los datos como su análisis se harán anualmente. Los datos se recopilarán mediante encuestas y cuestionarios administrados en contacto directo, o por vía telefónica, o por medios electrónicos.

Estos estudios se llevarán a cabo a partir del primer año de implantación del programa, aunque solo a partir del sexto en adelante se tendrá suficiente información como para evaluar todos y cada uno de los aspectos antes enunciados.

6.7 Prontuarios de los cursos

Se incluye en prontuario de los cursos, siguiendo la Certificación 130 y los requerimientos de ABET.

NOTA: Todos los cursos siguen el formato de notas cuatificable en base letras ("Quantifiable(letters)"). Las letras son:

- A – Excelente
- B – Bueno
- C – Promedio
- D – Deficiente
- F – Fracasado
- W – Baja
- S – Satisfactorio
- NS – No Satisfactorio

University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachelor of Science in Computer Science and Engineering
Bachelor of Science in Software Engineering

Course Syllabus

1. General Information:
Alpha-numeric codification: CIIC 3XXX
Course Title: Fundamentals of Computing
Number of credits: 3
Contact Period: 3 hours of lecture per week
2. Course Description:
English: Discrete structures in computer sciences and engineering with emphasis on problem-solving skills and algorithms. Topics include: set theory, logic and proof techniques, graph theory, computability, and discrete probability applied to computing problems.
Spanish: Estructuras discretas en ciencia de computación e ingeniería con énfasis en destrezas de solución de problemas y algoritmos. Los temas incluyen: teoría de conjuntos, lógica y técnicas de demostración, teoría de grafos, computabilidad y probabilidad discreta aplicada a problemas de computación
3. Pre/Co-requisites and other requirements:
Pre-requisite: COMP 3010 or CIIC 3XXX (Introduction to Computer Programming I)
4. Course Objectives:

Students will learn the fundamental mathematical and logical concepts and algorithms used in the modeling and analysis of computing systems.

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 Departmental facilities to complete course homeworks.

7. Course time frame and thematic outline

Outline	Contact Hours
Logical staments and predicates	3
Proof techniques	4
Sets and set operations	2
Ordered structures: tuples and lists,	4
Counting formulas and techniques	3
Graphs and trees	4
Relations and functions	4
Equivalence relations	2
Order relations	2
Topological sorting and well-founded orders	3
Inductively defined sets	2
Recursive functions	4

Proofs by induction	4
Tests	4
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	65%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input checked="" type="checkbox"/> Short Quizzes	variable	10%
Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
Projects		
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Kenneth H. Rosen, *Discrete Mathematics and Its Applications: And Its Applications* , 6th Ed., McGraw-Hill, 2006.

Susanna S. Epp, *Discrete Mathematics with Applications* , 3rd Ed. , Bruce Cole, 2003.

John A. Dossey, Albert D. Otto, Lawrence E. Spence, and Charles Vanden Eynden, *Discrete Mathematics (5th Edition)*, Addison-Wesley, 2005.

Norman L. Biggs , *Discrete Mathematics*, Oxford University Press, 2003.

11. According to Law 51

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University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachelor of Science in Computer Science and Engineering
Bachelor of Science in Software Engineering

Course Syllabus

1. General Information:
Alpha-numeric codification: CIIC 4XXX Course Title: Analysis and Design of Algorithms Number of credits: 3 Contact Period: 3 hours of lecture per week
2. Course Description:
English: Study of methods and techniques for the complexity analysis of computer algorithms. Design of new algorithms capable of minimizing execution time while optimizing the use of computer resources. Topics include: asymptotic analysis, greedy strategies, divide and conquer, dynamic programming, backtracking, and graph, search, and sorting algorithms.
Spanish: Estudio de métodos y técnicas para el análisis de la complejidad de algoritmos computacionales. Diseño de nuevos algoritmos capaces de minimizar el tiempo de ejecución y optimizar el uso de recursos computacionales. Los temas incluyen: análisis asintótico, estrategias ambiciosas, división y conquista, programación dinámica, “backtracking” y algoritmos de grafos, búsqueda y ordenamiento.
3. Pre/Co-requisites and other requirements:
Prerequisites: [ICOM 4035 or CIIC 4XXX (Data Structures)] and CIIC 3XXX (Fundamentals of

Computing)

4. Course Objectives:

Students will learn the techniques to analyze algorithms, and how chose the best algorithm for a particular problem based on the performance behavior obtained from an algorithmic analysis.

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
Mathematical background: recurrences, bounding sums, asymptotic analysis.	6
Design Techniques: Divide and Conquer, Dynamic Programming, Greedy Search, Branch and Bound,	8
Search Structures: Heaps, Balanced Trees, Hashing	8
Amortized Analysis and Data Structures: Fibonacci Heaps and Disjoints sets.	6
Graph Algorithms: search, shortest paths and flow problems	8
Intractability and NP-Completeness	6
Exams and discussions	3

Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	60%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	variable	15%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Anany V. Levitin, *Introduction to the Design and Analysis of Algorithms*, 2nd Ed. Addison-Wesley, 2006.

Jon Kleinberg, Éva Tardos, *Algorithm Design*, Addison-Wesley, 2005.

Sanjoy Dasgupta, Christos H. Papadimitriou, and Umesh Vazirani *Algorithms*, McGrawHill, 2006

T. Cormen, C. Leiserson, R. Rivest. C. Stein, *Introduction to Algorithms.*, 2nd ed., McGraw-Hill, 2001.

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University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachelor of Science in Electrical Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: CIIC 4XXX

Course Title: Computer Networks

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: Study and development of skills required for the design of network protocols and network-centric applications, with emphasis on Internet protocols. Topics include: the ISO layered model, TCP/IP, routing, client-server model, World Wide Web, and Web Services. Practice with analysis and programming problems.

Spanish: Estudio y desarrollo de destrezas para el diseño de protocolos y aplicaciones orientadas a redes computacionales, con énfasis en protocolos utilizados en la Internet. Los temas incluyen: el modelo estratificado ISO, TCP/IP, establecimiento de rutas, modelo cliente-servidor, World Wide Web y "Web Services". Práctica con problemas de análisis y programación.

3. Pre/Co-requisites and other requirements:

Pre-requisite ICOM 5007 or CIIC 4XXX (Operating Systems) .

4. Course Objectives:

Students will learn about the Fundamental protocols for network design, implementation and testing. They will design secure network systems and analyze the performance of communication protocols.

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 homeworks.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to Computer Networks	4
The Physical Layer	4
The Data Link Layer	8
The Medium Access Control Sublayer	7
The Network Layer	6
The Transport Layer	6
The Application Layer	2
Network Security	3

Review	3
Exam	2
Total hours: (equivalent to contact period)	45

8. Grading System
 Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	2	40%
<input checked="" type="checkbox"/> Final Exam	1	30%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input type="checkbox"/> Projects		
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Homework	variable	30%
TOTAL:		100%

10. Bibliography:

James F. Kurose, Keith W. Ross ,“Computer Networking: A Top-Down Approach Featuring the Internet”, 3rd Ed. Morgan-Kaufmann, 2004

Larry L. Peterson and Bruce S. Davie , *Computer Networks, Fourth Edition: A Systems Approach* Morgan Kaufmann, 2007.

Douglas E Comer and Ralph E. Droms , *Computer Networks and Internets, Fourth Edition*, Prentice Hall, 2003.

Andrew S. Tanenbaum, “Computer Networks,” Forth Edition, Prentice Hall, 2002.

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University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachelor of Science in Computer Science and Engineering
Bachelor of Science in Software Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: CIIC 3XXX

Course Title: Introduction to Computer Programming I

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: Analysis of algorithmic problems, development of solutions, and their implementation in a high level programming language using object-oriented programming techniques. Topics: Numerical systems, internal representation, constants, variables, and data types, selection and iteration control structures, functions and data passing mechanisms, basic data structures, pointers, and dynamic memory management, Data input/output and files, Software development environments.

Spanish: Análisis algorítmico de problemas, desarrollo de soluciones, y su implementación en un lenguaje de programación orientado a objetos. Temáticas: sistemas numéricos, representación interna, constantes, variables, tipos de datos, estructuras de control e iteración, funciones, métodos para paso de parámetros, estructuras de datos básicas, apuntadores, archivos, y sistemas de desarrollo de software.

3. Pre/Co-requisites and other requirements:	
None	
4. Course Objectives:	
Students will get an overview of the computing discipline by studying introductory, but fundamental, topics that are needed for future courses in the program and by every professional in the discipline.	
5. Instructional Strategies:	
<input checked="" type="checkbox"/> conference <input type="checkbox"/> discussion <input checked="" type="checkbox"/> computation <input type="checkbox"/> laboratory <input type="checkbox"/> seminar with formal presentation <input type="checkbox"/> seminar without formal presentation <input type="checkbox"/> workshop <input type="checkbox"/> art workshop <input type="checkbox"/> practice <input type="checkbox"/> trip <input type="checkbox"/> thesis <input type="checkbox"/> special problems <input type="checkbox"/> tutoring <input type="checkbox"/> research <input type="checkbox"/> 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 Computing	5
Software Development Process and environments	4
Data Types and Representation	4
Operations and Expressions	4
Flow Control	4
Functions	4
Objects and Classes	4
Files and I/O Streams	3

Arrays and Vectors	2
Classes and ADT	4
Pointers and Dynamic Memory	4
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	50%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	variable	25%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Tony Gaddis and Barret Krupnow, *Starting out with C++ Brief*, 5 Ed., Addison Wesley, 2007.

Kari Laitinen, *A Natural Introduction to Computer Programming With C++*, Trafford, 2003.

Diane Zak, *An Introduction to Programming With C++*, Fifth Edition, ,Course Technology, 2007.

Joel Adams, Larry R. Nyhoff, Larry Nyhoff, *C++:An Introduction to Computing*, Prentice Hall; 3rd edition, 2002

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University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachelor of Science in Computer Science and Engineering
Bachelor of Science in Software Engineering

Course Syllabus

1. General Information:
Alpha-numeric codification: CIIC 4XXX
Course Title: Advanced Programming
Number of credits: 4
Contact Period: 3 hours of lecture and 2 hours of laboratory per week
2. Course Description:
English: Advanced programming techniques applied to the solution of engineering problems;extensive use of subprograms,logical and specifications statements. Principles of multiprogramming, multiprocessing,and real-time systems.
Spanish: Estudio de técnicas avanzadas de programación aplicadas a la solución de problemas en ingeniería; uso extensivo de subprogramas, descripciones lógicas y de especificaciones. Principios de multiprogramación, mutiprocésamiento y sistemas "real-time".
3. Pre/Co-requisites and other requirements:
Pre-requisite: CIIC 3XXX or COMP 3010 (Introduction to Computer Programming I)
4. Course Objectives:
The student will learn how to use sub-routines, arrays, classes, and other object-oriented

techniques for the design, implementation and analysis of complex software systems used in Computer Science, Computer Engineering and Software Engineering.

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: Discussion of the organization of the course, general view of the topics to be covered, and ethical behavior of the computing professional.	1
Introduction to Computing: Introduction to the computer language to be used, and how to get it.. General format of a computer program, compilation and execution of a program, and recognition of errors.	1.5
Fundamental Data Types, Operations, Expressions, and I/O: The numeric data types, strings, characters, and booleans. Variables, constants and literals of each of these primitive data types. The assignment statement, mathematical expressions, mathematical functions, type conversions, and comparison between primitive data types and objects. The String data type. Text based I/O.	2.5
Decisions: Review the topic of decisions in programs, this time in the context of the programming language used. We study selection constructs, the <i>if-statement</i> and the <i>switch-statement</i> . We also study about Boolean expressions and grouping of statements in a	1.5

program.	
Iteration: Review the topic of iterations in programs, the <i>while</i> and <i>for loops</i> .	1.5
Functions: Review of functions in a program, by-reference and by-value parameters, returning values, the activation record. Use of functions in procedural abstractions.	3
Arrays: Introduction to arrays – one-dimension and two-dimensional arrays. Different applications and typical operations with these structures are discussed.	3
Introduction to ADTs: Study of the concept of ADT and their application in describing new data types. The following ADTs are studied: Strings and lists. Different applications are discussed.	3
Object-Oriented Concepts: Study of objects, classes, interfaces, inheritance, virtual functions, polymorphism, and language constructs for their support. Emphasis is given to their application in the implementation of ADT's.	4
Object Oriented Design: Study of the object-oriented techniques applied to the software development process. In particular: the software life cycle, discovery of classes and member functions, cohesion and coupling, UML class diagrams, modularization, and the development of complex programs.	4
Input/Output and File Management: File operations, streams, conversions, sequential files, and random access files. Application in databases.	3
Recursive Algorithms: Study of recursion, the implementation mechanisms commonly used in programming languages, and its use in deriving algorithmic solutions to problems. Particular cases are studied: iteration by recursion and exhaustive searches.	3
Sorting Algorithms: Sorting algorithms for array-based containers; selection-sort, merge-sort, and quick-sort. Comparison of performance.	4
Searching Algorithms: Study of search algorithms over data containers based on arrays – sequential and binary search.	3

Introduction to the Analysis of Algorithms: Complexity issues in data structures and algorithms: correctness, execution time, and space requirements. Asymptotic notation. Particular algorithms are analyzed in sorting and searching.	4
Exams and discussions	3
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	35%
<input checked="" type="checkbox"/> Final Exam	1	30%
<input checked="" type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	4	25%
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Laboratory	10	10%
TOTAL:		100%

10. Bibliography:

Cay Horstmann, *Java Concepts* (4th Edition) John Wiley, 2005

Walter Savitch, *Absolute Java with Student Resource Disk, 2/E*, Addison-Wesley, 2006.

David Riley, *Object of Java, The: Introduction to Programming Using Software Engineering Principles, 2/E*, Addison-Wesley, 2006.

Paul T.Tymann and G. Michael Schneider, *Modern Software Development Using Java*, Thomson Brooks/Cole, 2004

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University of Puerto Rico
Mayagüez Campus
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Bachelor of Science in Computer Science and Engineering
Bachelor of Science in Software Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: CIIC 3XXX

Course Title: Computer Architecture I

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: Study of fundamental concepts of logic circuit analysis and design with the aim of understanding and designing the main components of a modern processor. Topics include: Boolean algebra, logic gates, combinational and sequential circuits, arithmetic logic units (ALU), memory and programmable logic devices, data paths, and control units. Practice with logic circuit design problems.

Spanish: Estudio de conceptos fundamentales para el análisis y diseño de circuitos lógicos con el objetivo de entender y diseñar los componentes principales de un procesador moderno. Los temas incluyen: álgebra Booleana, compuertas lógicas, circuitos combinatorios y secuenciales, unidades lógicas aritméticas (ALU), memoria y dispositivos lógicos programables, vías de datos y unidades de control. Práctica con problemas de diseño de componentes lógicos.

3. Pre/Co-requisites and other requirements:

Pre-requisites: CIIC 3XXX (Introduction to Computer Programming I) or COMP 3010

4. Course Objectives:

Students will learn the basic techniques to understand and design logic circuits. Using this knowledge, students will design basic computer components such as logic gates, ALUs, memory banks, and a CPU.

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
Combinational logic circuits analysis	6
Combinational logic design	5
Sequential circuit analysis	5
Sequential circuit design	5
Memory and programmable logic devices	7
Register transfers and datapaths	7
Control Unit design	7
Exams and discussions	3

Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	45%
<input checked="" type="checkbox"/> Final Exam	1	30%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	variable	25%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

M. Morris Mano, Charles R. Kime, "Logic and Computer Design Fundamentals" 3rd. Ed., Prentice Hall, 2003.

John F. Wakerly, *Digital Design: Principles and Practices Package (4th Edition)*, Prentice Hall, 2005.

M. Morris Mano, Michael Ciletti, "Digital Design", 4th Ed., Prentice Hall, 2006.

Randy H. Katz, Gaetano Borriello, *Contemporary Logic Design (2nd Edition)* , Prentice Hall, 2004.

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University of Puerto Rico
Mayagüez Campus
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Bachelor of Science in Computer Science and Engineering
Bachelor of Science in Software Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: CIIC 4XXX
Course Title: Computer Architecture II
Number of credits: 3
Contact Period: 3 hours of lecture per week

2. Course Description:

English: Study of fundamental computer architecture concepts with the objective of designing efficient processors and computing systems to support operating systems and high-level programming languages. Topics include: subroutines, exceptions, input/output, pipelining, and hierarchical memories. Practice with analysis, design, and programming problems.

Spanish: Estudio de conceptos fundamentales de arquitectura de computadoras con el objetivo de diseñar procesadores y sistemas computacionales eficientes para apoyar sistemas operativos y lenguajes de programación de alto nivel. Los temas incluyen: subrutinas, excepciones, entrada/salida, "pipelining" y memorias jerárquicas. Práctica con problemas de análisis, diseño y programación.

3. Pre/Co-requisites and other requirements:

Pre-requisite: CIIC 3XXX (Computer Architecture I)

4. Course Objectives:

Students will learn the techniques necessary to evaluate and design computing systems that satisfy the requirements of modern operating systems and programming languages.

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
Instruction sets	7
Machine code and assembly language	6
Memory hierarchy	4
Pipelining	6
Input/Output system	6
Computer Arithmetic	6
Architectural support for operating systems and programming languages	7
Exams and discussions	3

Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	1	45%
<input checked="" type="checkbox"/> Final Exam	1	30%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	variable	25%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

David Patterson, John Hennessy, *Computer Organization and Design: The Hardware/Software Interface, 3rd Ed*, Morgan-Kaufmann, 2004.

Andrew S. Tanenbaum, *Structured Computer Organization (5th Edition)* , Prentice Hall, 2005.

Miles J. Murdocca and Vincent P. Heuring , *Computer Architecture and Organization: An Integrated Approach*, Wiley, 2007.

William Stallings, *Computer Organization and Architecture, 7th Ed.*, Prentice Hall, 2005.

11. According to Law 51

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University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachelor of Science in Computer Science and Engineering
Bachelor of Science in Software Engineering

Course Syllabus

1. General Information:
Alpha-numeric codification: CIIC 4XXX
Course Title: Data Structures
Number of credits: 4
Contact Period: 3 hours of lecture and 2 hours of laboratory per week
2. Course Description:
English: Data structures in programming languages; representation of information as data; lists in linear, orthogonal, string, and array form; tree structures; techniques for storage allocation, distribution, collection, and sorting of data.
Spanish: Estructuras de datos en lenguajes de programación; representación de información en forma de datos; listas de forma lineal, ortogonal, en sucesión y en arreglo; estructuras tipo árbol; técnicas para el almacenamiento, la distribución, la recolección y el
3. Pre/Co-requisites and other requirements:
Pre-requisite: CIIC 4XXX (Advanced Programming)
4. Course Objectives:
Students will learn how to implement fundamental data structures such as linked lists, hash

tables, and trees. Using this knowledge, students will write programs whose major components are built using the data structures previously implemented.

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
Review of arrays, pointers, classes, inheritance and templates	3
Container classes: Vector, Bag, and Set	3
Discrete Mathematics: Induction and Basic Set Theory	2
Computational Complexity	3
Linked Lists	3
Stacks	2
Queues	2
Trees	5
Binary Search Trees	3
AVL-trees	2
B-trees	2
Maps and Hash Tables	3

Heaps and Priority Queues	3
Graphs and their implementation	2
Graph Traversal Algorithms	2
Sorting	2
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	45%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	variable	30%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Michael T. Goodrich, Roberto Tamassia, "Data Structures and Algorithms in Java", John Wiley

and Sons, 2005.

Mark Allen Weiss , *Data Structures and Problem Solving Using Java (3rd Edition)* , Addison-Wesley, 2005.

Frank M. Carrano, "*Data Structures and Abstractions with Java*", 2nd Ed, Addison-Wesley, 2006.

William H. Ford and William R. Topp , *Data Structures with Java*, Prentice Hall, 2004.

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University of Puerto Rico
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College of Engineering
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Bachelor of Science in Software Engineering

Course Syllabus

1. General Information:
Alpha-numeric codification: CIIC 4XXX
Course Title: Programming Languages
Number of credits: 3
Contact Period: 3 hours of lecture per week
2. Course Description:
English: Comparative study of programming styles, including imperative, object-oriented, functional, logic, and concurrent programming. Concepts of data encapsulation and inheritance. Formal specification of the syntactic structure of a language. Context-free grammars and parse trees.
Spanish: Estudio comparativo de paradigmas de programación que incluye programación imperativa, de objetos, funcional, lógica y concurrente; encapsulación de datos y herencia; especificación formal de la estructura sintáctica de un lenguaje; gramáticas de contexto libre y árboles sintácticos.
3. Pre/Co-requisites and other requirements:
Pre-requisites: ICOM 4035 or CIIC 4XXX (Data Structures)

4. Course Objectives:

Students will learn how to classify programming languages based on their underlying structures and judge their efficiency for a given application.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction	1
DFA and NFA	4
Syntactic structure	5
Imperative programming	6
Object-oriented programming	6
Functional programming	6
Logic programming	6
Concurrent programming	6
Final presentations	3
Exams	2

Total hours: (equivalent to contact period)	45

8. EGrading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	2	25%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input type="checkbox"/> Short Quizzes		
<input checked="" type="checkbox"/> Oral Reports	3	25%
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	variable	25%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Michael L. Scott , *Programming Language Pragmatics*, 2nd Ed. , Morgan Kaufmann, 2005.

Kenneth C. Louden , *Programming Languages: Principles and Practice, Second Edition: Principles and Practice*, Course Tecnology, 2002.

Benjamin C. Pierce , *Types and Programming Languages*, MIT Press, 2002.

Robert W. Sebesta, *Concepts of Programming Languages*, 6th Ed., Pearson, 2004.

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Course Syllabus

1. General Information:
Alpha-numeric codification: CIIC 4XXX
Course Title: Operating Systems
Number of credits: 4
Contact Period: 3 hours of lecture and three hours of laboratory per week
2. Course Description:
English: Study of operating systems, multiprogramming, multiprocessing, batch, partitioned, and real time processing; organization and processing of file systems; queuing theory and information flow control.
Spanish: Estudio de sistemas operativos, multiprogramación, multiprocesamiento, procesamiento por lotes, por tiempo compartido y por tiempo real; organización y manejo de sistemas de archivo; teoría de colas y control de flujo de información.
3. Pre/Co-requisites and other requirements:
Pre-requisites: [ICOM 4035 or CIIC 4XXX (Data Structures)] and CIIC 4XXX (Computer Architecture II).

4. Course Objectives:

Students will gain an understating of the various modules in an operating system, and their relationship with he underlying computer architecture. In addition, students will design and implement various software modules for a simple operating system.

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: project

6. Minimum or Required Resources Available:

Students will use Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction: operating system structures and function	1.5
Processes, threads, and concurrency:	9
Memory management and virtual memory	4.5
CPU scheduling	3
I/O management and the disk block cache	3
File systems	3
Distributed processing and network implementation	9
Security issues	3
Project in-class reports (definition and requirements, design, implementation and verification)	6
Exams and discussions	3

Laboratory sessions (45 hours equivalent)	45 laboratory
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	45%
<input checked="" type="checkbox"/> Final Exam	1	15%
<input type="checkbox"/> Short Quizzes	variable	10%
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	15%
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: laboratory, oral and written reports are included in projects	10	25%
TOTAL:		100%

10. Bibliography:

Andrew S Tanenbaum, Albert S Woodhull, "Operating Systems Design and Implementation, 3rd Edition, Prentice Hall, 2006.

William Stallings , *Operating Systems: Internals and Design Principles (5th Edition)* , Prentice Hall, 2004.

Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne, "Operating System Concepts", 7th

Ed., John Wiley, 2004.

William S. Davis and T.M. Rajkumar , *Operating Systems: A Systematic View (6th Edition)*
Addison-Wesley, 2004.

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Course Syllabus

1. General Information:
Alpha-numeric codification: CIIC 4XXX
Course Title: Database Systems
Number of credits: 3
Contact Period: 3 hours of lecture per week
2. Course Description:
English: Study of database system architectures; design and implementation of database applications; conceptual and representational models; SQL and the relational model; functional dependencies and normalization; transaction processing.
Spanish: Estudio de arquitecturas de sistemas de bases de datos; diseño e implantación de aplicaciones de bases de datos; modelos conceptuales y representacionales; SQL y el modelo relacional; dependencias funcionales y normalización; procesamiento de transacciones.
3. Pre/Co-requisites and other requirements:
Prerequisite CIIC 4XXX (Operating Systems)
4. Course Objectives:
Students will learn how to develop database applications, starting with the E-R model, then

mapping it to the relational model, and implementing this latter model with an application. Students will also gain an understanding of basic database management systems architectures.

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 Database Systems and DBMS Architectures	2
Web-based Application Development for Databases	3
E-R Model and UML	5
Relational Model and Algebra	6
E-R to Relational Mappings	2
Structured Query Language (SQL)	6
Normalization and Integrity	3
Storage and File Systems	3
Indexing and Access Methods	2
Query Evaluation and Optimization	3
Transaction Processing	5
Concurrency Control	2

Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	45%
<input checked="" type="checkbox"/> Final Exam	1	20%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	variable	35%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, Database Systems Concepts, 5th Ed., McGraw-Hill, 2005

Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 5th Ed.

Addison-Wesley, 2006.

Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill,

2002.

C.J. Date, *An Introduction to Database Systems*, Eighth Edition, Addison-Wesley, 2003.

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Bachelor of Science in Software Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INSO 4XXX

Course Title: Introduction to Software Engineering

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: Introduction to the software development cycle. Models for the software development process and related metrics. Ethical issues in software engineering.

Spanish: Introducción a las actividades del ciclo de desarrollo de software. Modelos de procesos de desarrollo de software y métricas relacionadas. Aspectos éticos en la ingeniería de software.

3. Pre/Co-requisites and other requirements:

Pre-requisites: ICOM 4035 or CIIC 4XXX (Data Structures).

4. Course Objectives:

Students will develop skills for the analysis, design, coding, testing and documentation of software systems, using an object-oriented framework.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to the course	1
The Software Lifecycle	3
Estimation: Cost, effort and agenda	3
Planning and tracking	3
Risk analysis and management	2
User Interface design	1
UML language	4
Requirements analysis and specification	5
Design principles and concepts, system design testing	6
Software testing	4
Exams, lab sessions, and discussion	13
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	30%
<input checked="" type="checkbox"/> Final Exam	1	15%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	40%
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Homeworks	variable	15%
TOTAL:		100%

10. Bibliography:

Plfeeger, S.L. and Atlee, J.M., "Software Engineering, Theory and Practice", 3rd Ed., Prentice Hall, 2006

Bernd Bruegge and Allen H. Dutoit , *Object-Oriented Software Engineering: Using UML, Patterns and Java, Second Edition*, Prentice Hall, 2003.

Ian Sommerville, *Software Engineering (8th Edition)* , Addison-Wesley, 2006.

Carlo Ghezzi, Mehdi Jazayeri, and Dino Mandrioli , *Fundamentals of Software Engineering (2nd Edition)* , Prentice Hall, 2002.

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Course Syllabus

1. General Information:
Alpha-numeric codification: INSO 4XXX
Course Title: Software Project Management
Number of credits: 3
Contact Period: 3 hours of lecture per week
2. Course Description:
English: Discussion of techniques and tools for estimation, planning, monitoring, documentation, evaluation, refinement, and quality control of software. Development of skills for the effective administration of complex software engineering projects. Practice in project administration.
Spanish: Discusión de técnicas y herramientas de estimación, planificación, verificación, documentación, evaluación, refinamiento y control de calidad de software. Desarrollo de destrezas para la administración efectiva de proyectos complejos de ingeniería de software. Práctica en la administración de proyectos.
3. Pre/Co-requisites and other requirements:
Pre-requisites: ICOM 4009 or INSO 4XXX (Introduction to Software Engineering)

4. Course Objectives:

Students will learn how to plan and manage a software development project, including practical experience with budget analysis, software requirements analysis, software design, implementation and testing.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction	1
Overview of software project planning	2
Software project evaluation	6
Development process models	3
Effort estimation	6
Project planning	8
Risk management	3
Resource allocation	3
Monitoring and control	5
Contract management	2

Personnel management	2
Software quality standards	2
Exams	2
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	2	40%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	35%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Bob Hughes and Mike Cotterrel, *Software Project Management*, 4th Ed. , McGraw Hill, 2005.

Andrew Stellman and Jennifer Greene , *Applied Software Project Management* , O'Reilly, 2005.

Robert K. Wysocki, *Effective Software Project Management* , John Wiley, 2006.

Richard Bechtold , *Essentials of Software Project Management*, Management Concepts, 2007.

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Course Syllabus

1. General Information:
Alpha-numeric codification: INSO 4XXX Course Title: Introduction to Human-Computer Interaction Number of credits: 3 Contact Period: 3 hours of lecture per week
2. Course Description:
English: Introduction to the principles of human-computer interaction with the objective of developing the skills necessary to design and implement graphical user interfaces (GUI). Topics include: cognitive psychology, human factors, and interaction styles. Practice in designing and evaluating the usability of various graphical user interfaces.
Spanish: Introducción a los principios de interacción entre los seres humanos y las computadoras con el objetivo de desarrollar las habilidades necesarias para el diseño e implantación de interfaces gráficas (GUI). Los temas incluyen: psicología cognoscitiva, factores humanos y estilos de interacción. Práctica en el diseño y evaluación de uso de varias interfaces gráficas.
3. Pre/Co-requisites and other requirements:
Pre-requisite: ICOM 4009 or INSO 4XXX (Introduction to Software Engineering)

4. Course Objectives:

Students will learn how to build ergonomically-centered graphical user interfaces (GUIs) and also learn how humans react to various modalities of computer usage.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Cognitive psychology	6
Human factors	10
Interaction Styles	10
Task analysis	6
GUI development tools	6
Usability evaluation methods	5
Exams and discussions	2
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	2	35%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	40%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Ben Shneiderman and Catherine Plaisant, *Designing the User Interface: Strategies for Effective Human-Computer Interaction*, 4th Ed., Addison-Wesley, 2004.

Dov Te'eni, Jane M. Carey, and Ping Zhang, *Human-Computer Interaction: Developing Effective Organizational Information Systems*, Wiley, 2006.

Alan Dix, Janet E. Finlay, Gregory D. Abowd, and Russell Beale, *Human-Computer Interaction*, 3rd Ed., Prentice Hall, 2003.

Helen Sharp, Yvonne Rogers, and Jenny Preece, *Interaction Design: Beyond Human-Computer Interaction*, Wiley, 2007.

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Course Syllabus

1. General Information:

Alpha-numeric codification: INSO 4XXX

Course Title: Software Engineering Requirements

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: Techniques used to determine the requirements of a complex software system: specification standards, the UML language, validation, specification management tools, and quality metrics. Elicitation and development of software system requirements. Discussion of ethical issues arising during requirements elicitation.

Spanish: Técnicas utilizadas para determinar los requisitos de un sistema complejo de software: estándares de especificación, lenguaje UML, validación, herramientas para manejo de especificaciones y métricas de calidad. Recopilación y desarrollo de requisitos de sistemas de software. Discusión de aspectos éticos que surgen durante la recopilación de requisitos.

3. Pre/Co-requisites and other requirements:

Pre-requisites: ICOM 4009 or INSO 4XXX (Introduction to Software Engineering)

4. Course Objectives:

Students will learn the techniques used to gather the requirements for a software system, and will put in use these skills by completing a semester long project.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction	1
Requirements engineering process	3
Requirements analysis	6
Requirements elicitation	12
Requirements specification	10
Scope and change management	4
Quality metrics	3
Validation and verification	2
Exams and discussions	4

Total hours: (equivalent to contact period)	45
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8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	2	35%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	40%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Dean Leffingwell and Don Widrig, *Managing Software Requirements: A Use Case Approach*, 2nd Ed., Addison-Wesley, 2003.

Soren Lauesen, *Software Requirements: Styles and Techniques*, Addison-Wesley, 2002.

Karl E. Wiegers, *Software Requirements*, 2nd Ed. , Microsoft Press, 2003.

Stephen Withall , *Software Requirement Patterns (Best Practices)* , Microsoft Press, 2007.

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Course Syllabus

1. General Information:

Alpha-numeric codification: INSO 4XXX

Course Title: Software Design

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: Fundamental principles and development of skills required for the effective design of complex software systems. Topics include: formal design methods, design specification standards, design patterns, design validation, and design metrics. Use of computer-aided software engineering (CASE) tools.

Spanish: Conceptos fundamentales y desarrollo de destrezas requeridas para el diseño efectivo de sistemas complejos de software. Los temas incluyen: métodos formales, estándares de especificaciones, patrones, validación y métricas de diseño. Uso de herramientas de diseño asistido por computadora (CASE).

3. Pre/Co-requisites and other requirements:

Pre-requisites: INSO 4XXX (Software Engineering Requirements)

4. Course Objectives:

Students will learn techniques for software design and apply these by completing the design of a software system during the course of the semester.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction	1
Software desing process	1
Review of Object-oriented principles	1
Standard design notation	8
Design principles	6
Design patterns and software architectures	4
System design	12
Detailed design	8
Exams and discussions	4

Total hours: (equivalent to contact period)	45
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8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	2	35%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input checked="" type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	40%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Partha Kuchana, *Software Architecture Design Patterns in Java*, Auerbach, 2004

David Budgen, *Software Design*, 2nd Ed. Addison-Wesley, 2003.

Steven John Metsker and William C. Wake, *Design Patterns in Java(TM) (Software Patterns Series)*, Addison-Wesley, 2006.

Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides, *Design Patterns: Elements of Reusable Object-Oriented Software*, Addison-Wesley, 1995.

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University of Puerto Rico
Mayagüez Campus
College of Engineering
Department of Electrical and Computer Engineering
Bachelor of Science in Computer Science and Engineering
Bachelor of Science in Software Engineering

Course Syllabus

1. General Information:

Alpha-numeric codification: INSO 4XXX

Course Title: Software Reliability Testing

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: Software testing and validation techniques with the aim of developing the skills required to design reliable and fault-tolerant software systems. Topics include: unit, integrated, performance, stress, usability, and fault tolerance testing. Practice with computerized testing and debugging tools.

Spanish: Técnicas de prueba y validación de software para desarrollar destrezas para el diseño de sistemas de software confiables y tolerantes a fallas. Los temas incluyen: pruebas de unidad, integración, desempeño, esfuerzo, uso y de tolerancia a fallas. Práctica con herramientas computarizadas de prueba y depuración.

3. Pre/Co-requisites and other requirements:

Pre-requisites: INSO 4XXX (Software Design)

4. Course Objectives:

Students will study and apply, in a term project, the techniques necessary to debug and test the code for a software system to ensure its quality and reliability.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction	1
Software testing philosophy and ethics	3
The software testing process	12
Software testing methods and tools	20
Test management	4
Exams and discussions	5
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	2	35%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	40%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Ron Patton, *Software Testing*, 2nd Ed., Sams, 2005.

William E. Lewis , *Software Testing and Continuous Quality Improvement, Second Edition* , Auerbach, 2004.

Glenford J. Myers, Corey Sandler, Tom Badgett, and Todd M. Thomas, *The Art of Software Testing*, 2nd Ed. , John Wiley, 2004.

Rick D. Craig and Stefan P. Jaskiel , *Systematic Software Testing* , Artech House Computer Library, 2002.

11. 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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

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Course Syllabus

1. General Information:

Alpha-numeric codification: INSO 4XXX

Course Title: Software Engineering Project I

Number of credits: 3

Contact Period: 3 hours per week

2. Course Description:

English: Team project to design a system that encompasses all phases of the software engineering development process to solve an academic, governmental, commercial, or industrial problem.

Spanish: Proyecto en equipo con el propósito de diseñar un sistema que conlleve todos los aspectos del proceso de desarrollo de ingeniería de software para resolver un problema académico, gubernamental, comercial o industrial.

3. Pre/Co-requisites and other requirements:

Pre-requisites: INSO 4XXX (Software Reliability Testing) and INSO 4XXX (Introduction to Human Computer Interaction).

4. Course Objectives:

Students will work in teams to design a software system that solves a real-world problem from the academia, government, business sector or industry.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction and project proposal preparation	6
Design of software system and progress reports	36
Oral presentation of project report	3
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input type="checkbox"/> Exams		

<input type="checkbox"/> Final Exam		
<input type="checkbox"/> Short Quizzes		
<input checked="" type="checkbox"/> Oral Reports	1	30%
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	50%
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Weekly and final reports	variable	20%
TOTAL:		100%

10. Bibliography:

Dependant on specific software project chosen.

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Course Syllabus

1. General Information:

Alpha-numeric codification: INSO 4XXX

Course Title: Software Engineering Project II

Number of credits: 3

Contact Period: 3 hours per week

2. Course Description:

English: Team project to implement a previously designed system of software engineering development to solve an academic, governmental, commercial, or industrial problem. Final presentation and evaluation of the project.

Spanish: Proyecto en equipo con el propósito de implantar un sistema previamente diseñado de desarrollo de ingeniería de software para resolver un problema académico, gubernamental, comercial o industrial. Presentación final y evaluación del proyecto.

3. Pre/Co-requisites and other requirements:

Pre-requisites: INSO 4XXX (Software Engineering Project I)

4. Course Objectives:

Students will work in teams to implement and test a software system which they had previously

designed, and which solves a real-world problem from the academia, government, business sector or industry.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction and project implementation proposal	6
Software implementation, testing and progress reports	36
Oral presentation and demonstration of project	3
Total hours: (equivalent to contact period)	

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input type="checkbox"/> Exams		

<input type="checkbox"/> Final Exam		
<input type="checkbox"/> Short Quizzes		
<input checked="" type="checkbox"/> Oral Reports	1	30%
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	50%
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Weekly and final reports	variable	20%
TOTAL:		100%

10. Bibliography:

Dependant on specific software project chosen.

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Course Syllabus

1. General Information:
Alpha-numeric codification: INSO 4XXX Course Title: Undergraduate Research in Software Engineering Number of credits: 1-3 Contact Period: 1-3 hours of research per credit
2. Course Description:
English: Development of a research project related to Software Engineering, under the supervision of a faculty member.
Spanish: Desarrollo de un proyecto de investigación relacionado con la ingeniería de software bajo la supervisión de un miembro de la facultad.
3. Pre/Co-requisites and other requirements:
Pre-requisite: Permission of Department Chairperson.
4. Course Objectives:
Students will work under the supervision of a faculty member to define a research project, and then conduct experiments, field studies, and the necessary literature survey to complete a

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input type="checkbox"/> Exams		
<input type="checkbox"/> Final Exam		
<input type="checkbox"/> Short Quizzes		
<input checked="" type="checkbox"/> Oral Reports	1	30%
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	50%
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Review of research papers	variable	20%
TOTAL:		100%

10. Bibliography:

Depending on the specific research project

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Course Syllabus

1. General Information:

Alpha-numeric codification: CIIC 5XXX

Course Title: Automata and Formal Languages

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: Study of theoretical computational models, languages, and machines. Introduction to the theory of intractable and un-decidable problems. Topics include: finite automata, regular languages, context-free languages, pushdown automata, Turing machine, halting problem, undecidability, and intractable problems.

Spanish: Estudio de la teoría sobre modelos computacionales, lenguajes, y maquinas. Introducción a la teoría de problemas intractables y no computables. Temas incluidos: autómatas finitos, lenguajes regulares, lenguajes libres de contexto, autómatas de tipo "pushdown", maquinas de Turing, problema de convergencia, problemas no computables e intractables.

3. Pre/Co-requisites and other requirements:

Pre-requisites: CIIC 4XXX (Data Structures) or permission from Department Chair.

8. Grading System Quantifiable (letters) Not Quantifiable**9. Evaluation Strategies**

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	50%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input checked="" type="checkbox"/> Short Quizzes	variable	10%
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input type="checkbox"/> Projects		
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Homeworks	variable	15%
TOTAL:		100%

10. Bibliography:

J.E. Hopcroft, R. Motwani, and J.D. Ullman, "Introduction to Automata Theory, Languages, and Computation", 3rd ed, Addison-Wesley, 2007.

Dexter C. Kozen, "Theory of Computation", Springer, 2006.

Peter Linz, "An Introduction to Formal Language and Automata", 4th ed. Jones & Bartlett, 2006.

John Martin , "Introduction to Languages and the Theory of Computation", McGraw-Hill, 2002.

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Course Syllabus

1. General Information:

Alpha-numeric codification: CIIC 4XXX

Course Title: High-Performance Computing

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: Study of the fundamentals of high-performance computing systems. Discussion of techniques used to reduce the number of operations and the response time incurred in solving computationally expensive problems. Introduction to strategies for program parallelization, concurrency, and the use of tools used for this purpose.

Spanish: Estudio de conceptos fundamentales asociados al rendimiento de un sistema de computación. Discusión de técnicas para la reducción de operaciones con el objetivo de minimizar el tiempo de respuesta de un sistema a la solución de problemas de alta demanda computacional. Estudio de estrategias de paralelización y concurrencia y experiencias prácticas en el uso de sistemas y herramientas que las implantan.

3. Pre/Co-requisites and other requirements:

Pre-requisites: ICOM 4035 or CIIC 4XXX (Data Structures)

4. Course Objectives:

Students will learn the algorithms and architectures used for parallel program execution, and will write parallel programs to solve scientific and engineering problems.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Sources of error	5
Algebraic equations	10
Dynamics	10
Computational Geometry	10
Graphics and Scientific Visualization	7
Exams	3
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	40%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports		
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	25%
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Homeworks	variable	10%
TOTAL:		100%

10. Bibliography:

Rubin Landau, *A First Course in Scientific Computing: Symbolic, Graphic, and Numeric Modeling Using Maple, Java, Mathematica, and Fortran90*, Princeton University Press, 2005.

L. Ridgway Scott, Terry Clark, Babak Bagheri, *Scientific Parallel Computing*, Princeton University Press, 2005.

Alfio Quarteroni and Fausto Saleri, *Scientific Computing with MATLAB and Octave (Texts in Computational Science and Engineering)*, 2nd ed, Springer, 2006.

Laurence Tianruo Yang and Yi Pan, *High Performance Scientific and Engineering Computing: Hardware/Software*, Springer, 2003.

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Course Syllabus

1. General Information:

Alpha-numeric codification: CIIC 5XXX

Course Title: Artificial Intelligence

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: An Introduction to The Field of Artificial Intelligence: LISP Language, search Techniques, Games, Vision, Representation of Knowledge, Inference and Process of Proving Theorems, Natural Language Understanding.

Spanish: Introducción al Campo de la Inteligencia Artificial: Lenguaje Lisp, Técnicas de Búsqueda, Juegos, Visión, Representación del Conocimiento, inferencia y Proceso de Prueba de Teoremas, Entendimiento de Lenguaje Natural.

3. Pre/Co-requisites and other requirements:

Pre-requisite: Permission from the Department Chair.

4. Course Objectives:

Students will learn the fundamental concepts of artificial intelligence and write programs that

will provide them the ability to analyze and design intelligent systems.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to AI	2
Programming in LISP language	6
Problem representation and search techniques	6
Search in game trees	2
Vision: scene analysis and the blocks world	7
Knowledge representation techniques including logic and semantic networks	7
Natural language understanding: grammars, parsing and natural language processing systems	7
Application of AI in various fields	6
Exams and discussions	2

Total hours: (equivalent to contact period)	45
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8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	1	25%
<input checked="" type="checkbox"/> Final Exam	1	35%
<input checked="" type="checkbox"/> Short Quizzes	variable	10%
<input checked="" type="checkbox"/> Oral Reports	1	5%
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects		25%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Second Edition, 2002.

Ben Copping, Artificial Intelligence Illuminated, Jones and Bartlett, 2004.

Nilsson, N. J. Artificial Intelligence: A new Synthesis. Morgan Kauffman, San Francisco, 1998.

N. P. Padhy , Artificial Intelligence and Intelligent Systems, Oxford University Press, 2005.

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Course Syllabus

1. General Information:

Alpha-numeric codification: CIIC 5XXX

Course Title: Compiler Development

Number of credits: 3

Contact Period: two hours of lecture and three hours of laboratory per week.

2. Course Description:

English: Techniques involved in the analysis of source languages and the generation of efficient object codes with emphasis on the components of a compiler.

Spanish: Estudio y aplicación de técnicas asociadas al análisis de los lenguajes fuente y la generación de objetos de códigos eficientes con énfasis en los componentes de un compilador.

3. Pre/Co-requisites and other requirements:

Pre-requisites: Permission from Department Chair.

4. Course Objectives:

Students will learn the techniques involved in the analysis of source languages and the generation of efficient object codes with emphasis on a project designed to build the components of a compiler.

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 Departmental computer laboratories to complete all course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction and structure of a basic compiler	2
Lexical analysis and the lexical analyzer lex	2
Trees (especially search trees)	2
Parsing techniques and context-free grammars	3
LL parsing	3
Operator-precedence grammars	3
LR and LALR parsing and the parser generator yacc	3
Syntax-directed translation	3
Intermediate and target code generation	3
Object file formats and optimization`	3
Exams and discussions	3
Laboratory	15

Total hours: (equivalent to contact period)	45
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8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	2	25%
<input checked="" type="checkbox"/> Final Exam	1	25%
<input type="checkbox"/> Short Quizzes		
<input checked="" type="checkbox"/> Oral Reports	3	25%
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	variable	25%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

Alfred V. Aho, Monica S. Lam, Ravi Sethi, and Jeffrey D. Ullman, *Compilers: Principles, Techniques, and Tools*, 2nd Ed. , Addison-Wesley, 2006.

Keith Cooper and Linda Torczon , *Engineering a Compiler* , Morgan Kaufmann, 2003.

Andrew W. Appel and Jens Palsberg, *Modern Compiler Implementation in Java* , Cambridge Press, 2002.

David Galles, *Modern Compiler Design*, Addison-Wesley, 2005.

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Course Syllabus

1. General Information:
Alpha-numeric codification: CIIC 5XXX
Course Title: Selected Topics
Number of credits: 1-3
Contact Period: 1-3 hours per week
2. Course Description:
English: Selected topics in Computer Science and Engineering.
Spanish: Temas selectos en ciencias e ingeniería de la computación.
3. Pre/Co-requisites and other requirements:
Pre-requisite: [ICOM 4035 or CIIC 4XXX (Data Structures)] or permission of Department Chair.
4. Course Objectives:
Students will work under the supervision of a faculty member to study a contemporary topic in Computer Science and Engineering, and then define a project, conduct studies, and perform the necessary literature survey to complete a report on the project outcomes.

	Quantity	Percent
<input type="checkbox"/> Exams		
<input type="checkbox"/> Final Exam		
<input type="checkbox"/> Short Quizzes		
<input checked="" type="checkbox"/> Oral Reports	variable	40%
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input type="checkbox"/> Projects		
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Technical Report	1	60%
TOTAL:		100%

10. Bibliography:

Dependant of specific selected topic chosen by students.

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Course Syllabus

1. General Information:
Alpha-numeric codification: CIIC 4XXX Course Title: Undergraduate Research Number of credits: 1-3 Contact Period: 1-3 hours per week
2. Course Description:
English: Development of a research project related to Computer Science and Engineering, under the supervision of a faculty member.
Spanish: Desarrollo de un proyecto de investigación relacionado con ciencia e ingeniería de la computación bajo la supervisión de un miembro de la facultad.
3. Pre/Co-requisites and other requirements:
Pre-requisite: [ICOM 4035 or CIIC 4XXX (Data Structures)] and permission of Department Chairperson.
4. Course Objectives:
Students will work under the supervision of a faculty member to define a research project, and

then conduct experiments, field studies, and the necessary literature survey to complete a report on the project outcomes.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to research plan and strategies	6
Topics depending on specific research projects	37
Oral presentation and technical report	2
Total hours: (equivalent to contact period)	45

8. Grading System Quantifiable (letters) Not Quantifiable**9. Evaluation Strategies**

	Quantity	Percent
<input type="checkbox"/> Exams		
<input type="checkbox"/> Final Exam		
<input type="checkbox"/> Short Quizzes		
<input checked="" type="checkbox"/> Oral Reports	1	30%
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	50%
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Review of research papers	variable	20%
TOTAL:		100%

10. Bibliography:

Dependant on the specific research project.

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Course Syllabus

1. General Information:

Alpha-numeric codification: CIIC 5XXX

Course Title: Network Security and Cryptography

Number of credits: 3

Contact Period: 3 hours of lecture per week

2. Course Description:

English: Theoretical and practical aspects in computer and network security. Models for threats, vulnerability to attacks from hackers, malicious code, Trojan horses, viruses, and worms. Cryptographic techniques to protect systems from attacks.

Spanish: Aspectos teóricos y prácticos de seguridad en sistemas de computadoras y redes; modelos de amenazas; vulnerabilidad a ataques tales como: "hackers", código malicioso, caballos de Troya, virus y gusanos; técnicas criptográficas para defender los sistemas de dichos ataques.

3. Pre/Co-requisites and other requirements:

Pre-requisite CIIC 4XXX (Operating Systems) or permission from Department Chair.

4. Course Objectives:

Students will learn to identify security threats and the cryptographic algorithms used to protect computer data and network communications. Then, students will use these algorithms to develop schemes to protect computer systems against typical security threads.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to cryptography	3
Modern algebra and private-key cryptography	3
Contemporary symmetric ciphers	6
Number theory and public-key algorithms	6
Key management and distribution	3
Authentication, signature, and electronic commerce protocols	3
Secure layers in the protocol stack	6
Security in applications, mail and web, Malware and countermeasures	6
Legal and Social Issues - Current legislation	3
Project presentations	3

Exams and discussions	3
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	3	60%
<input checked="" type="checkbox"/> Final Exam	1	20%
<input type="checkbox"/> Short Quizzes		0%
<input checked="" type="checkbox"/> Oral Reports	3	Included in project
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	20%
<input type="checkbox"/> Journals		
<input type="checkbox"/> Other, specify:		
TOTAL:		100%

10. Bibliography:

William Stallings, *Cryptography and Network Security*, 4th Ed. Prentice Hall, 2005.

Matt Bishop , *Introduction to Computer Security* , Addison-Wesley, 2004.

Niels Ferguson, Bruce Schneier, *Practical Cryptography* , John Wiley and Sons, 2003.

Chuck Easttom , *Computer Security Fundamentals*, Prentice, 2005.

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Course Syllabus

1. General Information:

Alpha-numeric codification: CIIC 5XXX

Course Title: System and Network Administration and Security

Number of credits: 3

Contact Period: 2 hours of lecture and three hours of laboratory per week

2. Course Description:

English: Practical experience with the administration and security of operating systems and computer networks. Design and development of methods for the detection and response to attacks to the computer systems.

Spanish: Experiencia práctica en la administración y seguridad de sistemas operativos y redes. Diseño y desarrollo de medidas de detección de y respuesta a ataques en estos sistemas.

3. Pre/Co-requisites and other requirements:

Pre-requisite: CIIC 4XXX (Operating Systems) or permission from Department Chair.

4. Course Objectives:

Students will learn how to use the software tools developed for the administration of computer operating systems. In addition, students will learn how to develop countermeasures for security attacks.

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 Departmental computer laboratories to complete course projects.

7. Course time frame and thematic outline

Outline	Contact Hours
Introduction to system administration	3
System, user, and file system configuration and backup	6
Installation, event logging and problem investigation	3
Administering network configuration and services	3
User services and maintenance	3
Cryptographic basics and secure socket and other layers	6
Hacking methods, intrusion and virus countermeasures	9
Legal and ethical issues	6

Project presentations	3
Exams and discussions	3
Total hours: (equivalent to contact period)	45

8. Grading System

Quantifiable (letters) Not Quantifiable

9. Evaluation Strategies

	Quantity	Percent
<input checked="" type="checkbox"/> Exams	2	40%
<input checked="" type="checkbox"/> Final Exam	1	20%
<input type="checkbox"/> Short Quizzes		
<input type="checkbox"/> Oral Reports	1	5%
<input type="checkbox"/> Monographies		
<input type="checkbox"/> Portfolio		
<input checked="" type="checkbox"/> Projects	1	20%
<input type="checkbox"/> Journals		
<input checked="" type="checkbox"/> Other, specify: Laboratory	10	20%
TOTAL:		100%

10. Bibliography:

Evi Nemeth, Garth Snyder, and Trent R. Hein, *Linux Administration Handbook*, 2nd Ed., Prentice Hall, 2006.

Mark Burgess , *Principles of Network and System Administration* , Wiley, 2004.

Steve Shah and Wale Soyinka, *Linux Administration: A Beginner's Guide* , 4th Ed., McGraw-Hill, 2005.

Mark Burgess , *Analytical Network and System Administration: Managing Human-Computer*

Systems , Wiley, 2004.

11. 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 (Chemistry Building, room 019) at (787)265-3862 or (787)832-4040 extensions 3250 or 3258.

7. ADMISIÓN, MATRÍCULA Y GRADUACIÓN

7.1 Requisitos de Admisión

Los requisitos de admisión son haber aprobado la escuela secundaria y tener el índice de ingreso mínimo requerido. El índice de ingreso es función del promedio general de escuela superior y la puntuación obtenida en el "College Board". El índice de ingreso mínimo se computará basado en una proyección de oferta/demanda dado por el número de solicitudes y la proyección de matrícula.

7.2 Proyección de la Matrícula

Los recursos solicitados en esta propuesta están calculados para atender entre 25 y 50 estudiantes del programa de ICOM que se transferirían al nuevo programa y en adición una matrícula de cincuenta (50) estudiantes de nuevo ingreso por año.

7.3 Requisitos académicos para otorgar el grado

Los requisitos académicos para otorgar el grado de bachillerato en ingeniería de software y el grado de bachillerato de ciencia e ingeniería de computación se indican en las siguientes secciones.

7.3.1 Total de Horas-Crédito que se Requieren

Se requiere la aprobación de un total de ciento sesenta y tres (163) créditos para otorgar el grado según se indica en la sección 5.3.1.

7.3.2 Índices Académicos Mínimos

Se requiere un índice académico no menor de 2.0 para graduarse del programa.

7.3.3 Total de Créditos a Aceptarse en Transferencia

Las reglas del Recinto Universitario de Mayaguez establecen que el máximo número de créditos transferibles en cursos tomados en otra institución de educación superior es la mitad del total de créditos requeridos para el grado. En el caso de los grados otorgados por este programa el máximo correspondiente es de ochenta y un (81) créditos.

7.3.4 Requisitos de Idioma

No hay requisitos de idioma.

7.3.5 Tiempo Límite para Completar el Grado

El tiempo límite para completar el grado es de diez (10) años como estudiante a tiempo completo.

8. FACULTAD

8.1 Perfil de la facultad

8.1.1 Listado de la facultad

La facultad actualmente disponible para ofrecer el programa se desglosa en la Tabla 10.

Nombre del Profesor	Area de Investigación
Jose Borges	Software Engineering/HCI
Jaime Seguel	Bioinformatics/Cloud Computing
Wilson Rivera-Gallego	High Performance Computing
Nayda G. Santiago-Santiago	High Performance Computing
Pedro I. Rivera-Vega	Parallel and Distributed Algorithms
Manuel Rodríguez-Martinez	Databases/Cloud Computing
Nestor J. Rodríguez	Software Engineering/HCI
Fernando Vega-Riveros	Artificial Intelligence
Bienvenido Vélez-Rivera	Web Application Development
Kejie Lu	Computer Networks/Security
Ramon Vásquez Espinosa	Artificial Intelligence
Amirhossein Chinaei	Databases/Data Privacy
Emmanuel Arzuaga	Operating Systems/Virtual Computing

Table 10: Facultad Disponible para Ofrecer los Programas.

8.1.2 Curriculum vitae (CV) de toda la facultad

A continuación se incluye el CV de toda la facultad, siguiendo el formato para ABET del Departamento de Ingeniería Eléctrica y Computadoras.

4. J. Seguel "Design and Implementation of a Parallel Prime Edge-length Symmetric FFT" Elsevier Lecture Notes in Computer Science, LNCS 2667, pp 1025-1034, 2003.
5. J. Seguel, D. Burbano "A Scalable Crystallographic FFT" Elsevier Lecture Notes in Computer Science, LNCS 2840, pp. 134-141, 2003.
6. L. de la Torre, J. Seguel "A Comparison of Two Multi-round Schedulers" To appear in IEEE Proceedings of the High Performance Computing and Communications Conference, HPCC 2009, June 2009.
7. L. de la Torre, J. Seguel "A Parallel Approach to Biosequence Motif Discovery Based on Scheduling and Dynamic Programming" To appear in the Proceedings of the Scientific Computing Conference, WORLDCOMP 2009, July 2009.
8. J. Seguel, M. Cabrera "A Minor in Bioinformatics Within a College of Engineering" To appear in the Proceedings of the Conference in Frontiers of Education, Las Vegas, NV, July 2009.

Grants or externally funded project active during the last four years: (FY 2002-2003 - 2006-2007)

Principal Investigator in "Assisting Bioinformatics Efforts at Minority Schools", NIH-MARC grant PAR-03-026, started FY 2005

Co-Principal Investigator in "Wide-area Large-scale Automated Information Processing", NSF-MII grant No. 0424546, started FY 2004

Co-Principal Investigator in "A Program for Research in Computing and Information Sciences and Engineering (PRECISE)", NSF-CISE, started on FY 1999 – ended FY 2004

Principal Investigator in "A Universal Crystallographic FFT Package", NIH MBRS/SCORE, grant NIGMS S06GM08103, started FY 1999 – ended FY 2004.

Scientific and professional societies of which a member:

Member of IEEE.

Honors and awards:

None

Institutional and professional service in the last four years: (FY 2002-2003 - 2006-2007)

Member of a Consulting Board of the Council of Higher Education of Puerto Rico

Professional development activities in the last four years: (FY 2002-2003 - 2006-2007)

None

Offered Courses in the past two years (2005-2007)

ICOM 5995 Special Problems, CIIC 6005 Foundations of Computing (Graduate), CIIC 8015 Advanced Topics , ICOM 4075 Foundations of Computing (Undergraduate), CIIC 9995 Doctoral Dissertation , CIIC 8996 Doctoral Seminar

Community service activities: (FY 2002-2003 - 2006-2007)

None

RIVERA-GALLEGO, WILSON

Academic rank: Associate Professor

Degrees with fields, institution, and date:

BS	Mathematics	Universidad del Valle	1989
MS	Computational Mathematics	University of Puerto Rico	1994
Ph. D.	Computational Engineering	Mississippi State University	2000

Faculty service at UPRM:

Date of original appointment: July 2000

Dates of advancement in rank:

Assistant Professor:	2000 to 2004
Associate Professor	2004 to Present
Total years of service:	7

Areas of professional expertise:

High Performance Computing, Parallel and Distributed Computing, Information Technology

Other related experience—academic or industrial.

None

Consulting, patents

None

State in which registered

None

Principal publications of last four years: (FY 2002-2003 - 2006-2007)

1. D. Arias, M. Mendoza, F. Cintron, K. Cruz, and **W. Rivera**, "Grid Portal Development for Sensing Data Retrieval and Processing." *IEEE/ACM Second International Workshop on Grid Computing Environments (GCE06), Supercomputing 2006*.
2. D. Arias and **W. Rivera**, "Using Grid Computing to Enable Distributed Radar Data Retrieval and Processing." *IEEE International Conference on Parallel and Distributed Computing, Applications and Technologies (PDCAT), 2006*.
3. C. Gerardino, Y. Rivera, J. Goodman, and **W. Rivera**, "Parallel Implementation of an Inversion Model for Hyperspectral Remote Sensing." *49th IEEE Midwest Symposium on Circuits and Systems (MWSCAS), 2006*.
4. W. Lozano and **W. Rivera**, "An Adaptive Quality of Service Based Scheduling Algorithm for Wide Area Large Scale Problems" *IEEE International Conference on Network Computing and Applications, 2006*.
5. G. Chaparro, N.G. Santiago, **W. Rivera**, and J.F. Vega, "Petri net workflow modeling for digital publishing measuring quantitative attributes." *IEEE International Symposium on Dependable, Autonomic and Secure Computing (DASC'06), 2006*

6. **W. Rivera**, C. Carvajal, and W. Lugo. "A Service Oriented Architecture Grid Based Environment for Hyperspectral Imaging Analysis." *International Journal of Information Technology*, Vol. 11 No. 4, p. 104-111, 2005.
7. C. Carvajal-Jimenez, W. Lugo-Beauchamp, K. Cruz, and **W. Rivera**, "Grid-HSI: Using Grid Computing to Enable Hyperspectral Imaging Analysis." *Proc. Third IASTED International Conference on Communications, Internet, and Information Technology*, p. 583-588, 2004
8. W. Lugo-Beauchamp, C. Carvajal-Jimenez and **W. Rivera**, "Performance of Hyperspectral Imaging Algorithms on IA-64". *Proc. IASTED International Conference on Circuits, Signals, and Systems*, p. 327-332, 2004
9. **W. Rivera**, J. Zhu, and D. Huddleston, "An efficient parallel algorithm with application to computational fluid dynamics," *Journal of Computers & Mathematics with Applications*, 45: 165-188, 2003.
10. **W. Rivera**, "Stability analysis of numerical boundary conditions in domain decomposition algorithms." *Journal of Applied Mathematics and Computation*, 137: 375-385, 2003.
11. F. Perez and **W. Rivera**, "An object-oriented framework for computational fluid dynamic simulations," *Proc. International Conference on Parallel and Distributed Processing Technology and Applications*, 2003.
12. **W. Rivera**, "CompuGe: A computational geometry learning environment." *Proc. IASTED International Conference on Computers and Advanced Technology in Education (CATE2003)*.
13. **W. Rivera**, J. Zhu, and D. Huddleston, "An efficient parallel algorithm for solving unsteady equations." *Parallel Computational Fluid Dynamics: Practice and Theory*, P. Wilders, A. Ecer, J. Periaux, N. Satofuka, and P. Fox Eds. 293 - 300, Elsevier Science, Amsterdam, 2002.

Grants or externally funded project active during the last four years: (FY 2002-2003 - 2006-2007)

1. Co-PI, "An Infrastructure for Wide-Area Large Scale Automated Information Processing" National Science Foundation (NSF), 10/15/04-10/14/09. \$1,499,012
2. Co-PI, "Center for Industrial Software Development (InduSoft)" Puerto Rico Industrial Development Company (PRIDCO) 6/1/04-5/31/07, \$ 2,162,077
3. PI, "Digital Publishing Research Program" Hewlett-Packard 03/01/04-02/28/05, \$450,000
4. PI, "Enhancing High Performance Computing Research and Education at UPRM" Hewlett-Packard 06/01/03-07/01/04, \$151,872 (+ \$126,000 fondos de pareo HP-Puerto Rico)

Scientific and professional societies of which a member:

Association for Computing Machinery - ACM

Honors and awards:

Distinguished Professor 2005-2006; Electrical and Computer Engineering Department

Institutional and professional service in the last four years: (FY 2002-2003 - 2006-2007)

1. *Member INEL/ICOM Graduate Committee, 2000-2003*
2. *Member CISE Graduate Committee, 2001-2004*
3. *Member ICOMSW committee, 2000-Present*
4. *Member Faculty Computational Resources committee, 2000-2003*

Professional development activities in the last four years: (FY 2002-2003 - 2006-2007)

1. *HP University Relations Latin America Grid & Utility Computing Workshop - San Juan, Puerto Rico, May 22 - 23, 2006*
2. *Emerging computing trends: utility computing and digital publishing Workshop – Santiago, Chile, August 20-26, 2006*
3. *Global Entrepreneurship: Strategy and Execution, Guayacan Center for Global Entrepreneurship and Private Equity, October 31-November 1, 2005 (15 hours).*
4. *How to create & grow your technology business, Puerto Rico SBDC, September 7, 2004.*
5. *IBM Faculty Workshop, December 8-11, 2003*
6. *Presentation skills, Texas Instrument, April 30, 2003*
7. *Workshop on Systems Security, February 28, 2003*
8. *EOT-PACI/AN-MSI High Performance Computer Clusters Workshop National Center for Supercomputing Applications, Champaign, IL, May 6-7, 2002*

Offered Courses in the past two years (2005-2007)

CIIC 8996 Doctoral Seminar, ICOM 6999 Master Thesis, ICOM 6998 Master Project, ICOM 6025 High Performance Computing,, ICOM 6006 Distributed Operating Systems, ICOM 4998 Undergraduate Research, CIIC 8997 Independent Study, CIIC 9995 Doctoral Dissertation,, CIIC 8997 Independent Study, INEL 6046 Master Thesi, INEL 6995 Special Topics in Electrical Engineering (I, II), ICOM 4075 Foundations of Computing

Community service activities: (FY 2002-2003 - 2006-2007)

1. *Director, Parallel and Distributed Computing Laboratory at UPRM.*
2. *Executive Director, Institute for Computing and Informatics Studies at UPRM*
3. *Referee for the Journal of Computational and Applied Mathematics, the Journal of Parallel and Distributed Computing Practices, and the Journal of Parallel and Distributed Computing.*
4. *Chair of the International Workshop on Adaptive Grid Middleware 2003, 2004, 2005*
5. *Voting member of the Gelato Strategy Council*

SANTIAGO-SANTIAGO, NAYDA G.

Academic rank: Assistant Professor

Degrees with fields, institution, and date:

BS	Electrical Engineering	University of Puerto Rico, Mayagüez Campus	1989
MS	Electrical Engineering	Cornell University	1990
Ph. D.	Electrical Engineering	Michigan State University	2003

Faculty service at UPRM:

Date of original appointment: August 1990

Dates of advancement in rank:

Instructor:	1990 to 1994
	2000 to 2003
Assistant Professor	2003 to 2008
Total years of service:	11

Areas of professional expertise:

Performance Evaluation Methods, HPC systems, and Parallel Processing

Other related experience—academic or industrial:

August 1997 to 2000 – Research Assistant, Department of Electrical and Computer Engineering, **Michigan State University**, East Lansing, MI

June 1996 to August 1996 – Summer Intern, **Cornell Theory Center**, Ithaca, NY

August 1995 to May 1996 -- Teaching Assistant, **Michigan State University**, East Lansing, MI

August 1990 to June 1994 – Instructor, University of Puerto Rico, Mayagüez, PR

September 1989 to May 1990 – Research Assistant , Cornell University, Ithaca, NY

August 1988 to May 1989 — Digital Electronics Laboratory Instructor, **University of Puerto Rico**, Mayagüez, PR

1988 Summer -- Research Assistant, **Texas A&M University**, College Station, TX

Consulting, patents:

None.

State(s) in which registered:

Puerto Rico

Principal publications of last five years: (FY 2002-2003- 2007-2008)

-David Gonzalez, Christian Sanchez, Ricardo Veguilla, Nayda G. Santiago, Samuel Rosario, Miguel Velez-Reyes.

Abundance Estimation Algorithms Using NVIDIA CUDATM Technology. **Proceedings of SPIE -- Volume 6966**,

Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIV, 69661E, Orland

FL, March 2008.

-Manuel Jimenez, Nayda G. Santiago, J. Fernando Vega, Carlos Rubert, Giselle Bonilla, Isa Torres, Christian Maldonado, Javier Malave, Ricardo Rosario. Integrating Fundamental and Advanced Concepts in a Rounded Capstone Design Experience in Computer Engineering. **Proceedings of the 37th Annual Frontiers in Education Conference**, Oct 10-13, 2007, Milwaukee, Wisconsin, pp F4D-1-F4D-6.

-D.A. Ortiz and N.G. Santiago. High-level optimization for low power consumption on microprocessor-based systems. **50th IEEE International Midwest Symposium on Circuits and Systems (MWSCAS'07)**, pages 1265 –1268, Montreal, Canada, Aug. 2007.

-Jimenez, Manuel; Nieves, Ana; Pomales-Garcia, Cristina; Santiago, Nayda; Vega, Jose; Lopez, Vilma. An Analysis of Behavior Patterns in Generation Y Engineering Students. **Proceedings of the 114th ASEE Annual Conference and Exposition**, June 24-27, 2007, Honolulu, HI, 13p.

-Javier Morales, Nayda G. Santiago, and Alejandro Fernandez, An FPGA Implementation of Image Space Reconstruction Algorithm for Hyperspectral Imaging Analysis, **Proceedings of the SPIE**, Vol. 6565 65651V (2007), **Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIII**, pp. V-1 to V-12, March 2007.

-Gustavo A. Chaparro-Baquero, Nayda G. Santiago, Wilson Rivera, J. Fernando Vega-Riveros, Measuring quantitatively dependability attributes in Digital Publishing using Petri Net Workflow Modeling, **Proceedings of the 2nd IEEE International Symposium on Dependable, Autonomic and Secure Computing**, Indianapolis, Indiana, September 29-October 1, 2006, pages 119 - 126.

-Morales, Javier; Medero, Nelson; Santiago, Nayda G.; Sosa, Julio; Hardware implementation of image space reconstruction algorithm using FPGAs, **Proceedings of the 2006 49th Midwest Symposium on Circuits and Systems**, v 1, **MWSCAS'06**, Aug 6- 9, 2006, San Juan, PR, p 433-436.

-R. Veguilla, N. G. Santiago, D. A. Rodríguez, "Issues in Terrain Visualization for Environmental Monitoring Applications", **Proceedings of the fourth Latin American and Caribbean Conference for Engineering and Technology**, LACCEI 2006, June 21-23, 2006, Mayaguez, PR.

-Santiago, Nayda, Aceros Moreno, Cesar A.; Rodriguez, Domingo, "Performance measures for parameter extraction of sensor array point targets using the discrete chirp fourier transform", **Proceedings of SPIE - The International Society for Optical Engineering**, v 6235, **Signal Processing, Sensor Fusion, and Target Recognition XV**, 2006, Apr 17-19 2006, Kissimmee, FL.

-M. Jimenez and N. Santiago, "The Supporting Role of CAD/CAM Tools in Undergraduate Research Education in Electrical and Computer Engineering", **Proceedings 6th International Conference on Information Technology Based Higher Education and Training**, ITHET 2005, July 7-9, 2005.

-D. Rodriguez and N. Santiago, "Integrating Novel Methodologies, Tools, and IT Resources for Graduate Level Courses in High Performance Computing and Advanced Signal Processing Algorithms", **Proceedings 6th International Conference on Information Technology Based Higher Education and Training**, ITHET 2005, July 7-9, 2005.

-D, Rodriguez, N. G. Santiago, H. Nava, "High Performance SAR Raw Array Data Simulation Environment (SARADAS)," **IEEE 5th European Conference on Synthetic Aperture Radar**, EUSAR 2004, Germany, May 2004.

-Santiago, N.G.; Rover, D.T.; Rodriguez, D., "A statistical approach for the analysis of the relation between low-level performance information, the code, and the environment", The 4th Workshop on High Performance Scientific and Engineering Computing with Applications, HPSECA-02, Page(s): 282 -289.

Grants or externally funded project active during the last five years: (FY 2002-2003- 2007-2008)

-PI, **Integrating Software and Hardware Components of WIMS testbeds** – Wireless Integrated Microsystems Engineering Research Center (WIMS-ERC), PI: Kensall Wise, University of Michigan, Ann Arbor, Integrate diverse components developed by different research groups, Sept 07 – Ago 08, \$64,994.00, NSF Award **9986866**, ENGINEERING RESEARCH CENTERS NSF Program, EEC Division of Engineering Education and Centers, ENG Directorate for Engineering.

-CoPI, **BPC: Paving the Road to Professorship for Female Students**, Aid female students to obtain PhD degrees, Feb 08 – Ene 2011, \$428,162.00, NSF Broadening Participation in Computing.

-CoPI, **Establishment of a Computational Infrastructure for Research Hardware and Electronics Design Challenges at the UPRM** – IBM Sur Grant, Performance Evaluation of Advanced Computational Structures, Abr 07 – Mar 08, \$389,147.00, IBM Sur Grant.

-CoPI, **Study of System Level Design Methodologies for Implementing SAR Support Algorithms** – Lockheed Martin, Study of performance metrics and evaluation on FPGA and DSP platforms, Dic 06 – Nov 07, \$259,988.00, Lockheed Martin Corp.

-PI, **Analyzing the Effect of Algorithmic Decisions on Power Consumption** – WIMS, Study of the effect of code transformations on power consumption in embedded systems, Sept 06 – Aug 07, \$64,994.00, NSF ERC Program.

-Collaborator, **Computing Alliance for Hispanic Serving Institutions** – NSF, A cargo de la intervención sobre investigación subgraduada en colaboración con UTEP, Mar 06 – Feb 09, \$2,848,716.00, NSF Broadening Participation in Computing Program.

-PI, **Code Development for the Neural Prosthesis and EMT testbeds for WIMS ERC** – WIMS, , Code for cochlear implant and micro gas chromatograph with low power constraints, Sept 05 – Aug 06, \$65,000.00, NSF Engineering Research Centers Program.

-PI, **Porting Benchmarks and Environmental Monitoring Testbed Application Coding for the WIMS microcontroller** – WIMS, Develop code for EMT testbed, Sept 04 – Aug 05, \$39,740.00, NSF Engineering Research Center Program.

-CoPI, **Research Program on Digital Publishing** – HP, Dependability Analysis using Petri Nets, Mar 04 – Feb 05, \$442,467.00, Hewlett Packard

PI, **Evaluation of the WIMS microcontroller and floating point support** – WIMS – PI, , Evaluate floating point support of the WIMS MC, Feb 04 – Aug 04, \$20,108.00, NSF Engineering Research Center Program.

-Collaborator, **An infrastructure for Wide area large scale automate information processing (Walsaip)**, PI: Domingo Rodriguez, Award Number 0424546, Terrain Visualization Tool: VTE, Feb 04 – Present, \$1,499,012.00, NSF CISE Minority Institution Infrastructure (MII) Program, Division of Computer and Network Systems.

Scientific and professional societies of which a member:

Institute of Electrical and Electronic Engineers -- member.

Colegio de Ingenieros y Agrimensores de Puerto Rico -- member

Association for Computing Machinery -- member.

Honors and awards:

Distinguished Engineer CIAPR 2008

NSF Dean's Distinguished Fellowship for Minorities and Women (1994-1998)

University Graduate Fellowship (UGF) (Fall 1997, Fall 1995)

GTE Corporation Fellowship Award (Spring 1996)

Georg Simon Ohm Award (Best EE Student in Class 1988-89 at University of PR, Mayagüez)

NASA Graduate Student Researcher Fellowship (1989-1990)

USAA Scholastic All-American Award

National Collegiate Engineering Award

Honor Student (University of PR Dean's List)

The National Dean's List

NACME Fellowship (1984-1989)

Institutional and professional service in the last five years: (FY 2002-2003- 2007-2008)

Reviewer for Data & Knowledge Engineering (DKE) Journal, Peter Chen, Editor-in-Chief, Feb 07.

Midwest Symposium on Circuits and Systems, June 2006.

Served in NSF Cyberinfrastructure Panel – June 2007

Served in NSF MRI Panel – April 2007

IEEE Computer Society Undergraduate Teaching Award Chair (National IEEE), 2007 Year.

Professional development activities in the last five years: (FY 2002-2003- 2007-2008)

Project Management Overview, UPR Mayaguez, CEP, 9 Sept 03

Electrónica de Potencia, CIAPR, CIAPR, 22 Dec 04

Exercising Influence, UPR Mayaguez, CEP, 1 Apr 05

Orientación a profesores de nueva contratación, UPR Mayaguez, CEP, 3-5 Aug 05

Emotional Intelligence, , UPR Mayaguez, CEP, 6 Apr 06

Group Decision Making, UPR Mayaguez, CEP, , 9 May 06

Four disciplines of execution, UPR Mayaguez, CEP, 31 Aug 06

Integrating Mentoring into Undergraduate Research Experience, UPR Mayaguez, CEP, 21 Sept 06

Time Management, UPR Mayaguez, CEP, 6 Sept 07

CID 101: Budget Preparation, UPR Mayaguez, CEP, 18 Sept 07

Entrepreneurship for Educators, Babson y Guayacán, Grupo Guayacán, 8-11 Jan 08

Offered Courses in the past two years (2005-2007)

INEL 3105, Analisis de circuitos I, F05, F07, 3 credits

INEL 4075, Fundamentos de Ing Electrica, F 03, S04, F04, F06, 3 credits

INEL 4215, Arquitectura de Compt y Organiz., F03, S03, F04, S05, 3 credits

ICOM 5047, Diseño en Ing de Computadoras, S06, F06, S07, S08, 5 credits

INEL 6046, Tesis de Maestría Ing Eléctrica, De F06 to S07., 3 y 1 credits

INEL/ICOM 4998, Investigación Subgraduada, Todos los semestres, 3 credits

INEL 6067, Procesamiento distribuído y arq de computadoras avanzado, S05, 3 credits

ICOM 6115, Tópicos Especiales: Evaluación y medidas de sistemas de computación, F06, 3 credits

ICOM 6999, Tesis de Maestría Ing Computadoras, F06, S07, F07, 3 y 1 credits

INTD 3995, Experiencias en desarrollo de las comunidades, S06, 1 credits

INEL 4998 Undergraduate Research

Community service activities: (FY 2002-2003- 2007-2008)

Relay for Life, American Cancer Society, 2004, 2005, 2006, 2007 and 2008

RIVERA-VEGA, PEDRO I.

Academic rank: Professor

Degrees with fields, institution, and date:

BS	Mathematics	University of Puerto Rico, Río Piedras	1977
MS	Applied Mathematics	University of Puerto Rico, Río Piedras	1980
Ph. D.	Computer Sciences	University of Florida	1990

Faculty service at UPR:

Date of original appointment: August 2001 (since August 1984 at UPR – Río Piedras)

Dates of advancement in rank:

Instructor:	1983 to 1990
Assistant Professor:	1990 to 1994
Associate Professor:	1994 to 1999
Professor:	1999 to Present
Total years of service:	21

Areas of professional expertise:

Algorithms, Data Structures, and Databases

Consulting, patents:

Consultant: PR State Elections Commission: 1997-1999: Information Systems Consultant

State(s) in which registered:

None

Principal publications of last four years: (FY2002-2003- 2006-2007):

1. Juddy Gómez and P.I. Rivera-Vega, "A Framework for the Smooth Composition of Choreography of Web Services," *ICWS (Work-in-Progress Track) 2007*, July 2007.
2. P. I. Rivera-Vega, Y. Qian, and M. Rodriguez-Martinez, "A Peer-to-Peer System to Provide Internet-based Asynchronous Educational Services," *Proceedings of the 6th International Conference on Information Technology Based Higher Education and Training*, Santo Domingo, Dominican Republic, July 7-9, 2005.
3. Manuel Rodríguez-Martínez, Omar G. Rodríguez-Martínez, Maritere Martínez-Montes, Elfred Pagan, and Pedro I. Rivera-Vega, "Smart Mirrors: Peer-to-Peer Web Services for Publishing Electronic Documents", to appear in *Proc. 14th IEEE International Workshop on Research Issues on Data Engineering: Web Services for E-Commerce and E-Government*, Boston, MA, March 28-29, 2004.
4. A. Alvear-Suarez, M. Rodriguez-Martinez, P. I. Rivera-Vega, J. Ferra, and A. Villalain, "Database Middleware System Supporting Remote Sensing Analysis over Distributed Sources," *IASTED 2003*, May 2003.

Grants or externally funded project active during the last four years: (FY2002-2003- 2006-2007)

Senior Personnel for UPRM eGovernment Project, NSF Digital Government Program, \$750K, 2003-2006.

Co-PI for Indusoft Project, Puerto Rico Industrial Development Company, \$1M, 2004-2007.

Scientific and professional societies of which a member:

Association for Computer Machinery (ACM)

Honors and awards:

NSF Graduate Fellowship, 1978-1980. While being a graduate student at the Department of Mathematics at UPR.

NASA Graduate Fellowship, 1988-1989. As a PhD student at the University of Florida, Gainesville.

Institutional and professional service in the last four years: (FY2002-2003 - 2006-2007)

Faculty advisor of the Local Engineering and Sciences ACM Student Chapter in UPR-Mayaguez.

Reviewer for various technical journals and conferences, including: CRC UPR-RUM, and The IASTED International Conference in Information and Knowledge Sharing, and in Databases.

Member of the IASTED Technical Committee on Information and Knowledge Sharing. Reviewer in different grant programs:

NSF - CISE NSF – SBIR

Local arrangements chairman for the International Conference on Wireless Pervasive Computing, 2007.

Faculty advisor for several undergraduate students sponsored by the following projects or grants: IAP at UPR-Mayaguez, PR-LSAMP, E-Government Project, and InduSoft Project.

Evaluator appointed by the Board of Higher Education in Puerto Rico to evaluate a graduate program in e-commerce at the Interamerican University of Puerto Rico, Bayamon.

Professional development activities in the last four years: (FY2002-2003 - 2006-2007)

Global Entrepreneurship: Strategy and Execution, Grupo Guayacán, Ritz Carlton Hotel, Casino and Spa, Carolina, PR, October 31st, 2007.

Puerto Rico Venture Forum and Enterprize Competition, Ritz Carlton Hotel, Casino and Spa, Carolina, PR, November 13, 2006.

Offered Courses in the past two years (2005-2007)

ICOM 4015 Advanced Programming, ICOM 4035 Data Structured, ICOM 6999 Master Thesis, ICOM 4075 Foundations of Computing, ICOM 4048 Practical Experience in Computer Engineering, ICOM 4998 Undergraduate Research

Community service activities: (FY2002-2003- 2006-2007)

Vice-president of Board of Residents at Condominium Los Almendros, Rincón, PR.

RODRÍGUEZ-MARTÍNEZ, MANUEL

Academic rank: Associate Professor

Degrees with fields, institution, and date:

BS	Mathematics	University of Puerto Rico, Rio Piedras	1994
MS	Computer Science	University of Maryland, College Park	1996
Ph. D.	Computer Science	University of Maryland, College Park	2001

Faculty service at UPRM:

Date of original appointment: July 2001 (Month, Year)

Dates of advancement in rank:

Assistant Professor:	2001 to 2005
Associate Professor	2005 to Present
Total years of service:	6

Areas of professional expertise:

Database Management Systems, Computer Networks

Other related experience—academic or industrial:

None

Consulting, patents:

Database Consultant for Polaroid Caribbean Corp., Summer of 1999.

State(s) in which registered:

None

Principal publications of last five years: (FY2002-2003- 2006-2007)

1. Juan Correa and Manuel Rodriguez, "Design and Implementation of JSwitch: A Web-Based Transaction Coordination Framework ", 4th International Conference on Information Technology: New Generations, Las Vegas, NV, April 2-4, 2007.
2. Agustín A. Irizarry-Rivera , Manuel Rodríguez-Martínez , Bienvenido Vélez , Miguel Vélez-Reyes, Alberto R. Ramirez-Orquin, Efraín O'Neill-Carrillo, and José R. Cedeño, "INTELLIGENT POWER ROUTERS: A DISTRIBUTED COORDINATION APPROACH FOR ELECTRIC ENERGY PROCESSING NETWORKS", to appear in special issue of International Journal on Critical Infrastructures.
3. Elliot Vargas-Figueroa and Manuel Rodriguez , "Design and Implementation of the NetTraveler Middleware System based on Web Services", in Proc. 2006 IEEE International Conference on Internet and Web Applications and Services, Guadalupe, France, February 23-25, 2006.
4. Edilberto Garcia and Manuel Rodríguez, "WAMDAS: A Web Service-Based Wireless Alarm Monitoring and DataAcquisition System for Pharmaceutical Plants", in Proc. 2006 IEEE International Conference on Internet and Web Applications and Services, Guadalupe, France, February 23-25, 2006

5. Hillary Caituiro and Manuel Rodriguez , "NetTraveler: A Framework for Autonomic Web Services Collaboration, Orchestration and Choreography in E-Government Information Systems", in Proc. 2004 IEEE International Conference on Web Services, San Diego, CA, July 6-9, 2004
6. Manuel Rodríguez-Martínez, Omar G. Rodríguez-Martínez, Maritere Martínez-Montes, Elfred Pagan, and Pedro I. Rivera-Vega, "Smart Mirrors: Peer-to-Peer Web Services for Publishing Electronic Documents", to appear in *Proc. 14th IEEE International Workshop on Research Issues on Data Engineering: Web Services for E-Commerce and E-Government*, Boston, MA, March 28-29, 2004.
7. Manuel Rodríguez-Martínez, Jose F. Ensenat, Elfred Pagan, and Juan G. Arbola, "Registration and Discovery of Services and Applications in the **NetTraveler** Integration System for Mobile Devices", to appear in *Proc. of 3^d IEEE ITCC Conference*, Las Vegas, NV, April 5-7, 2004.
8. Jose F. Enseñat, Manuel Rodriguez-Martinez, "Design of the Registration Server for the **NetTraveler** Middleware System", to appear in *7th International Conference on Internet and Multimedia Systems and Applications (IMSA 2003)*, Honolulu, Hawaii, USA.
9. Manuel Rodriguez-Martinez, Nick Roussopoulos, "Wide-Area Query Execution in MOCHA", *2002 IASTED Conference on Information and Knowledge Sharing (IKS 2002)*.

Grants or externally funded project active during the last five years: (FY2002-2003- 2006-2007)

PI for CAREER: NetTraveler – A Database Middleware System for Ubiquitous Data Access on Wide Area Networks, NSF CAREER Program, \$500K, 2005-2010.

Co-PI for IPRS- Intelligent Power Router, NSF EPNES Program, \$600K, 2002-2005.

Co-PI for UPRM eGovernment Project, NSF Digital Government Program, \$750K, 2003-2006.

Co-PI for WALSAIP Project, NSF MII Program, \$1.5M, 2004-2009.

Co-PI for Indusoft Project, Puerto Rico Industrial Development Company, \$1M, 2004-2007.

Co-PI for HP Digital Publishing Project, HP, \$400K, 2004-2006

PI for IBM SUR Grant, IBM, \$100K, 2005-2006

Co-PI for Dynamic Image Retrieval Project, NASA TCESS, \$50K,, 2003-2005.

Scientific and professional societies of which a member:

Association for Computer Machinery (ACM)

Special Interest Group on the Management of Data (SIGMOD)

Honors and awards:

2005 NSF CAREER AWARD for projec "CARREER: NetTraveler – A Database Middleware System for Ubiquitous Data Access on Widea-Area Networks".

Institutional and professional service in the last five years: (FY2002-2003- 2006-2007)

1. *Member of the ICOM Computing Systems Committee*
2. *Member of the INEL/ICOM Graduate Committee*
3. *Member of the CISE Ph.D. Graduate Committee*
4. *Member of the Campus Senate Computing Ad Hoc Committee*
5. *Coordinator for the CISE Ph.D. Program*
6. *Member of NSF Panel on Cyber Infrastructure*
7. *Member of NSF Panel on IT SBIR Proposals*
8. *Member of NSF Panel on Minority Infrastructure and Instrumentation Proposals*
9. *Member of the Ad Hoc Committee for the Puerto Rico Higher Education Board regarding the IT B.S. degree of the National College of Business and Technology.*

Professional development activities in the last five years: (FY2002-2003- 2006-2007)

Global Entrepreneurship: Strategy and Execution, Grupo Guayacan, Ritz Carlton Hotel, Casino and Spa, Carolina, PR, October 31st, 2007.

Puerto Rico Venture Forum and Enterprize Competition, Ritz Carlton Hotel, Casino and Spa, Carolina, PR, November 13, 2006.

Offered courses in the past two years (2005-2007)

ICOM 4048 Practical Exp in Com. Engineering, ICOM 5016 Database System, ICOM 6998 Master's Projects, ICOM 6999 Master Thesis, ICOM 6005 Data Base System Design, ICOM 4998 Undergraduate Research, CIIC 9995 Doctoral Dissertation., CIIC 8997 Independent Study

Community service activities: (FY2002-2003, 2006-2007)

Palo Seco Sports Club, Board of Directors for the Caboqueron Condominium

RODRÍGUEZ, NÉSTOR J.

Academic rank: Professor

Degrees with fields, institution, and date:

BS	Electrical Engineering	University of Puerto Rico	1978
MS	Electrical Engineering	Ohio State University	1981
Ph. D.	Electrical Engineering	University of Wisconsin Madison	1988

Faculty service at UPRM:

Date of original appointment: July 1981

Dates of advancement in rank:

Instructor:	1981 to 1988
Assistant Professor:	1988 to 1991
Associate Professor:	1991 to 1996
Professor:	1996
Total years of service:	16

Areas of professional expertise:

Human computer interaction, usability engineering, computer architecture

Other related experience—academic or industrial:

Design Engineer at Phillips Puerto Rico Core (June 78 to August 79)

Consulting, patents:

None

State(s) in which registered:

None

Principal publications of last four years: (FY 2002-2003- 2006-2007)

12. Jose Borges, Nestor Rodriguez and Carlos Perez, "Usability Issues in the Development of a User Interface for an Alerts and Reminders System for a Nursing Documentation Application". HCI International 2007 (Accepted for publication).
13. Nestor J. Rodriguez and Maria I. Diaz, "Word Processing in Spanish Using an English Keyboard: A Study of Spelling Errors". 2nd International Conference on Usability and Internationalization (UI 2007) (Accepted for publication).
14. Néstor J. Rodríguez, José A. Borges, Gilberto Crespo, Carlos Pérez, Carlos Martínez, Celia R. Colón-Rivera, Aixa Ardín, Tablet PC vs. PDA: A Usability Study of Nurses' Interaction with Two Versions of a Nursing Documentation Application. IASTED International Conference on Human Computer Interaction (IASTED-HCI 2007) (Accepted for publication).
15. N. J. Rodriguez, J. A. Borges, Naomi Acosta, "A Study of Text and Numeric Input Modalities on PDAs", HCI International 2005.

16. N. J. Rodriguez, J. A. Borges, Y. Soler, V. Murillo, D. Z., Sands, "A Usability Study of Physicians' Interaction with PDA and Laptop Applications to Access an Electronic Patient Record System," 17th. IEEE International Symposium on Computer-Based Medical Systems, 2004.
17. A. Cuaresma, N. J. Rodriguez, J. Arroyo, J. A. Borges, E. Moulrier, J. Yeckle, M. A. Rivas, "A Comparison Of A Rule Definition Language (Rdl) and the Java Object Oriented Language For Implementing A Distributed ," International Conference on Computer Science and its Applications (ICCSA-2003)
18. N. J. Rodriguez, J. A. Borges, Y. Soler, V. Murillo, D. Z., Sands, T. Bourie and C. R. Colón-Rivera, "PDA vs. Laptop: A Comparison of Two Versions of a Nursing Documentation Application," 16th. IEEE International Symposium on Computer-Based Medical Systems, 2003.
19. Arroyo J., Borges. J., Rodríguez N., Moulrier E., Rivas M., Cuaresma A., Yeckle J., "An Event/Rule Framework (ERF) for specifying the Behavior of Distributed Systems", 3rd International Workshop on Software Engineering and Middleware, 2002, pp 59 – 71.
20. Rodriguez, N.J., Borges, J.A., Murillo, V., Sands, D.Z., and Ortiz, J.. A Usability Study of Physicians Interaction with a Paper-Based Patient Record System and a Graphical-Based Electronic Patient Record System., Proc AMIA Symp 2002, November 2002.
21. Rodriguez, N.J., Murillo, V., Borges, J.A., Sands, D.Z., and Ortiz, J. A study of physicians' interaction with text-based and graphical-based electronic patient record systems. Proceedings of the 15th. IEEE International Symposium on Computer-Based Medical Systems, June, 2002.

Grants or externally funded project active during the last four years: (FY 2002-2003 - 2006-2007)

CoPI, "Computing Alliance for Hispanic-Serving Institutions" National Science Foundation, \$2,000,000, March 1, 2006 – February 28, 2009

Co-PI, "An Infrastructure for Wide-Area Large Scale Automated Information Processing", National Science Foundation, \$1,000,000, September 2004-August 2009

Co-PI, "Center for Industrial Software Development (InduSoft)", Puerto Rico Industrial Development Company (PRIDCO), \$1,500,000, June 2004-May 2007

Scientific and professional societies of which a member:

Institute of Electrical and Electronics Engineers, (IEEE), Member

Association of Computer Machinery (ACM), Member

American Medical Informatics Association, Member

Honors and awards:

None.

Institutional and professional service in the last four years: (FY 2002-2003- 2006-2007)

None.

Professional development activities in the last four years: (FY 2002-2003- 2006-2007)

Workshops:

1. *Expediting the Usability Testing Process (HC International 2005, July 2005)*
2. *Project Management: Implementing Systems on Time and Within Budget (AMIA 2005, October 23, 2005)*
3. *Introduction to the Theory and Methods of Natural Language Processing in Biomedicine (MedInfo 2004, September 7, 2004)*
4. *Managing Information Security in Health Care – A HIPAA Focus (AMIA 2003, November 11, 2003)*

Offered courses in the past two years (2005-2007)

INEL 4998 Undergraduate Research, INEL 6046 Master's Thesis, INEL 6068 ICOM 6095 Human-Computer Interaction, ICOM 6998 Master's Project, ICOM 6999 Master Thesis, ICOM 4215 Computer Architecture and Organization, INEL 6009 Computer System Architecture, INEL 4152 Electromagnetics I,

Community service activities: (FY 2002-2003 - 2006-2007)

None.

VEGA-RIVEROS, J. FERNANDO

Academic rank: Professor

Degrees with fields, institution, and date:

BS	Electrical Engineering	University Javeriana	1979
MS	Electrical Engineering	Syracuse University	1983
Ph. D.	Electrical Engineering	Syracuse University	1989

Faculty service at UPRM:

Date of original appointment: July 2001

Dates of advancement in rank:

Associate Professor:	2001 to 2006
Professor	2006 to Present
Total years of service:	5.5

Areas of professional expertise:

Artificial Intelligence, knowledge-based systems

Other related experience—academic or industrial:

Communications Engineer ; Communications Division; Avianca Airlines ; Planning; design and support of communication systems. July 1979, December 1980. Colombia.

Communications Projects Coordinator; Communications Division; Avianca Airlines; coordination and management of communication projects. January 1981, July 1982. Colombia.

Postdoctoral Research Associate; Institute for Energy Research at Syracuse University; research on Artificial Intelligence Applications for Energy Management Systems. June 1989, June 1990. USA.

Professor; Department of Electronics Engineering; Javeriana University; October 1990, June 2001. Colombia.

Chairman Electronics Engineering Department; Javeriana University; May 1999, June 2001. Colombia.

Consulting, patents:

None

State(s) in which registered:

None

Principal publications of last four years: (FY 2002-2003 - 2006-2007)

-Jiménez, M., Santiago, N. G., Vega-Riveros, J. F., Rubert, C., Bonilla, G., Torres, I., Maldonado, C., Malavé, J., and R. Rosario. Integrating Fundamental and Advanced Concepts in a Rounded Capstone Design Experience in Computer Engineering. Abstract accepted. Paper submitted for publication at the Frontiers in Education Conference. Milwaukee, Wisconsin, October 10-13, 2007.

-Jiménez, M., Santiago, N., Pomales, C., Nieves, A., López, V. and J. F. Vega-Riveros. An Analysis of Behavior Patterns in Generation Y Engineering Students and their Implications in the Teaching-Learning Process. Accepted for publication at the 2007 ASEE Annual Conference and Exposition. Honolulu, Hawaii, June 24-27, 2007.

-Chaparro-Baquero, G. A., N. G. Santiago, W. Rivera and J. F. Vega-Riveros. Measuring quantitatively dependability attributes in digital publishing using Petri Net workflow modeling. Accepted for publication in the 2nd IEEE International Symposium on Dependable, Autonomic and Secure Computing DASC'06. Indianapolis, IN, USA, Sep 29-Oct 1, 2006. Pp. 119-126. Full paper review.

-Carvajal, J. P and J. F. Vega Riveros. An information theory approach to measuring semantic similarity among multiple ontologies of the same domain. Submitted to 26th Puerto Rico Interdisciplinary Scientific Meeting (Prism). University of Puerto Rico, Cayey. March 11, 2006. Abstract review.

-Jaimes, L. G. and Vega Riveros, J. F. Técnicas de recuperación de información. XXI Seminario Interuniversitario De Investigación en ciencias Matemáticas SIDIM 2006. Universidad del Turabo, Gurabo, Puerto Rico. February 24-25, 2006. Abstract review.

-Vega-Riveros, J. Fernando and Hector J. Santos Villalobos, Graphic design principles for automated document segmentation and understanding. SPIE Electronic Imaging 2006 EI 2006 – Document Recognition and Retrieval XIII, San Jose, California, January 15-19, 2006. Abbreviated paper review.

-Vega-Riveros, J. Fernando and Hector J. Santos Villalobos, A Hybrid Intelligence Approach to Artifact Recognition in Digital Publishing. SPIE Electronic Imaging 2006 EI 2006 - Digital Publishing I, San Jose, California, January 15-19, 2006. Extended abstract review.

-Dinos, J. L. and Vega Riveros, J.F. A document ontology and agent-based RDF metadata retrieval. Semantic Web Personalization Workshop. San José, California, USA. July 25, 2004. pp 13-17. Full paper review.

-Dinos, J. L. and Vega Riveros, J.F. Architecture of a system for document retrieval using semantic metadata. Computing Research Conference CRC 2004. University of Puerto Rico, Mayagüez. April 2, 2004. Full paper review.

-Millan, M.G.; Kamer S. and J. F. Vega. Towards the development of a learning management system: a case study of students' use of information. University of Puerto Rico, Mayagüez, April 6, 2003. Full paper review.

Grants or externally funded project active during the last four years: (FY 2002-2003 - 2006-2007)

- Principal Investigator. "Autonomous Document Analysis Expert". HP Corporate philanthropy. PI Jan Allebach, Purdue University. Other Co-PI, Joao Batista Souza de Oliveira, Pontifical Catholic University of Rio Grande do Sul, Brasil. January 2007-January 2008.

-Co-Principal Investigator. "Digita Publishing Mashup Site". HP Corporate philanthropy. PI Malu Roldan, San Jose State University. Other Co-PI, Frank Cost, Rochester Institute of Technology, Andre Santanche, Universidade Salvador (UNIFACS), Brazil. January 2007-January 2008.

- Altova Education-Training Partners Program. Software License Gift of Altova XML Suite for 30 users.

-Principal Investigator. "High-quality web-based digital publishing service for higher education. July 2005-July 2006.

- Co-Principal Investigator. "A Research program on Digital Publishing". Hewlett Packard Puerto Rico. Collaboration with Hewlett Packard Labs and Purdue University. March 1, 2004 – February 28, 2005. PI Wilson Rivera. Other CoPIs: Nayda Santiago, Manuel Rodríguez and Jaime Seguel from UPRM; and Jan Allebach from Purdue University

-Co-Principal Investigator. "Artifact Recognition in Digital Publishing". Project which is part of the research program on Digital Publishing. March 1, 2004 – February 28, 2005.

-Co-Principal Investigator. "Workflow Management in Digital Publishing". Project which is part of the research program on Digital Publishing. March 1, 2004 – February 28, 2005.

- Principal Investigator. "Development of a Knowledge Management System for Learning and Teaching in Higher Education". IAP, September 2003 – September 2004.

Scientific and professional societies of which a member:

Institute of Electrical and Electronics Engineers, (Member)

Honors and awards:

"Mención de Honor" from Vicerectoría Académica (Mention of Honor, Academic Vicerector), Pontificia Universidad Javeriana (Javeriana University). Awarded for the research project "Tecnologías de Información y Educación" (Education and Information Technologies), Oct 8 1999.

Diamond Award; 2nd Asia-Pacific Forum on Engineering and Technology Education. To the best Forum Paper. Sydney, Australia, July 4-7 1999.

Gold Award; 1st Asia-Pacific Forum on Engineering and Technology Education, To the third best Forum Paper. Melbourne, Australia, July 6-9 1999.

Fellow; Parallel Architectures Center at Syracuse University, June-Aug 1987.

Institutional and professional service in the last four years: (FY 2002-2003 - 2006-2007)

-Associate Director for Academic Affairs, Dept. of Electrical and Computer Engineering, January 2002 – August 2004.

-Coordinator for Accreditation and Continuous Quality Improvement for the Computer Engineering program, Dept. of Electrical and Computer Engineering, January 2005 – present.

Professional development activities in the last four years: (FY 2002-2003 - 2006-2007)

Founding member and UPRM representative in Digital Publishing University Research Community (Chameleon Federation), led by HP Labs.

Offered courses in the past two years (2005-2007)

ICOM 4998 Undergraduate Research, ICOM 5015 Artificial Inteligence, ICOM 5047 Computer Engineering Design, ICOM 6215 Expert Systems, ICOM 6995 Independent Studies in Computer Engineering, ICOM 6999 Master Thesis, INEL 6995 Special Topics in Electrical Engineering, CIIC 8997 Independent Stud , CIIC 9995 Doctoral Dissertatin, ICOM 6998 Master's Project, ICOM 6015 Artificial Neural Networks

Community service activities: (FY 2002-2003 - 2006-2007)

- President of Parents and Teachers Association, Immaculate Conception Academy – Elementary School level, Mayagüez, FY 2004-05

- Vicepresident of Parents and Teachers Association, Immaculate Conception Academy – High School level, Mayagüez, FY 2005-06.

VÉLEZ-RIVERA, BIENVENIDO

Academic rank: Associate Professor

Degrees with fields, institution, and date:

BA	Computer Science	Cornell University	1986
MS	Computer Science	University of California Berkeley	1988
Ph. D.	Computer Science	Massachusetts Institute of Technology	1999

Faculty service at UPRM:

Date of original appointment: January 2000

Dates of advancement in rank:

Assistant Professor: January 2000 - 2005

Associate Professor 2005 to Present

Total years of service: 7

Areas of professional expertise:

Software Quality Assurance, Information Retrieval

Other related experience—academic or industrial:

Assistant Professor. **University of Puerto Rico – Río Piedras**, Department of Mathematics and Computer Science, August 1999 – December 1999

Teaching Assistant. **Massachusetts Institute of Technology** – Laboratory for Computer Science, CS 6.821 – Graduate Course on Programming Languages Taught by Professor David K. Gifford, Fall 95

Teaching Assistant, **Massachusetts Institute of Technology** – Laboratory for Computer Science. CS 6.001 Structure and Interpretation of Computer Programs, Taught by Professor Gerald J. Sussman. Spring 95

Instructor of Computer Science, **University Puerto Rico – Río Piedras**, Department of Mathematics and Computer Science, Fall 89 - Summer 93

Other related experience—academic or industrial:

Colegio de Abogados de PR, Development of membership information system. 1993.

CEO and Founder of Phidelix Technologies Corporation (www.phidelix.com)

Consulting, patents

Hewlett Packard, Development of system software to support intelligent network devices, (2000-2001).

Puerto Rico Senate. Consulted on Computational Statistics. (1992-1993).

Corporación Fondo del Seguro del Estado. Consulted on Computational Statistics. (1992-1993).

State(s) in which registered:

Principal publications of last four years: (FY 2002-2003-2006-2007):

- Christian Feliciano & Bienvenido Vélez. A Time-Domain Simulation Framework of an IPR-Based Shipboard Integrated Power System. IEEE 2006 Transmission and Distribution Conference. Caracas, Venezuela. August 15-18, 2006.
- Iván Vélez & Bienvenido Vélez. Lynx: An Open Architecture for Catalyzing the Deployment of Interactive Digital Government Workflow-Based Systems 7th Annual International Conference on Digital Government Research (DG.O 2006). San Diego, California, USA. May 21-24, 2006.
- Iván Vélez & Bienvenido Vélez. Lynx: An Open Email Extension for Workflow Systems Based on Web Services and its Application to Digital Government International Conference on Internet and Web Applications and Services (ICIW'06). Guadeloupe, French Caribbean. February 23-25, 2006.
- Lizvette Malavé y Bienvenido Vélez. TerraScope Image Clustering: Applying Clustering Techniques to Image Agglomeration in Image Retrieval Systems. International Conference on Communications, Internet and Information Technology. Saint Thomas VI. November 2004.
- Amaury Cabarcas, Lizvette Malavé y Bienvenido Vélez. TIN: An Interactive Image Navigator Providing Ubiquitous Access to Distributed GeoSpatial Data. IEEE ITCC Conference. Las Vegas, Nevada. April 2004.
- Elastically Replicated Information Services: Sustaining the Availability of Distributed Storage Across Dynamic Topological Changes. 2003 Southern Association of Information Systems Conference. Savannah, Georgia, USA. March 7-8 2003.

Grants or externally funded project active during the last four years: (FY 2002-2003-2006-2007)

Digital Government Project (PI:NSF:750K)

Indusoft Center of Excellence in Industrial Software Development (PI:PRIDCO:1.4M)

Assisting Bio-Informatics Efforts at Minority Institutions (CoPI:NIH:500K)

Scientific and professional societies of which a member:

Association for Computing Machinery (ACM)

IEEE-Computer Society – UPRM Chapter Faculty Advisor

Honors and awards:

MIT Special Minority Award (1993)

Cornell University Computer Science Distinction in all Subjects (1986)

Ford Foundation Doctoral Fellowship Award (1986-1988)

Professional development activities in the last four years: (FY 2004-2005-2006-2007)

MIT Entrepreneurship Development Program

Workshop: Development of Outcomes-based Courses

Workshop: Systems Security

Workshop: CFR21-11 Federal Regulations for Electronic Records and Signatures

Workshop: IBM Websphere Studio

Workshop: WebCT

Workshop: How to Create and Grow your Technology Business

MIT Entrepreneurship Development Program

Offered Courses in the past two years (2006-2007)

CICC 9995 Doctoral Dissertation , ICOM 4015 Advanced Programming, ICOM 4036 Structure and Properties of Programming Languages, ICOM 4048 Practical Experience in Comp. Engineering, ICOM 4036 Structure and Properties of Programming Languages. INEL 6046 Master Thesis, ICOM 6999 Master Thesis, ICOM 5995 Special Problems, ICOM 4998 Undergraduate Research, ICOM 4036 Structures and Properties of Programming Languages. ICOM 4015 Advanced Programming, CIIC 8015 Advanced Topics, ICOM 4029 Compiler Construction.

Community service activities: (FY 2004-2005-2006-2007)

Condominio Playa Buyé Residents Association – President

Colegio San Agustin Parents Teachers Association – Vice President

LU, KEJIE

Academic rank: Assistant Professor

Degrees with fields, institution, and date:

BE	Telecommunications Engineering	Beijing University of Posts and Telecommunications	1994
ME	Communications and Electronic Systems	Beijing University of Posts and Telecommunications	1997
Ph.D.	Electrical Engineering	The University of Texas at Dallas	2003

Faculty service at UPRM:

Date of original appointment: July 2005

Dates of advancement in rank:

Assistant Professor: 2005 to present

Total years of service: 2

Areas of professional expertise:

Computer and communications networks: architecture and protocol design, performance evaluation, network security

Wireless communications: space-time coding, channel capacity

Other related experience—academic or industrial:

4 years experience in research and development in telecommunications industry

1.5 years experience conducting research as a postdoc research associate

Consulting, patents:

N/A

State(s) in which registered:

N/A

Principal publications of last four years: (FY 2002-2003 - 2006-2007)

JOURNAL ARTICLES (PUBLISHED OR ACCEPTED)

1. Bo Rong, Yi Qian, and Kejie Lu, "Integrated Downlink Resource Management for Multiservice WiMAX Networks", accepted for publications, to appear in *IEEE Transactions on Mobile Computing*.
2. Kejie Lu, Yi Qian, Mohsen Guizani, and Hsiao-Hwa Chen, "A Distributed Key Management Scheme in Heterogeneous Wireless Sensor Networks", accepted for publications, to appear in *IEEE Transactions on Wireless Communications*.
3. Kejie Lu, Yi Qian, and Hsiao-Hwa Chen, "A Secure and Service-Oriented Network Control Framework for WiMAX Networks", *IEEE Communications*, Vol.45, No.5, May 2007.
4. Kejie Lu, Jianfeng Wang, Dapeng Wu, and Yuguang Fang, "Performance of A Burst-Frame-Based CSMA/CA Protocol: Analysis and Enhancement," accepted by *ACM Wireless Networks*.

5. Kejie Lu, Dapeng Wu, Yi Qian, Yuguang Fang, and Robert C. Qiu, "Performance of An Aggregation-Based MAC Protocol for High-Data-Rate Ultra-Wideband Ad Hoc Networks", *IEEE Transactions on Vehicular Technology*, Vol.56, No.1, pp 312-321, Jan. 2007.
6. Yu Zheng, Kejie Lu, Dapeng Wu, and Yuguang Fang, "Performance Analysis of IEEE 802.11 DCF in Imperfect Channels," *IEEE Transactions on Vehicular Technology*, Vol. 55, No. 5, pp. 1648-1656, Sept. 2006.
7. Tao Zhang, Kejie Lu, and Jason P. Jue, "Shared Buffering in Optical Packet-Switched Networks," *IEEE Journal on Selected Area in Communications (JSAC)*, Vol. 24, No. 4, pp. 118-127, Apr. 2006.
8. Wei Liu, Yanchao Zhang, Kejie Lu, and Yuguang Fang, "Energy conservation through resource-aware movement in heterogeneous mobile ad hoc networks," *Journal of Combinatorial Optimization, Special Issue on Network Applications*, Vol. 11, No. 1, pp. 7-20, Jan. 2006.
9. Kejie Lu, Shengli Fu, and Xiang-Gen Xia, "Closed-Form Designs of Complex Orthogonal Space-Time Block Codes of Rates $(k+1)/(2k)$ for $2k$ or $2k+1$ Transmit Antennas," *IEEE Transaction on Information Theory*, Vol 51, No. 12, pp. 4340-4347, Dec 2005.
10. Kejie Lu, Dapeng Wu, and Yuguang Fang, "A Novel Framework for Medium Access Control in Ultra-Wideband Ad Hoc Networks", *Dynamics of Continuous, Discrete and Impulsive Systems, Series B*, Vol. 12, No. 3, pp. 427-441, Jun. 2005.
11. Yu Zheng, Kejie Lu, Dapeng Wu, and Yuguang Fang, "Performance Analysis Of Frame-Burst-based Medium Access Control Protocols Under Imperfect Wireless Channels, " *International Journal of Intelligent Control and System* Vol. 10, No. 1, pp. 43-51, Mar 2005.
12. Kejie Lu, Gaoxi Xiao, and Imrich Chlamtac, "Analysis of Blocking Probability for Distributed Lightpath Establishment in WDM Optical Networks," *IEEE/ACM Transaction on Networking*, Vol. 13, No. 1, Feb. 2005.
13. Tao Zhang, Kejie Lu, and Jason P. Jue, "Differentiated Contention Resolution for QoS in Photonic Packet-Switched Networks," *IEEE/OSA Journal of Lightwave Technology (JLT)*, Vol.22, No.11, pp.2523--2535, Nov. 2004.
14. Gaoxi Xiao, Kejie Lu, and Imrich Chlamtac, "An Evaluation of Distributed Wavelength Provisioning in WDM Optical Networks with Sparse Wavelength Conversion," *IEEE/OSA Journal of Lightwave Technology (JLT)*, Vol.22, No.7, pp.1668--1678, Jul. 2004.
15. Kejie Lu, Jason P. Jue, Gaoxi Xiao, Imrich Chlamtac, and Timucin Ozugur, "Intermediate-Node Initiated Reservation (IIR): A New Signaling Scheme for Wavelength-Routed Networks," *IEEE Journal on Selected Areas in Communications (JSAC)*, Vol.21, No.8, pp.1285--1294, Oct. 2003.

CONFERENCE PAPERS

1. Kejie Lu, Tao Zhang, and Ayat Jafari, "Performance of An Anycast Routing Scheme in All-Optical Networks", *Proceedings of IEEE ICC'2007*, Glasgow, UK, June 24-28, 2007.
2. Bo Rong, Yi Qian, and Kejie Lu, "Downlink Call Admission Control in Multiservice WiMAX Networks", *Proceedings of IEEE ICC'2007*, Glasgow, UK, June 24-28, 2007.
3. Yi Qian, Kejie Lu, and David Tipper, "Towards Survivable and Secure Wireless Sensor Networks", *WIA'2007, Proceedings of IEEE IPCCC'2007*, New Orleans, LA, April 11-13, 2007.
4. Kejie Lu, Yi Qian, and Shengli Fu, "Enhancing The Performance of Wireless LANs in Error-Prone Environment", in *Proc. IEEE Globecom 2006*, Nov. 2006, San Francisco, CA, USA.
5. Tao Jiang, Kejie Lu, Dapeng Wu, and Guangxi Zhu, "On The Uniform Companding Transform for Reducing PAPR of MCM Signals", in *Proc. IEEE Globecom 2006*, Nov. 2006, San Francisco, CA, USA.

6. Jieyan Fan, Dapeng Wu, Kejie Lu, and Antonio Nucci, "Design of Bloom Filter Array for Network Anomaly Detection", in Proc. IEEE Globecom 2006, Nov. 2006, San Francisco, CA, USA.
7. Kejie Lu and Yi Qian, "On The Performance Of A Distributed Key Management Scheme In Heterogeneous Wireless Sensor Networks", in Proc. of IEEE MILCOM, Oct. 2006, Washington DC, USA.
8. Hua Zhu and Kejie Lu, "On The Interference Modeling Issues for Coordinated Distributed Scheduling in IEEE 802.16 Mesh Network," in the Third International Conference on Broadband Communications, Networks and Systems (BROADNETS 2006), October 1-5, 2006, San José, California, USA.
9. Xiaodong Huang, Qinya She, Tao Zhang, Kejie Lu, and Jason P. Jue, "Small Group Multicast with Deflection Routing in Optical Burst Switched Networks," in Proc. of International Workshop on Optical Burst/ Packet Switching (WOBS 2006), in conjunction with BroadNets 2006 in San José, Ca. on Oct. 2nd, 2006.
10. Kejie Lu, Jiangfeng Wang, Dapeng Wu, and Yuguang Fang, "Performance of A Burst-Frame-Based CSMA/CA Protocol for High Data Rate Ultra-Wideband Networks: Analysis and Enhancement," in Proc. of The Third International Conference on Quality of Service in Heterogeneous Wired/Wireless Networks (QShine 2006), August 7-9, 2006, Waterloo, Ontario, Canada.
11. Marc De Leenheer, Farid Farahmand, Kejie Lu, Tao Zhang, Pieter Thysebaert, Bruno Volckaert, Filip De Turck, Bart Dhoedt, Piet Demeester, and Jason P. Jue, "Anycast Algorithms Supporting Optical Burst Switched Grid Networks," in Proc. of International Conference on Networking and Services (ICNS'06), July 16-18, 2006, Silicon Valley, USA.
12. Hua Zhu and Kejie Lu, "Performance of IEEE 802.16 Mesh Coordinated Distributed Scheduling Under Realistic Non-Quasi-Interference Channel," in Proc. of the International Conference on Wireless Networks (ICWN'06), June 26-29, 2006, Las Vegas, USA.
13. Kejie Lu and Yi Qian, "Performance Analysis of A Retransmission Scheme for High-Data-Rate MAC Protocol in Wireless LANs," in Proc. of IEEE International Conference on Communications (ICC) 2006, Istanbul, Turkey, June 11-15, 2006.
14. Kejie Lu, Yi Qian, and Jiankun Hu, "A Framework for Distributed Key Management Schemes in Heterogeneous Wireless Sensor Networks," in Proc. of IEEE International Performance Computing and Communications Conference (IPCCC), Workshop on Information Assurance 2006, pp. 513-519, Phoenix, Arizona, USA, April 10-12, 2006.
15. Yu Zheng, Kejie Lu, Dapeng Wu, and Yuguang Fang, "Performance Analysis of IEEE 802.11 DCF in Binary Symmetric Channels," in Proc. of IEEE Globecom 2005, St. Louis, MO, USA, November 28 - December 2, 2005.
16. Kejie Lu, Jieyan Fan, James Greco, Dapeng Wu, S. Todorovic, and Antonio Nucci, "A Novel Anti-DDoS System for Large-Scale Internet," ACM SIGCOMM 2005, Work-in-Progress Session, Philadelphia, PA, USA, August 22--26, 2005.
17. M.-A. Park, Kejie Lu and Jason P. Jue, "On the Routing and Wavelength Assignment with Inaccurate Network State Information in Wavelength-Routed Networks," in Proc. of IASTED International Conference on Optical Communication Systems and Networks, Banff, Canada, July 2005.
18. Kejie Lu, Dapeng Wu, Yuguang Fang, and Robert C. Qiu, "Performance Analysis of A Burst-Frame-Based MAC Protocol for Ultra-Wideband Ad Hoc Networks", in Proc. of IEEE International Conference on Communications (ICC) 2005, Vol. 5, pp. 2937-2941, Seoul, Korea, May 2005.
19. Tao Zhang, Kejie Lu, and Jason P. Jue, "An Analytical Model for Shared Fiber Delay Line Buffers in Asynchronous Optical Packet and Burst Switches," in Proc. of IEEE International Conference on Communications (ICC) 2005, Vol. 3, pp. 1636-1640, Seoul, Korea, May 2005.
20. Tao Zhang, Kejie Lu and Jason P. Jue, "Performance of Fiber Delay Line Buffers in Packet-Based Multifiber Optical Networks," in Proc. of OFC 2005, Vol.1, pp 220-222.

21. Kejie Lu, Dapeng Wu, Yuguang Fang, and Robert C. Qiu, "On Medium Access Control for High Data Rate Ultra-Wideband Ad Hoc Networks", in Proc. of IEEE Wireless and Communications and Networking Conference (WCNC) 2005, Vol. 2, pp. 795-800, New Orleans, LA, March, 2005.
22. Kejie Lu, Gaoxi Xiao, Jason P. Jue, Tao Zhang, Shengli Yuan, and Imrich Chlamtac, "Blocking Analysis of Multifiber Wavelength-Routed Networks," in Proc. of IEEE Global Telecommunications Conference (Globecom) 2004, pp. 1958--1962, Dallas, TX, December 2004.
23. Guoping Zeng, Kejie Lu, and Imrich Chlamtac, "On the Conservation Law in Optical Burst Switching Networks," in Proc. of Symposium on Performance Evaluation of Computer and Telecommunication Systems (SPECT) 2004, pp.124--129, San Jose, CA, July, 2004.
24. Guoping Zeng, Imrich Chlamtac, and Kejie Lu, "A Finite Queueing Network Model for Burst Assembler in OBS Networks", in Proc. of Symposium on Performance Evaluation of Computer and Telecommunication Systems (SPECT) 2004, pp. 642--648, San Jose, CA, July, 2004.
25. Kejie Lu, Shengli Fu, and Xiang-Gen Xia, "Closed Form Designs of Complex Orthogonal Space-Time Block Codes of Rates $(k+1)/(2k)$ for $2k$ or $2k+1$ Transmit Antennas," in Proc. of IEEE International Symposium on Information Theory (ISIT) 2004, pp. 307--307, Chicago, IL, June 2004.
26. Tao Zhang, Kejie Lu, and Jason P. Jue, "Differentiated Contention Resolution for QoS in Photonic Packet-Switched Networks," in Proc. of IEEE International Conference on Communications (ICC) 2004, pp. 1599--1603, Paris, France, June 2004.
27. Kejie Lu, Jason P. Jue, Gaoxi Xiao, Imrich Chlamtac, and Timucin Ozugur, "A Distributed Signaling Scheme for Provisioning Dynamic Traffic in Wavelength-Routed Networks," in Proc. of SPIE Opticomm. 2003, pp.151--162, Dallas, TX, October 2003.
28. Kejie Lu, Jason P. Jue, Timucin Ozugur, Gaoxi Xiao, and Imrich Chlamtac, "Intermediate-Node Initiated Reservation (IIR): A New Signaling Scheme for Wavelength-Routed Networks with Sparse Conversion," in Proc. of IEEE International Conference on Communication (ICC) 2003, Anchorage, AK, vol.2, pp.1386--1390, May 2003.
29. Kejie Lu, Gaoxi Xiao, and Imrich Chlamtac, "Behavior of Distributed Wavelength Provisioning in Wavelength-Routed Networks with Partial Wavelength Conversion," in Proc. of IEEE INFOCOM 2003, San Francisco, CA, vol.3, pp.1816--1825, March-April 2003.
30. Kejie Lu, Gaoxi Xiao, and Imrich Chlamtac, "Blocking Analysis of Dynamic Lightpath Establishment in Wavelength-Routed Networks," in Proc. of IEEE International Conference on Communication (ICC) 2002, New York, NY, vol.5, pp.2912--2916, April 2002. .

Scientific and professional societies of which a member:

- Member of IEEE
- Member of IEEE Communications Society

Honors and awards:

Institutional and professional service in the last four years: (FY 2002-2003- 2006-2007)

SERVICE

University, School and Department Committees

- UPRM ECE Department, Graduate Committee (2006-current)
- UPRM ECE Department, ICOM Software Committee (2005-current)

- UPRM ECE Department, Communications and Signal Processing Committee (2005-current)

Conference Program Committees

- Technical Program Committee Member, IEEE Globecom'2007, Washington, DC, November 2007.
- Special Session Chair, IASTED PDCS 2007
- Technical Program Committee Member, Chinacom 2007
- Technical Program Committee Member, AccessNets 2007
- Technical Program Committee Member, IEEE ICC'2007, Glasgow, UK, June 2007.
- TPC co-Chair, International Symposium on Wireless Pervasive Computing 2007, San Juan, Puerto Rico, February 5-7, 2007.
- Publication Chair, International Symposium on Wireless Pervasive Computing 2007, San Juan, Puerto Rico, February 5-7, 2007.
- Technical Program Committee Member, IEEE Globecom'2006, San Francisco, CA, December, 2006.
- Publicity co-chair, Valuetools 2006
- Publicity vice chair, SPECTS 2005
- Publicity chair, BroadWISE 2004
- Publicity chair, GridNets 2004
- Technical Program Committee Member, BroadWise'2004, 2004

Reviews of Journal Articles, Conference Papers, and Book Proposals

- Reviewer of Journals:
 1. IEEE Transaction on Communication
 2. IEEE Journal on Selected Areas in Communications (JSAC)
 3. IEEE Transaction on Vehicular Technology
 4. IEEE Transaction on Wireless Communications
 5. IEEE Communications Magazine
 6. IEEE Communication Letter
 7. IEEE Signal Processing Letter
 8. SPIE / Kluwer Optical Networks Magazine
 9. Elsevier Computer Networks
 10. Elsevier Theoretical Computer Science A
 11. Elsevier Optics Communications

12. Wiley Wireless Communications and Mobile Computing (WCMC)

13. The International Journal of Management Science (OMEGA)

• Reviewer of Conferences:

1. IEEE INFOCOM (2003-2005)

2. IEEE ICC (2003-2007)

3. IEEE Globecom (2002-2006)

4. IEEE WCNC (2006)

5. SPIE Opticomm (2002-2003)

6. IEEE ICCCN (2001)

7. IEEE LANMAM (2004)

8. IEEE VTC (2005)

9. BroadNets (2004)

10. QShine (2004)

Professional development activities in the last four years: (FY 2002-2003 - 2006-2007)

Taken various short courses and training.

Offered Courses in the past two years

ICOM 5026 Computer Networks, ICOM 4015 Advanced Programming INEL 4207 Digital Electronics, ICOM 4998 Undergraduate Research, ICOM 4075 Foundations of Computing, ICOM 5026 Computer Networks, ICOM 6999 Master's Thesis. CIIC 9995 Doctoral Dissertation, ICOM 6505 Wireless Networks, ICOM 6995 Independent Studies in Computer Engineering

Community service activities: (FY 2002-2003 - 2006-2007)

VÁSQUEZ-ESPINOSA, RAMÓN E.

Academic rank: Professor

Degrees with fields, institution, and date:

BS	Electrical Engineering	University of Puerto Rico, Mayagüez	1974
MS	Electrical Engineering	University of Puerto Rico, Mayagüez	1979
Ph. D.	Electrical Engineering	Louisiana State University	1984

Faculty service at UPRM:

Date of original appointment: August 1975

Dates of advancement in rank:

Instructor:	1975 to 1984
Assistant Professor:	1984 to 1987
Associate Professor:	1987 to 1992
Professor:	1992 to Present
Total years of service:	31

Areas of professional expertise:

Remote Sensing, Computer Vision, Geographic Information Systems, Image Processing, Artificial Intelligence

Other related experience—academic or industrial:

Feb., 2000-present **Dean**, College of Engineering, University of Puerto Rico at Mayagüez

June, 1999 to Jan. 2000 **Director**, Center for Research and Development, UPRM

June 1998 to June 1999 **Associate Dean** of Academic Affairs, College of Engineering, UPRM

Mar. 1990 to June, 1998 **Associate Director**, Dept. of Electrical and Computer Engineering, UPRM

1994 to 1998 **Director**, Center for Computing Research and Development, Dept. of Electrical and Computer Engineering, (CECORD) UPRM

1989 to 1998 **Director**, Laboratory of Remote Sensing and Image Processing (LARSIP), Department of Electrical and Computer Engineering, UPRM

Consulting, patents:

None

State(s) in which registered:

None

Principal publications of last four years: (FY 2002-03 -- 2006-07):

- "An Empirical Model to Estimate Soil Moisture over Vegetated Areas", by N. Ramírez, C. Calderón and R. Vásquez, 21th Conference on Hydrology, 87th Annual AMS Meeting, San Antonio TX, January 14-19, 2007.
- "Vertical Soil Moisture Profile Based on *In-Situ* and Satellite Observations", by N. Ramírez, C. Calderón and R. Vásquez, The NOAA/EPP Fourth Education and Science Forum, Tallahassee, FL, October 30-November 1, 2006.
- "Integrating Cross-Comparison Methodologies for Retrieval of Cloud Top Heights over the Caribbean", by A. Picón, H. Parsiani, and R. Vásquez, WSEAS Transactions on Signal Processing, Issue2, Vol. 2, Pages 265-270, February 2006.
- "MODIS Land Surface Retrieval in San Juan, during the ATLAS Field Campaign" by A.J. Picón, R. Vásquez, J.E. González, J.C. Luvall and D. Rickman, 86th AMS Annual Meeting Combined Preprints, Atlanta, GA, 29 January - 2 February 2006.
- "Cross Comparison of MODIS and MISR Cloud Top Height Retrieval Over The Caribbean" by A. Picón, R. Vásquez and H. Parsiani, WSEAS 2005 Conference, November 2005, Italy.
- "ABET's Engineering Criteria 2000: Our Efforts in a Nutshell", by A.D. Sharma, I. Davis, R. Vásquez, and L. Morell, INEER Special Volume: INNOVATIONS 2004, World Innovations in Engineering Education and Research (ISBN 0-9741252-1-0), Chapter 24.
- "Continuous Improvement Educational Initiative: A Campus-Wide Assessment Effort", by A.D. Sharma and R. Vásquez, World Congress on Engineering & Technology Education - WCETE 2004 in Santos, Brazil, March 14-17, 2004; and also at the ASEE Annual Meeting in Salt Lake City, Utah, June 22-24, 2004.
- "A Short- and Long-Term Memory Model to Estimate Soil Moisture", by N. Ramírez, R. Vásquez, H. Cruzado and E. Harmsen, The 31th International Symposium on Remote Sensing of Environment 2005 "Global Monitoring for Sustainability and Security", Saint Petersburg Russia, June 20-24, 2005.
- "2005: Urban Heat Islands Developing in Coastal Tropical Cities" by J.E. González, J.C. Luvall, D. Rickman, D.E. Comarazamy, A.J. Picón, E.W. Harmsen, H. Parsiani, N. Ramírez, R. Vásquez, R. Williams, R. B. Waide, and C. A. Tepley, EOS Transactions, AGU, 86, 42, pp. 397 & 403.
- "A Transfer Function Model to Estimate Soil Moisture", by N. Ramírez, R. Vásquez, H. Cruzado, and E. Harmsen, Proceedings of Research & Education Advancements in Oceanic & Atmospheric Sciences, New York, pp 175-180, October 21-23, 2004.
- "Retrieval of Cloud Top Heights over the Caribbean" by A. Picón and R. Vásquez, SPIE Remote Sensing of Clouds and the Atmosphere IX Conference, Maspalomas, Gran Canaria, Spain, September 2004.
- "Cloud top height retrieval over the Caribbean by using MODIS and MISR data" by A. Picón and R. Vásquez, American Society for Photogrammetry and Remote Sensing (ASPRS) Annual Conference, Denver, CO, May 2004.
- "A study on cloud-top height retrieval by using MISR and MODIS data," by A. Picón and R. Vásquez, IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2003), Toulouse, France, July 2003.

"Texture based cloud detection in MODIS images", by V. Manian and R. Vásquez, SPIE Vol. 4882, Sept. 22-27, 2002

"Approaches to color and texture based image classification", V. Manian and R. Vásquez, Journal of Optical Engineering, SPIE, July 2002.

"A genetic algorithm for texture description and classification", by V. Manian and R. Vásquez, Proceedings of AeroSense'02, April 2002.

- "The Laboratory for Applied Remote Sensing and Image Processing at University of Puerto Rico at Mayaguez", by S. Cruz-Pol, M Vélez-Reyes, S. Hunt, H. Parsiani, J. Colom-Ustari, L.O. Jiménez, and R. Vasquez, IEEE Geoscience and Remote Sensing Newsletter, January 2002.

Grants or externally funded project active during the last four years: (FY 2002-03-- 2006-07)

- "Center of Remote Sensing & Technology", CREST-NOAA, \$2,500,000/5 year, 2006-2011-Deputy-PI

- "Statistical Techniques to Improve the Hydro-Estimator Rainfall Algorithm During Heavy Storms over Puerto Rico" Funded by NOAA/NWS, **\$100,000**, September 2006 to July 2008-Collaborator for Remote Sensing
- "Soil Moisture Estimation and Validation a Hydro-Estimator" Funded by NOAA-CREST, **\$270,000**, August 2003 to July 2006, PI
- "National Aeronautical Space Administration: Experiments Program to Stimulate Competitive Research" NASA-EPSCOR, **1,125,000/** 5 year, 2002-2007-Co-PI
- "Center of Remote Sensing & Technology", CREST-NOAA, **\$2,500,000/5** year, 2001-2006-Deputy PI
- "Tropical Center for Earth and Space Studies", NASA-URC II, Goddard Flight Center, NASA, **\$4,999,513.00**, UPR matching fund for **\$2,450,000**, 2000-2005-Co-PI
- "PaSCOR-NASA" grant, **\$3,163,167.00**, UPR matching fund for **\$299,918**, 1999-2004-Research collaborator
- "Partnership for Spatial Computational Research" (PaSCoR), NASA (PAIR), **\$2,301,289**, June 1998 to May 2003 – PI

Scientific and professional societies of which a member:

IEEE, ASEE, SPIE, ASPRS, PRS, ADMI, and ACM.

Honors and awards:

(1) Centennial Certificate, The American Society for Engineering Education, Best of Session Award for the Plenary Session on COASTAL MAPPING AND CHARTING entitled: "An Integrated Mapping and Databank System for Coastal Changes"; (2) Tau Beta Pi; (3) Eta Kappa Nu; (4) Who is Who Among Students in American Universities; (5) Sigma Xi.

Institutional and professional service in the last four years: (FY 2002-03 -- 2006-07)

- Chair, Co-Chair and/or committee member of numerous conferences such as ISWPC 2007, ICEE 2006, LACCEI 2006, MWSCAS 2006, ITHET 2005, ADMI 2005, and others
- Editor of the publication: "Innovations 2006", ISSN 1553-9911, ISBN 0-9741252-5-3
- Member of several departmental, faculty and institutional committees

Professional development activities in the last five years: (FY 2002-03 -- 2006-07)

- 7mo Taller de Gerencia Académica, March 2007
- 6to Taller de Gerencia Académica, September 2006
- Propiedad Intelectual en UPR y Ley de Ética, May 2006
- 5to Taller de Gerencia Académica, April 2006
- "Orientation in Institutionalizing Assessment in the Administrative Service Units", March 2006

Offered Courses in the past two years (2005-2007)

INEL 4075 Fundamentals of Electrical Engineering, ICOM 4998 Undergraduate Research in Computer Engineering, ICOM 6999 Master Thesis in Computer Engineering, INEL 4998 Undergraduate Research in Electrical Engineering, INEL 6046 Master Thesis in Electrical Engineering, ININ 6999 Master Thesis in Industrial Engineering, INGE 3016 Algorithms and Computer, ICOM 6999 Master's Thesis

Community service activities: (FY 1996-97 -- 2001-02)

None

AMIR H. CHINAEI

Academic rank: Assistant Professor

Degrees with fields, institution, and date:

B. Eng.	Computer Engineering	Isfahan University, Iran	1994
M. Eng.	Software Engineering	Amir Kabir University of Technology, Iran	1997
Ph.D.	Computer Science	University of Waterloo, Canada	2007
Post Doc.	Database Security & Privacy	University of Calgary Canada	2009

Faculty service at UPRM:

Date of original appointment: August 2009

Dates of advancement in rank: N/A

Total years of service: 3

Areas of professional expertise: Database Security, User Privacy

Other related experience—academic or industrial:

Post-doc Instructor (Fall 2008)

Department of Computer Science

University of Calgary, Calgary, Alberta, Canada

List of courses taught: CPSC 471 "Data Base Management Systems"

Adjunct Lecturer (Fall 2007-Spring 2008 and Fall 2004)

David R. Cheriton School of Computer Science

University of Waterloo, Ontario, Canada

List of courses taught: CS 126 "Introduction to Software Development", CS 134 "Principles of Computer Science", and CS 348 "Introduction to Database Management"

Founding Manager of an Internet Service Provider System

Khorasgan University, Isfahan, Iran (2000-2001)

Founded an ISP with over 2000 users; Determined network protocols, servers, equipments, and software; Installed and maintained network, devices and software systems; Designed and implemented an accounting system to monitor ISP users

Faculty Member (1997-2000)

Department of Computer Engineering

Khorasgan University, Isfahan, Iran

List of areas taught: Database Management Systems (taught several times), Data Structures (both basic and advanced levels, taught several times), Operating Systems, Programming (both basic and advanced levels, taught several times), Finite Automata

Operating Director, Software Analyst and Developer

Salabat Ltd., Isfahan, Iran (1994-1997)

Analyzed, designed and implemented accounting and warehousing systems; Implemented a large-coded banking transactions system

Consulting, patents:

N/A

State(s) in which registered:

N/A

Principal publications of last five years: (2006-2011)

- Kambiz Ghazinour, Sampson Pun, Maryam Majedi, **Amir H. Chinaei**, and Ken Barker. Extending SQL to Support Privacy Policies. A chapter of From Sociology to Computing in Social Networks: Theory, Foundations and applications, edited by Nasrullah Memon and Reda Alhaj, July 2010
- Maryam Majedi, Kambiz Ghazinour, **Amir H. Chinaei**, and Ken Barker. *SQL Privacy Model for Social Networks*, in Advances in Social Network Analysis and Mining, pp. 369-370, July 2009
- Sampson Pun, **Amir H. Chinaei**, and Ken Barker. *Twins (1): Extending SQL to Support Corporation Privacy Policies in Social Networks*, in Advances in Social Network Analysis and Mining, pp. 306-311, July 2009
- **Amir H. Chinaei**, Rosa Karimi Adl, Chenen Liang, and Ken Barker. *User-Centric Privacy Preservation in Social Networks*, in European and Mediterranean Conference on Information Systems, July 2009
- **Amir H. Chinaei**, Ken Barker, and Frank Wm. Tompa. *Space of Access Control Administration Models*, in the 4th International Conference on Information Technology, ICIT'04, June 2009
- **Amir H. Chinaei**, Ken Barker, and Frank Wm. Tompa. *Comparison of Access Control Administration Models*, in Journal of Ubiquitous Communication and Computing (JUBICC), 4 (3), pp. 525-532, 2009

- Mohammad Jafari, **Amir H. Chinaei**, Ken Barker, Mohammad Fathian. *Role Mining in Access History Logs*, International Journal of Computer Information Systems and Industrial Management Applications (IJCSIM), 1, pp. 258-265, 2009
- **Amir H. Chinaei**, Hamid R. Chinaei, and Frank Wm. Tompa. A Unified Conflict Resolution Algorithm, in VLDB Workshop on Secure Data Management, pp. 1-17, September 2007

Grants or externally funded project active during the last five years:)

N/A.

Scientific and professional societies of which a member:

- ACM
- IEEE

Honors and awards:

- Graduate Student NSERC Research Assistantship (2006)
- Sponsored by the Ontario Centers of Excellence to a "Team-based Project Management" course offered by the Queen's School of Business (2005)
- Graduate Student NSERC Research Assistantship (2001-2003)
- University of Waterloo Graduate Student Bursary (2002)
- Ranked 8th in the Iranian nation-wide university entrance exam for the CS Master's program (1995)

Institutional and professional service in the last five years:

- Member of CISE Ph.D. Qualifying Exam Committee
University of Puerto Rico at Mayaguez (October 2009-present)
- Member of Computing Systems Research Group
University of Puerto Rico at Mayaguez (August 2009-present)
- **External Reviewer**
 - ACM SIGMOD International Conference on Management of Data (2003, 2006)
 - International Conference on Web Information Systems Engineering (2002, 2005)
 - IEEE International Symposium on Applications and the Internet (2005)
- **Graduate Student Representative**
 - Mathematics Faculty Graduate Studies Committee, Univ. of Waterloo (2004-2006)
 - Mathematics Faculty Administrative Committee, University of Waterloo (2004-2005)
 - Faculty of Mathematics Representative Council, University of Waterloo (2004-2005)

Professional development activities in the last five years:

- NIH on CAMPUS, General Library, UPRM, PR, Oct 13 & 14, 2011
- NIH RePORT Workshop, Part I, R&D UPRMI, PR, Sept 8, 2011
- Professional Development Workshop Affinity Research Group (ARG), Rincon, PR, Aug 11-12, 2011
- NSF Trustworthy Computing Workshop, Arlington, VA, Oct 27-29, 2010

- NSF Proposal Writing Workshop, Darlington, UPRM, Feb 25, 2010

Offered Courses in the past two years

- ICOM4036: Programming Languages
- ICOM5016: Database Systems
- ICOM4998: Undergraduate Research (Access Control) (3 times)
- ICOM5047: Capstone: Computer Engineering Project Design
- INEL4206: Microprocessors
- ICOM4015: Advanced programming (twice)
- ICOM5995: Fundamentals of Access Control

Community service activities:

N/A

EMMANUEL ARZUAGA CRUZ

Academic rank: *Assistant Professor*

Degrees with fields, institution, and date:

BS	Computer Engineering	University of Puerto Rico, Mayagüez Campus	2000
MS	Computer Engineering	University of Puerto Rico, Mayagüez Campus	2002
PhD	Computer Engineering	Northeastern University, Boston, MA	2012

Faculty service at UPRM:

Date of original appointment: January 2012

Dates of advancement in rank:

Total years of service: 0

Areas of professional expertise:

Datacenter Resource Efficiency and Performance Analysis, Computer Systems and Virtualization Infrastructure, I/O Storage Systems, Workload Characterization, Computer Architecture, Pattern Recognition, Remote Sensing.

Other related experience—academic or industrial:

Research Assistant, May 2005 – December 2011.

Northeastern University Computer Architecture Research Group (NUCAR), ECE Department, Northeastern University.

PhD research: resource efficiency of virtualized enterprise systems. Using virtual machine migration to improve resource efficiency including system power consumption. Modeling and analysis of storage systems. Implementation of commercial workloads based on the TPC-C and TPC-H specifications. Installation, configuration and system administration of a 33 node computer cluster and its 16 TB storage array.

Bernard M. Gordon Center for Subsurface Sensing and Imaging Systems (Gordon-CenSSIS), ECE Department, Northeastern University.

Software Engineer of the CenSSIS Solutionware team. Provide software engineering support to the CenSSIS partner universities.

MTS Intern, July 2009 - January 2010.

VMware Inc, Cambridge, Massachusetts.

Software development engineer for R&D kernel development in the ESX I/O subsystem. Study I/O subsystem to identify performance enhancements for virtual machine execution.

Graduate Intern Technical, May - August 2008.

Intel Corporation, Fort Collins Design Center, Fort Collins, Colorado.

Create a synthetic enterprise workload that approximates the behavior of the TPC-C workload to model, simulate, and evaluate performance enhancement possibilities for Itanium processor designs.

Research Intern, July 2006 - January 2007.

ExaGrid Systems Inc, Westborough, Massachusetts.

Software performance evaluation and testing; contrast and compare the effectiveness of delta compression techniques as well as other data de-duplication techniques.

Software Developer, September 2002 - August 2004.

Gordon-CenSSIS, Laboratory for Applied Remote Sensing and Image Processing

(LARSIP), ECE Department, University of Puerto Rico Mayagüez Campus.

Development of software tools for image processing and train LARSIP students and professors on how to use the software being developed.

Teaching Assistant, September 2004 - April 2005.

ECE Department, Northeastern University.

ECEU324 Computer Architecture. The course presents computer organization and architecture and covers all elements of a computer system, including the CPU, memory hierarchy, I/O and network.

ECEU326 Optimization Methods. This course covers design and implementation of basic data structures, including arrays, lists, stacks, queues, trees, and graphs.

Instructor, August - December 2003.

ECE Department, University of Puerto Rico Mayagüez Campus.

INEL5046 Pattern Recognition. This course aims to introduce the students to the fundamental concepts of pattern recognition enabling them the ability to design algorithms to analyze signals and images.

Consulting, patents:

State(s) in which registered:

Principal publications of last five years: (2006-2011)

Increasing Power/Performance Resource Efficiency on Virtualized Enterprise Servers,

Arzuaga, E. and Kaeli, D.R., ACM International Conference on Computing Frontiers, 2011.

Quantifying Load Imbalance on Virtualized Enterprise Servers,

Arzuaga, E. and Kaeli, D.R., First ACM/SPEC International Conference on Performance Engineering, 2010.

M/G/1 Queue Model for Multiple Applications on Storage Area Networks,

Arzuaga, E., Kaeli, D.R., Workshop on Computer Architecture Evaluation using Commercial

Workloads (CAECW), in conjunction with the International Conference on High Performance Computer Architecture (HPCA), 2008.

Unsupervised Feature Extraction Methods and their Effects in the Classification of High Dimensional Data,

Jiménez-Rodríguez, L.O., Arzuaga-Cruz, E., Vélez-Reyes, M., IEEE Transactions on Geoscience and Remote Sensing (45-2), 2007.

Grants or externally funded project active during the last five years: (2006-2011)

Scientific and professional societies of which a member:

IEEE, IEEECS, ACM

Honors and awards:

Eta Kappa Nu Electrical and Computer Engineering Honor Society.

Student Travel awards to attend: HPCA 2008 and Computing Frontiers 2011.

Institutional and professional service in the last five years: (2006-2011)

Professional development activities in the last five years: (2006-2011)

Reviewer for:

Journals:

IEEE Transactions on Geoscience and Remote Sensing.

Conferences:

ISCA 2007, The International Symposium on Computer Architecture.

IGARSS 2007, The International Symposium on Geoscience and Remote Sensing.

Offered Courses in the past two years

Operating Systems

Community service activities: (2006-2011)

8.2 Plan de Reclutamiento de la Facultad

Los programas aquí propuestos se pueden comenzar con la facultad existente en el RUM. Pero, a fin de atender el crecimiento y continuidad del programa a largo/mediano plazo, es deseable implantar un plan para reclutar facultad con especialidad en diferentes áreas. Para determinar la facultad que se necesitaría adicionar se consideró una matrícula combinada para los dos programas de 50 estudiantes de nuevo ingreso por año. Se asumió que la facultad que se reclutó dedicará 50% de su carga académica a investigación. Tomados en cuenta todos estos parámetros se necesitarán reclutar 7 nuevos profesores(as) largo/mediano plazo.

En la Tabla 11 se presenta el plan de reclutamiento de la facultad y las áreas de especialidad necesarias para mantener la continuidad en los programas.

Área	Número de Profesores
Bases de datos	1
Lenguajes y sistemas	1
Ingeniería en Software	3
Redes de Computación	1
Arquitectura de Computadoras	1

Tabla 11: Plan de Reclutamiento de la Facultad Necesaria por Área de Especialidad en Ciencia de Computación e Ingeniería en Software.

8.3 Plan para el Desarrollo de la Facultad

Toda la facultad disponible para los programas propuestos cuenta con grados de Doctor en Filosofía (PhD) en especialidades directamente relacionadas a los cursos del programa. En este sentido, el Plan de Desarrollo de la Facultad se concentra en actividades destinadas a la creación de nuevo conocimiento y actualización de técnicas de enseñanza. El Colegio de Ingeniería y el Departamento encargado de la administración de estos programas apoyarán iniciativas tendentes a que los profesores asociados a estos programas se mantengan activos en investigación y actualizados en sus técnicas docentes mediante:

- a. La adjudicación de descargas docentes para investigación

- b. La puesta a disposición de esta facultad de apoyo técnico y facilidades de Teleconferencia y Comunicación electrónica
- c. Apoyo para asistencia a Conferencias Científicas y de Educación
- d. Facilitación de contactos para realizar internados de verano en la industria o en instituciones relacionadas al Departamento de Defensa
- e. La adjudicación de años sabáticos. El Colegio de Ingeniería otorgará al menos un año sabático para un profesor, cada dos años, en base al mérito intelectual y alineamiento de su propuesta para un período sabático con los objetivos educativos y científicos de estos programas.

En la propuesta se solicita contratar siete profesores adicionales, todos con grado de Doctor en Filosofía (PhD) en Ciencia de Computación y en Ingeniería de Software. La contratación de estos profesores responde a la necesidad de reforzar la enseñanza y ampliar la oferta de cursos electivos principalmente en el programa de Ingeniería de Software; y reforzar los recursos docentes existentes para atender las necesidades del programa de Ciencia e Ingeniería de Computación. Dicha facultad tendrá además la misión de expandir el espectro de investigación y oferta graduada en Ciencia de Computación, tal y cómo se explica en la *“Propuesta para la Creación de un Departamento en Ciencia e Ingeniería de Computación en el Colegio de Ingeniería del Recinto Universitario de Mayagüez”*.

9. ADMINISTRACIÓN DEL NUEVO PROGRAMA

El programa será administrado inicialmente por el Departamento de Ingeniería Eléctrica y Computadoras del Recinto Universitario de Mayagüez. Para estos efectos, se propone que el Director Asociado para Asuntos Académicos sea el administrador del programa. Dicho director asociado tendrá bajo su responsabilidad:

- currículum,
- desarrollo de infraestructura,
- planificación,
- matrícula de estudiantes,
- reclutamiento de personal,
- proceso de acreditación profesional del programa por la agencia acreditadora ABET

Este director(a) asociado será asesorado por el Comité Departamental para Sistemas de Computación. Dicho comité tendrá bajo su responsabilidad las siguientes tareas:

- Recomendar la asignación de cursos a los profesores del programa.
- Crear y/o revisar cursos requeridos y electivos técnicos del programa.
- Revisar el currículo de cada uno de los grados en el programa.
- Colaborar en todos los procesos de acreditación profesional de la agencia acreditadora ABET.
- Colaborar en asuntos relacionados a la consideración de candidatos a plazas docentes para apoyar el programa.

El plan para la administración permanente del programa se detalla en la *Propuesta para la Creación de un Departamento de Ciencia e Ingeniería de Computación en el Colegio de Ingeniería del Recinto Universitario de Mayagüez*, Certificación Número 05-06-422 de la Junta Administrativa del Recinto Universitario de Mayagüez. La aprobación e implantación del programa aquí descrito es un requisito "sine qua non" para la creación y activación del nuevo Departamento de Ciencia e Ingeniería de Computación.

10. RECURSOS DE LA INFORMACIÓN

10.1 Inventario de Recursos Existentes

La Facultad de Ingeniería tiene a su disposición la Biblioteca General del Recinto Universitario de Mayagüez. Esta biblioteca dispone de una colección de libros que puede servir para comenzar el programa propuesto. Hemos determinado, sin embargo que es necesario presentar un plan de mejoramiento bibliotecario con el propósito de asegurar que la biblioteca general provea la ayuda necesaria al estudiantado de este programa durante los próximos cinco años.

Especial atención se le dará a todo el sistema informático con que la biblioteca general dispone para la comunicación dentro del Recinto Universitario de Mayagüez como fuera de este de tal manera que este sistema informático provea al usuario(a) métodos eficientes para el acceso a los repositorios electrónicos con que cuenta dicha biblioteca. Pensamos que la biblioteca general del Recinto Universitario de Mayagüez debe convertirse en el repositorio y centro de comunicación de información electrónica.

10.2 Plan de Mejoramiento de Recursos Disponibles

El siguiente plan de cinco años está destinado a mejorar el estado actual de la Biblioteca General del RUM, con el objetivo de atender las necesidades inmediatas del programa propuesto. El plan consiste en cuatro partes principales: obtención de libros, obtención de materiales audiovisuales, obtención de acceso electrónico a documentación y base de datos.

10.2.1 Obtención de Libros

Al comienzo de cada semestre se solicitará a la Biblioteca General información sobre la disponibilidad de fondos para la adquisición de libros. Se enviará a la Biblioteca General la lista de libros que desea adquirir para el próximo semestre. La preparación de cada lista será coordinada con el representante de la biblioteca ante la facultad de ingeniería.

10.2.2 Obtención de Materiales Audiovisuales

Al principio de cada semestre se enviará a la biblioteca general una lista de recursos audiovisuales a adquirir para el próximo semestre. La preparación de cada lista será coordinada con el representante de la biblioteca ante la facultad.

10.2.3 Obtención de Acceso Electrónico a Base de Datos

La Biblioteca General del RUM está desarrollando infraestructura destinada a facilitar el acceso electrónico a documentación y bases de datos a través de la red electrónica de comunicación de nuestro recinto. Se evaluará periódicamente dicha infraestructura con el objeto de asegurar que posea los requisitos mínimos para sostener un ambiente activo de acceso a la biblioteca.

10.2.4 Uso de Otras Bibliotecas

Actualmente la Biblioteca General cuenta con un programa de préstamos interbibliotecarios. Además, mediante Internet y servicios como el "World Wide Web" se tiene acceso a un caudal de publicaciones e información científica.

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Department of Electrical and Computer Engineering
Program in Computer Science and Engineering
Program in Software Engineering

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IEEE/IEE Electronic Library (IEL) 2001 - 2001

ISSN: 0840-7789

Publisher: Unspecified

Subject: (unknown)

Electrical and Computer Engineering, 2002. IEEE CCECE 2002. Canadian Conference on

IEEE/IEE Electronic Library (IEL) 2002 - 2002

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Publisher: Unspecified

Subject: (unknown)

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Publisher: Unspecified
Subject: (unknown)

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Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: (unknown)

Electrical, Electronic and Computer Engineering, 2004. ICEEC '04. 2004 International Conference on

IEEE/IEE Electronic Library (IEL) 2004 - 2004

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: (unknown)

Elektrik : Turkish journal of electrical engineering & computer sciences

Academic Search Premier 2002 to present

Computer Source 2002 to present

DOAJ: Directory of Open Access Journals 1998 to present

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Open J-Gate 2005 to present

ISSN: 1300-0632 Online ISSN: 1303-6203

Publisher: Tubitak

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

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Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

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Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Engineering of Complex Computer Systems, 1997. Proceedings., Third IEEE International Conference on

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Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

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Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

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IEEE/IEE Electronic Library (IEL) 1999 - 1999

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

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Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering -- Electronics

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Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

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Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

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Publisher: IEEE Computer Society

Subject: Technology -- Engineering (General). Civil engineering (General) -- Systems engineering

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Publisher: IEEE Computer Society

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Publisher: IEEE Computer Society

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Publisher: IEEE Computer Society

Subject: Technology -- Engineering (General). Civil engineering (General) -- Systems engineering

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IEEE/IEE Electronic Library (IEL) 2003 - 2003

Publisher: IEEE Computer Society

Subject: Technology -- Engineering (General). Civil engineering (General) -- Systems engineering

Engineering of Computer-Based Systems, 2004. Proceedings. 11th IEEE International Conference and

Workshop on the

IEEE/IEE Electronic Library (IEL) 2004 - 2004

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Technology -- Engineering (General). Civil engineering (General) -- Systems engineering

Institution of Engineers: Computer Engineering

Open J-Gate 2005 to present

Publisher: (unknown)

Subject: (unknown)

Integrated computer-aided engineering

Academic Search Premier 1998 to present (Embargo: 9 months)

Computer Source 1998 to present (Embargo: 9 months)

ISSN: 1069-2509

Publisher: IOS Press

Subject: Technology -- Engineering (General). Civil engineering (General) -- Engineering mathematics.

Engineering analysis

Modern Problems of Radio Engineering, Telecommunications and Computer Science, 2002. Proceedings of the International Conference

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Publisher: Unspecified

Subject: (unknown)

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Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: (unknown)

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Publisher: Unspecified

Subject: (unknown)

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Publisher: Unspecified

Subject: (unknown)

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Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Technology -- Manufactures

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Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Technology -- Engineering (General). Civil engineering (General)

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IEEE/IEE Electronic Library (IEL) 1997 - 1997

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: Science -- Mathematics

Software Technology and Engineering Practice, 1997. Proceedings., Eighth IEEE International Workshop on [incorporating Computer Aided Software Engineering]

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Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: Science -- Mathematics -- Instruments and machines

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IEEE/IEE Electronic Library (IEL) 1994 - 1994

Publisher: Unspecified
Subject: (unknown)

Systems Engineering of Computer Based Systems, 1995., Proceedings of the 1995 International Symposium and Workshop on

IEEE/IEE Electronic Library (IEL) 1995 - 1995

Publisher: Unspecified
Subject: (unknown)

TENCON '93. Proceedings. Computer, Communication, Control and Power Engineering. 1993 IEEE Region 10 Conference on

IEEE/IEE Electronic Library (IEL) 1993 - 1993

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: Science -- Mathematics

Computer Programming:

Computer Programming, DP and Related Services Industry Yearbook

Business Source Complete 1998 - 2001

Publisher: Global Insight, Inc.

Subject: Science -- Mathematics

Science of Computer Programming

EBSCOhost EJS Your Access: January 1995 to present

IngentaConnect 1995 - 2003

ScienceDirect Web Editions 2005 to present

ISSN: 0167-6423

Publisher: Elsevier Science Limited

Subject: Science -- Mathematics -- Instruments and machines

Programming Models for Massively Parallel Computers, 1993. Proceedings

IEEE/IEE Electronic Library (IEL) 1993 - 1993

Publisher: Unspecified

Subject: (unknown)

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Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Science -- Mathematics -- Instruments and machines

Computer Software:

Application of Computer Aided Software Engineering Tools, IEE Colloquium on

IEEE/IEE Electronic Library (IEL) 1989 - 1989

Publisher: Institution of Electrical Engineers

Subject: Science -- Mathematics

CASE (Computer Aided Software Engineering): Towards Software Process Maturity, IEE Colloquium on
(Digest No.1993/222)

IEEE/IEE Electronic Library (IEL) 1993 - 1993

Publisher: Institution of Electrical Engineers

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

CompEuro '90. Proceedings of the 1990 IEEE International Conference on Computer Systems and
Software Engineering

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Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Science -- Mathematics

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IEEE/IEE Electronic Library (IEL) 1992 - 1992

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Subject: Science -- Mathematics

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IEEE/IEE Electronic Library (IEL) 1992 - 1992

Publisher: Unspecified

Subject: (unknown)

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IEEE/IEE Electronic Library (IEL) 1993 - 1993

ISSN: 1066-1387

Publisher: Unspecified

Subject: (unknown)

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Publisher: IEEE Computer Society

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

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Publisher: Institution of Electrical Engineers

Subject: Technology -- Mechanical engineering and machinery

Computer Assurance, 1989. COMPASS '89, 'Systems Integrity, Software Safety and Process Security',
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IEEE/IEE Electronic Library (IEL) 1989 - 1989

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Subject: Science -- Mathematics

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Subject: Science -- Mathematics

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Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: Science -- Mathematics

Computer Assurance, 1992. COMPASS '92. 'Systems Integrity, Software Safety and Process Security:
Building the System Right.', Proceedings of the Seventh Annual Conference on

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Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: Science -- Mathematics

Computer Assurance, 1995. COMPASS '95. 'Systems Integrity, Software Safety and Process Security'.
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IEEE/IEE Electronic Library (IEL) 1995 - 1995

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: Science -- Mathematics

Computer Assurance, 1996. COMPASS '96, 'Systems Integrity. Software Safety. Process Security'.
Proceedings of the Eleventh Annual Conference on

IEEE/IEE Electronic Library (IEL) 1996 - 1996

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: Science -- Mathematics

Computer Software

[DOAJ: Directory of Open Access Journals](#) 2000 to present

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ISSN: 0289-6540

Publisher: Japan Society for Software Science and Technology

Subject: Science – Mathematics

Computer Software and Applications Conference, 1978. COMPSAC '78. The IEEE Computer Society's Second International

[IEEE/IEE Electronic Library \(IEL\)](#) 1978 - 1978

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 1979. COMPSAC 79. Proceedings. The IEEE Computer Society's Third International

[IEEE/IEE Electronic Library \(IEL\)](#) 1979 - 1979

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 1988. COMPSAC 88. Proceedings., Twelfth International

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Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 1989. COMPSAC 89., Proceedings of the 13th Annual International

IEEE/IEE Electronic Library (IEL) 1989 - 1989

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 1990. COMPSAC 90. Proceedings., Fourteenth Annual International

IEEE/IEE Electronic Library (IEL) 1990 - 1990

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 1991. COMPSAC '91., Proceedings of the Fifteenth Annual International

IEEE/IEE Electronic Library (IEL) 1991 - 1991

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 1992. COMPSAC '92. Proceedings., Sixteenth Annual International

IEEE/IEE Electronic Library (IEL) 1992 - 1992

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 1993. COMPSAC 93. Proceedings., Seventeenth Annual International

IEEE/IEE Electronic Library (IEL) 1993 - 1993

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 1994. COMPSAC 94. Proceedings., Eighteenth Annual

International

IEEE/IEE Electronic Library (IEL) 1994 - 1994

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 1995. COMPSAC 95. Proceedings., Nineteenth Annual International

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ISSN: 0730-3157

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 1996. COMPSAC '96., Proceedings of 20th International

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ISSN: 0730-3157

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 1997. COMPSAC '97. Proceedings., The Twenty-First Annual International

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ISSN: 0730-3157

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

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ISSN: 0730-3157

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

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ISSN: 0730-3157

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 2000. COMPSAC 2000. The 24th Annual International

IEEE/IEE Electronic Library (IEL) 2000 - 2000

ISSN: 0730-3157

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 2001. COMPSAC 2001. 25th Annual International

IEEE/IEE Electronic Library (IEL) 2001 - 2001

ISSN: 0730-3157

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 2002. Proceedings. 26th Annual International

IEEE/IEE Electronic Library (IEL) 2002 - 2002

ISSN: 0730-3157

Publisher: IEEE Computer Society

Subject: Science -- Mathematics -- Instruments and machines

Computer Software and Applications Conference, 2003. COMPSAC 2003. Proceedings. 27th Annual International

IEEE/IEE Electronic Library (IEL) 2003 - 2003

ISSN: 0730-3157

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: Science -- Mathematics

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IEEE/IEE Electronic Library (IEL) 2004 - 2004

ISSN: 0730-3157

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: Science -- Mathematics

Computer Software and Networking Industry Yearbook

Business Source Complete 1998 - 2001

ISSN: 0289-6540

Publisher: Unspecified
Subject: Science -- Mathematics

Computer Systems and Software Engineering, 1988. Proceedings., Third Israel Conference on

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Subject: (unknown)

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Publisher: Unspecified

Subject: (unknown)

Computer Systems and Software Engineering, 1996., Proceedings of the Seventh Israeli Conference on

IEEE/IEE Electronic Library (IEL) 1996 - 1996

Publisher: Unspecified

Subject: (unknown)

Computer Systems and Software Engineering, 1997., Proceedings of the Eighth Israeli Conference on

IEEE/IEE Electronic Library (IEL) 1997 - 1997

Publisher: Unspecified

Subject: (unknown)

CSCW (Computer Supported Co-operative Working) and the Software Process (Digest No. 1995/036), IEE Colloquium on

IEEE/IEE Electronic Library (IEL) 1995 - 1995

Publisher: Unspecified

Subject: (unknown)

Software Engineering Conference, 1997. Asia Pacific ... and International Computer Science Conference 1997. APSEC '97 and ICSC '97. Proceedings

IEEE/IEE Electronic Library (IEL) 1997 - 1997

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Science -- Mathematics

Software in Computer Networks, IEE Colloquium on

IEEE/IEE Electronic Library (IEL) 1988 - 1988

Publisher: Institution of Electrical Engineers

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Software Technology and Engineering Practice, 1997. Proceedings., Eighth IEEE International Workshop on [incorporating Computer Aided Software Engineering]

IEEE/IEE Electronic Library (IEL) 1997 - 1997

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Science -- Mathematics -- Instruments and machines

Computer Hardware:

Computer Hardware Industry Profile: Asia-Pacific

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: Australia

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: Belgium

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: Brazil

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: Canada

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: China

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: Czech Republic

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: Denmark

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: Europe

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: France

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: Germany

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: Global

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: Hungary

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: India

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: Italy

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: Japan

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: Mexico

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: Norway

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: Poland

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: Russia

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: South Africa

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: South Korea

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: Spain

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: Sweden

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: Taiwan

Business Source Complete 2005 to present

Publisher: Datamonitor Plc

Subject: Social Sciences -- Industries. Land use. Labor

Computer Hardware Industry Profile: the Netherlands

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: United Kingdom

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Computer Hardware Industry Profile: United States

Business Source Complete 2003 to present

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Internet:

2004 International Symposium on Applications and the Internet (SAINT'04)

IEEE/IEE Electronic Library (IEL) 2004 - 2004

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Academic Open Internet Journal

DOAJ: Directory of Open Access Journals 2000 to present

Open J-Gate 2002 to present

ISSN: 1311-4360

Publisher: Unspecified

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Applications and the Internet, 2001. Proceedings. 2001 Symposium on

IEEE/IEE Electronic Library (IEL) 2001 - 2001

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Applications and the Internet, 2002. (SAINT 2002). Proceedings. 2002 Symposium on

IEEE/IEE Electronic Library (IEL) 2002 - 2002

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

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IEEE/IEE Electronic Library (IEL) 2003 - 2003

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Applications and the Internet (SAINT) Workshops, 2002. Proceedings. 2002 Symposium on

IEEE/IEE Electronic Library (IEL) 2002 - 2002

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Applications and the Internet Workshops, 2001. Proceedings. 2001 Symposium on

IEEE/IEE Electronic Library (IEL) 2001 - 2001

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Applications and the Internet Workshops, 2003. Proceedings. 2003 Symposium on

IEEE/IEE Electronic Library (IEL) 2003 - 2003

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Applications and the Internet Workshops, 2004. SAINT 2004 Workshops. 2004 International Symposium on

IEEE/IEE Electronic Library (IEL) 2004 - 2004

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: (unknown)

ATM (ICATM 2001) and High Speed Intelligent Internet Symposium, 2001. Joint 4th IEEE International Conference on

IEEE/IEE Electronic Library (IEL) 2001 - 2001

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: Science -- Mathematics

Broadband Communications for the Internet Era Symposium digest, 2001 IEEE Emerging Technologies Symposium on

IEEE/IEE Electronic Library (IEL) 2001 - 2001

Publisher: IEEE / Institute of Electrical and Electronics Engineers Incorporated
Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Broadband Residential Internet Access Industry Profile: France

Business Source Complete 2002 - 2002

Publisher: Datamonitor Plc
Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Broadband Residential Internet Access Industry Profile: Germany

Business Source Complete 2002 - 2002

Publisher: Datamonitor Plc
Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Broadband Residential Internet Access Industry Profile: Italy

Business Source Complete 2002 - 2002

Publisher: Datamonitor Plc
Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Broadband Residential Internet Access Industry Profile: Spain

Business Source Complete 2002 - 2002

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Broadband Residential Internet Access Industry Profile: Sweden

Business Source Complete 2002 - 2002

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Broadband Residential Internet Access Industry Profile: the Netherlands

Business Source Complete 2002 - 2002

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Broadband Residential Internet Access Industry Profile: United Kingdom

Business Source Complete 2002 - 2002

Publisher: Datamonitor Plc

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering

Chemical journal on internet

DOAJ: Directory of Open Access Journals 1999 to present

Free Medical Journals 1999 to present

FreeFullText.com 1999 to present

Open J-Gate 2002 to present

ISSN: 1523-1623

Publisher: Molecular Diversity Preservation International

Subject: Science -- Chemistry

Commercialising the Internet (Digest No: 1997/063), IEE Colloquium on

IEEE/IEE Electronic Library (IEL) 1997 - 1997

Publisher: Institution of Electrical Engineers

Subject: Bibliography. Library science. Information resources (General) -- Information resources (General)

Computer and Internet Lawyer

ABI/INFORM Global 1997 to present

Business Source Complete 2000 to present

Computer Source 2000 to present

LegalTrac 2001 to present

ProQuest Computing 1997 to present

ISSN: 1531-4944

Publisher: Aspen Law and Business

Subject: Law

Electron Technology - Internet Journal

DOAJ: Directory of Open Access Journals 2003 to present

Open J-Gate 2002 to present

ISSN: 0070-9816

Publisher: Institute of Electron Technology

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering -- Electronics

Emerging Technologies Symposium: Broadband, Wireless Internet Access, 2000 IEEE

IEEE/IEE Electronic Library (IEL) 2000 - 2000

Publisher: Unspecified

Subject: (unknown)

Financial Services Question & Answer: How Merchants Can Cut the Cost of Accepting Internet Payments

Business Source Complete 2005 - 2005

Publisher: Unspecified

Subject: Social Sciences -- Finance

Hands on the Internet - Gaining a Competitive Edge (Digest No: 1996/262), IEE Colloquium on

IEEE/IEE Electronic Library (IEL) 1996 - 1996

Publisher: Unspecified

Subject: (unknown)

He@lth information on the Internet

Free Medical Journals 1998 - 2001

ISSN: 1460-4140

Publisher: Royal Society of Medicine Press

Subject: Medicine

High - Speed Internet Access

ABI/INFORM Trade & Industry 1997 - 2002

ProQuest Computing 1997 - 2002

ProQuest Telecommunications 1997 - 2002

ISSN: 1531-4820

Publisher: Information Gatekeepers Incorporated

Subject: Social Sciences -- Transportation and communications

IEEE Internet computing

IEEE/IEE Electronic Library (IEL) 1997 to present

ISSN: 1089-7801

Publisher: IEEE Computer Society

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering -- Telecommunication

Inside the Internet

ProQuest Computing 1998 - 2006

ISSN: 1075-7902

Publisher: Eli Journals

Subject: Technology -- Electrical engineering. Electronics. Nuclear engineering -- Telecommunication

Internet Access in Public & Private Schools

MasterFILE Premier 2000 - 2000

Professional Development Collection 2000 - 2000

Publisher: US Department of Education

Subject: Education -- Special aspects of education

**TITULOS DE REVISTAS ACTIVOS EN PAPEL RELACIONADOS A INGENIERIA DE COMPUTADORAS,
PROGRAMACION DE COMPUTADORAS E INTERNET**

QA76.5 .I5635 International journal of computers & applications.

v. 23- 2001-

QA76.6 .S427 Science of computer programming.

1981-1986 (micro)

v. 2-57 1982-2005

QA76.7 .A77 ACM transactions on programming languages and systems.

v. 13- 1991-

v. 8-12 1986-1990 (micro)

QA76.7 .C647 Computer language, systems and structures.

v. 28- 2002-

QA76.9 .D3 I53 Information systems.

v. 6- 1981-

TA345 .C633 Computer-aided civil and infrastructure engineering.

v. 13, no. 1998-

TA345 .J648 Journal of computing and information science in engineering.

v. 1- 2001-

10.4 Desarrollo de los Recursos Bibliotecarios

La Biblioteca General del Recinto Universitario de Mayagüez (RUM) posee una amplia colección de recursos para apoyar los programas de B.S. en Ciencia e Ingeniería de la Computación y B.S. en Ingeniería de Software. No obstante, dada la alta actividad de producción de material educativo y el continuo surgimiento de nuevas áreas temáticas, es necesario expandir y actualizar dicha colección periódicamente. Para este propósito se usarán los fondos ya asignados al Colegio de Ingeniería para la acreditación de programas por ABET.

11. INFRAESTRUCTURA PARA LA ENSEÑANZA, LA INVESTIGACIÓN Y EL SERVICIO

11.1 Instalaciones, laboratorios y equipos de apoyo a la docencia

Los programas serán apoyados por las facilidades existentes del Departamento de Ingeniería Eléctrica y Computadoras.

11.1.2 Impacto del Programa Sobre las Instalaciones Físicas Existentes

El programa propuesto no afecta las instalaciones existentes en el RUM.

11.1.3 Necesidad y Disponibilidad de Servicios de Cómputos para el Nuevo Programa

El programa no necesita nuevos servicios de cómputos.

11.1.3.1 Laboratorios

El programa no necesita de la creación de nuevos laboratorios.

11.1.3.2 Recursos de computación para personal docente y administrativo

El programa no necesita de nuevos recursos de computación para el personal docente y administrativo.

11.2 Centros de práctica o localidades externas

El programa propuesto no hará uso de centros de practica o localidades externas.

12. SERVICIOS AL ESTUDIANTE

12.1 Sistemas de servicio y apoyo al estudiante

Los estudiantes del programa se servirán de los servicios estudiantiles provistos por el Decanato de Estudiantes de Recinto Universitario de Mayaguez, especificados en el catalogo sub-graduado del recinto.

12.1 Ayudas económicas

Las becas y préstamos usuales otorgados por agencias del gobierno de Puerto Rico y del gobierno federal, están a disposición de estudiantes cualificados. Aquellos estudiantes de rendimiento académico sobresaliente tendrán matrícula de honor y con ello, la exención del pago de la misma

13. CATÁLOGO Y DIVULGACIÓN

La descripción del programa según se indica en la sección 1.2, y la descripción de los cursos que se indican en la sección 6.2, y la secuencia curricular de la sección 6.3 se incluirán en el catálogo de ofrecimientos académicos del Recinto Universitario de Mayagüez (RUM). Una vez aprobado el programa se preparará un boletín informativo y afiches de promoción para informar a toda la comunidad estudiantil del Puerto Rico, Estados Unidos y América Latina. El siguiente texto es propuesto a modo de introducción al programa en dicho catálogo:

“El Colegio de Ingeniería del Recinto Universitario de Mayaguez ofrece grados de bachillerato en Ciencia e Ingeniería de Computación, y en Ingeniería de Software.

Bachillerato en Ciencia e Ingeniería de Computación

El bachillerato en Ciencia e Ingeniería de Computación integra modelos y métodos de Ciencia de Computación con las técnicas y prácticas de la ingeniería con el objeto de formar profesionales con un sólido conocimiento de principios teóricos y dotados de conocimientos y habilidades que les permitan aplicarlos en la creación de sistemas de software destinados al procesamiento eficiente y confiable de la información. Los sistemas de software son la tecnología básica en la realización de una vasta cantidad de actividades de la sociedad moderna, desde la entretención hasta los grandes proyectos de investigación científica y tecnológica, pasando por una amplia gama de servicios, comercio, educación, comunicaciones y cultura. El impacto de estos sistemas en el modo de vida actual es de tal magnitud que sociólogos e historiadores hablan de una cultura digital o de una era informática para referirse a los tiempos actuales. La era informática, sin embargo, está aún en sus inicios. Avances tales como el perfeccionamiento de la computación en redes y la minutarización de los computadores permite pensar en el futuro próximo, en una computación incorporada de un modo inconspicuo en la actividad social. Dicha computación posibilitaría el diseño de sistemas capaces de, por ejemplo, ordenar automáticamente el tránsito en una ciudad, o de prevenir el brote de epidemias, por mencionar solamente dos de sus posibles aplicaciones.

El programa de bachillerato en Ciencia e Ingeniería de Computación está diseñado para preparar profesionales especializados en la conceptualización, análisis, diseño, evaluación, mantenimiento y renovación de toda una amplia gama de sistemas informáticos, incluyendo entre estos, sistemas de computación industrial, comercial, científico, tecnológico y de informática médica. Los egresados del programa estarán también preparados para continuar estudios de post grado en computación o participar en proyectos de investigación y desarrollo en equipos multidisciplinarios.

Bachillerato en Ingeniería de Software

El Bachillerato en Ingeniería de Software prepara profesionales capacitados para una aplicación sistemática, disciplinada y cuantificable en el desarrollo, operación y mantenimiento de productos de software. El ingeniero de software comparte muchos de los conocimientos, principios y técnicas de diseño del graduado en Ciencia e Ingeniería de Computación, pero se especializa en el desarrollo de proyectos de software a nivel industrial y en general, en el desarrollo, evaluación y prueba de sistemas

computacionales para diversos usos. Algunos ejemplos clásicos de este tipo de sistemas son *computer games*, *word processing*, sistemas operativos y redes, compiladores y aplicaciones para negocios.

El Ingeniero de Software usualmente analiza las necesidades del usuario y diseña, prueba y desarrolla el sistema de software adecuado para satisfacer estas necesidades. Dicho desarrollo involucra diseño de algoritmos y programación. En el diseño y evaluación de algoritmos el Ingeniero de Software usa principios de Ciencia de Computación. Dependiendo del tamaño del proyecto, la fase de programación podría estar a cargo de un equipo de programadores supervisados por el ingeniero. Los Ingenieros de Software deben poseer conocimientos de sistemas operativos y *middleware* lo suficientemente profundos como para permitirle asegurar que el sistema creado trabajará apropiadamente y eficientemente.

El Ingeniero de Software coordina también la construcción, mantenimiento o expansión de la red de computación de una organización o empresa. En este trabajo, el ingeniero analiza las necesidades cada departamento, por ejemplo, ordenes, inventario, facturación y nomina, y coordina sus soluciones en un sistema integrado. El ingeniero puede diseñar también *intranet* — *networks* de computadores en una organización para facilitar la comunicación entre sus departamentos.

El Ingeniero de Software frecuentemente forma parte de equipos formados por manufacturadores, expertos en mercadeo, científicos de la computación y programadores; para el desarrollo de nuevos sistemas de hardware y/o software en compañías especializadas en el desarrollo y comercialización de estos sistemas.”

14. PLAN PRESUPUESTARIO

14.1 Cupo de estudiantes

El programa aquí propuesto está diseñado para aceptar 50 estudiantes de nuevo ingreso por año, en la modalidad de traslado articulado. La UPR en Bayamón será la unidad del Sistema UPR en la cual los estudiantes de nuevo ingreso al programa serán admitidos inicialmente. El cupo de 50 estudiantes se distribuye de la siguiente manera: 25 estudiantes para el grado de BS en Ciencia e Ingeniería de la Computación y 25 estudiantes para el grado de BS en Ingeniería de Software. En adición, el programa aceptará estudiantes que se transfieran internamente desde otros programas en el RUM.

14.2 Costo del Programa

El programa aquí propuesto no necesita recursos adicionales a los ya asignados al RUM. Esto se debe a que en el transcurso de los casi diez años desde que la propuesta original fue escrita, el RUM ha conseguido todos los recursos necesarios para la implantación del programa. Originalmente, la propuesta solicitaba alrededor de \$1.7 M en fondos para los primeros cinco años de operación, y en adelante, un presupuesto recurrente de \$981,861. Cada uno de los grados de bachillerato propuestos estaba diseñado para admitir 50 estudiantes de nuevo ingreso por año, durante los primeros cinco años. El presupuesto original, presentado en la propuesta sometida a nivel de Recinto fue revisado por la Oficina

de Presupuesto del RUM el 2 de febrero de 2006. Dicha revisión fue posteriormente aprobada por la Junta Administrativa del Recinto (Certificación Número 05-06-422). Para el 10 de septiembre de 2009, el presupuesto del propuesta fue revisado a luz de que el Colegio de Ingeniería del RUM había hecho muchos avances tendentes al desarrollo de Ciencia e Ingeniería de Computación e Ingeniería de Software. El impacto de dichos avances resulto en la actualización del presupuesto a la cantidad de \$184,270 en los primeros cinco años , y en adelante, un presupuesto recurrente de \$47,858 . En estos momentos, hemos identificado los recursos necesarios para implantar el programa sin costo adicional. La justificación para esto se describe a continuación.

14.2.1 Costos de Facultad

La propuesta inicial solicitaba nuevas plazas para profesores, a fin de atender los nuevos programas académicos, tomando un cupo de 100 estudiantes admitidos por año. Sin embargo, en los pasados 10 años el RUM ha hecho las siguientes contrataciones:

- Bienvenido Vélez Rivera
- Pedro I. Rivera Vega
- Manuel Rodriguez Martinez
- Wilson Rivera
- Kejie Lu
- Amir Chinae
- Nayda Santiago
- J. Fernando Vega

Esta facultad, junto a la plantilla de profesores con más 2 años de servicio, es suficiente para manejar el programa propuesto con un cupo de 50 nuevos estudiantes por año.

Las siguientes tablas presentan una distribución de cursos por profesores. Dicha distribución incluye los cursos del programa de Ingeniería de Computadoras y los cursos de los programas aquí propuestos. Esto debido a que los cursos requeridos de computación para Ingeniería de Computadoras son también requeridos en los nuevos programas. Y en adición, los cursos electivos de Ingeniería de Computadoras serán electivos y/o requeridos en los nuevos programas.

Curso	Codificación en ICOM	Condificacion en Nuevo Programa	Número de Secciones	Professor
Introducción a la Programación de Computadoras	N/A	CIIC 3XXX	1	Ramón Vasquez
Introducción a la Ingeniería de Software	ICOM 4009	INSO 4XXX	3	Jose Borges
Programación Avanzada	ICOM 4015	CIIC 4XXX	4	Amir Chinae (3) Pedro I. Rivera Vega (1)
Estructuras de Datos	ICOM 4035	CIIC 4XXX	2	Amir Chinae(1) Bienvenido Vélez (1)
Lenguajes de Programación	ICOM 4036	CIIC 4XXX	3	Wilson Rivera
Fundamentos de Computación	ICOM 4075	CIIC 4XXX	3	Bienvenido Vélez
Sistemas Operativos	ICOM 5007	CIIC 4XXX	3	Pedro I. Rivera-Vega
Sistemas de Bases de Datos	ICOM 5016	CIIC 4XXX	2	Manuel Rodriguez
Arquitectura de Computadoras I	N/A	CIIC 3XXX	1	Nayda Santiago
Análisis de Algoritmos	N/A	CIIC 4XXX	1	Manuel Rodriguez
Redes de Computadoras	ICOM 5026	CIIC 4XXX	1	Kejie Lu
Lenguajes Formales	N/A	CIIC 5XXX	1	Jaime Seguel
Diseño de Software	N/A	INSO 4XXX	1	Nestor Rodriguez
Proyecto de Ingeniería de Software I	N/A	INSO 4XXX	1	J. Fernando Vega
Computación de Alto Rendimiento	ICOM 6025	N/A	1	Wilson Rivera
Inteligencia Artificial	ICOM 6087	N/A	1	Ramón Vasquez
Programación Orientada a Objetos	ICOM 6089	N/A	1	Jose Borges
Interacción Humano-Computadora	ICOM 6095	N/A	1	Nestor Rodriguez
Redes Inalámbricas	ICOM 6505	N/A	1	Kejie Lu

Tabla 12: Distribución de secciones para el primer semestre del año académico

Curso	Codificación en ICOM	Condificacion en Nuevo Programa	Número de Secciones	Professor
Introducción a la Programación de Computadoras	N/A	CIIC 3XXX	1	Ramón Vasquez
Introducción a la Ingeniería de Software	ICOM 4009	INSO 4XXX	2	Jose Borges
Programación Avanzada	ICOM 4015	CIIC 4XXX	3	Amir Chinae
Estructuras de Datos	ICOM 4035	CIIC 4XXX	3	Manuel Rodriguez (2) Pedro I. Rivera Vega (1)
Lenguajes de Programación	ICOM 4036	CIIC 4XXX	2	Wilson Rivera
Fundamentos de Computación	ICOM 4075	CIIC 4XXX	3	Bienvenido Vélez
Sistemas Operativos	ICOM 5007	CIIC 4XXX	3	Pedro I. Rivera-Vega
Inteligencia Artificial	ICOM 5015	CIIC 5XXX	1	J. Fernando Vega
Sistemas de Bases de Datos	ICOM 5016	CIIC 4XXX	2	Manuel Rodriguez
Arquitectura de Computadoras II	N/A	CIIC 4XXX	1	Nayda Santiago
Computación de Alto Rendimiento	N/A	CIIC 4XXX	1	Wilson Rivera
Redes de Computadoras	ICOM 50256	CIIC 4XXX	1	Kejie Lu
Introducción a la Interacción Humano-Computadora	N/A	INSO 4XXX	1	Nestor Rodriguez
Requisitos de Ingeniería de Software	N/A	INSO 4XXX	1	Jose Borges
Pruebas de Confiabilidad de Software	N/A	INSO 4XXX	1	Jose Borges
Proyecto de Ingeniería de Software II	N/A	INSO 4XXX	1	Ramón Vasquez
Diseño de Sistemas de Base de Datos	ICOM 6005	N/A	1	Amir Chinae
Sistemas Operativos Distribuidos	ICOM 6006	N/A	1	Wilson Rivera
Redes Neuronales	ICOM 6015	N/A	1	Ramón Vasquez
Redes Inalámbricas	ICOM 6505	N/A	1	Kejie Lu
Fundamentos de Computación	CIIC 6005	N/A	1	Jaime Seguel

Tabla 13 : Distribución de secciones para el segundo semestre del año académico

Las tablas 12 y 13 muestran que la facultad del programa puede ofrecer los cursos, sin afectar los programas existentes. Cabe señalar que la distribución de carga por profesor se basa en el historial de tarea de académica de los últimos 4 años. También, se menciona que el cómputo de número de secciones se basa en la proyección de matrícula a razón de 50 estudiantes de nuevo ingreso por año, tomando como base el número de secciones actuales para el programa de Ingeniería de Computadoras. Este último, admite 100 estudiantes de nuevo ingreso al año.

14.2.2 Costo de Administración

Originalmente, se solicitaba un asistente de administración I para apoyar la gestión de administrar el programa. Junto a esto, se solicitaba presupuesto para una compensación adicional para un director asociado para el programa. Finalmente, se solicitaba un administrador de sistemas para manejar el servicio de correo electrónico, página web, centro de cómputos, e instalación de programados.

Sin embargo, el Departamento de Ingeniería Eléctrica y Computadoras dispone de personal de apoyo suficiente para manejar todo lo relacionado a la administración del programa. Por lo que se elimina esta partida del presupuesto. También se elimina la compensación para el director asociado ya que el actual Director Asociado para Asuntos Académicos tendrá el rol de administrador del programa. Finalmente, se elimina la plaza del administrador de sistemas por varias razones. En primer lugar, la adopción de la plataforma "Goole Apps" en la UPR, proveyó un sistema de correo electrónico, página web y programados para todos los usuarios del sistema. Segundo, la disminución del costo de la computadoras portátiles ha resultado en un incremento en el número de estudiantes que poseen computadoras, y esto reduce la necesidad de mantener centros de cómputos. Finalmente, el RUM entro en un acuerdo con la compañía Microsoft para la distribución de sus productos, por lo que el Centro de Computos del RUM se encarga de la distribución de estos programados.

14.2.3 Costo de Facilidades

La propuesta original solicitaba la cantidad de \$758,000 para nuevas instalaciones. Esta solicitud se elimina en base a la existencia de un Memorando de Entendimiento en el Departamento de Ingeniería Eléctrica y de Computadoras en el cual se establece que los nuevos programas serán servidos en las instalaciones existentes. Dicho memorando también incluye en el nuevo Edificio de Ingeniería Eléctrica y Computadoras las instalaciones necesarias para estos programas y eventualmente, las de un Departamento en Ciencia e Ingeniería de Computación, de ser este creado. Dicho edificio es parte del Plan de Mejoras Permanentes del Recinto Universitario de Mayagüez (Certificación Número 115, 2004-2005 de la Junta de Síndicos de la Universidad de Puerto Rico, y Certificación Número 66, 2008-2009 de la Junta de Síndicos de la Universidad de Puerto Rico.)

15. PLAN DE EVALUACIÓN Y DESARROLLO

El programa en Ciencias e Ingeniería de Computación e Ingeniería de Software será evaluado anualmente en evaluaciones de carácter formativo. Dichas evaluaciones se enfocarán en determinar el grado en que el programa está satisfaciendo sus objetivos y los criterios de la agencia acreditadora ABET. Habrá también una evaluación quinquenal de carácter sumativo sobre la cual se basará la revisión curricular del programa.

15.1. Comité de Evaluación Periódica

Una vez aprobado el programa se creará un comité para la implementación del plan de evaluación anual del programa. Dicho comité llevara el nombre de Comité de Excelencia Académica (CEA) y será un subcomité del Comité de Currículo del programa, electo por sus miembros.

15.2. Proceso de Evaluación

Las siguientes tareas de autoevaluación formaran parte de le encomienda del CEA.

1. Estar al tanto de las exigencias de ABET: revisión periodica de las reglamentaciones de esta agencia acreditadora. Produccion de un informe anual con el resumen de las tendencias o diferencias entre las exigencias recopiladas en el año previo.
2. Estar al tanto de las recomendaciones que periódicamente establece el comité conjunto de ACM y IEEE que establece los estándares curriculares programas en las disciplinas de Computación. Produccion de informes sobre cambios en estos estándares, cada vez que sea necesario.
3. Medir el desempeño de los estudiantes en el transcurso de sus años de estudio en el programa. Esta medición estará destinada a determinar el grado en que:
 - a. los cursos incluyen los tópicos apropiados;
 - b. las actividades académicas en cada curso son las adecuadas;
 - c. las facilidades físicas con las que contamos para satisfacer las exigencias de cada curso son las adecuadas; y el grado en que
 - d. los requerimientos de admisión vigentes son los adecuados.

El análisis de estos datos permitirá identificar deficiencias funcionales que, en general, podrían corregirse mediante cambios menores, bien sea en la modalidad como debe ofrecerse cada curso o en la infraestructura física con las que se cuenta.

Se recopilara además información sobre el desempeño de los graduados del programa en el mercado laboral o en estudios graduados. El análisis de dicha información servirá para determinar la efectividad del programa en cuanto al logro de aspectos claves del perfil profesional del egresado. En esencia, se pretende medir el grado en que los conocimientos que los estudiantes adquieren en el programa están a tono con las exigencias del mercado laboral o los estudios graduados. Los instrumentos de evaluación serán los usuales, esto es cuestionarios escritos o digitales, entrevistas personales o telefónicas; y los encuestados incluirán todas aquellas personas, agencias, compañías u organizaciones con las que los estudiantes del programa hayan tenido alguna relación de trabajo o académica (investigación, programas COOP, internados de verano, intercambio, etc.)

15.3. Plan estratégico para el fortalecimiento del programa

Factor Crítico	Objetivos	Indicadores de Exito
Admisión	Captar a los mejores entre los estudiantes interesados en el area de ciencia e ingeniería de computación o ingeniería de software	50 estudiantes por año con índices de ingreso superior al 95% de los/las estudiantes admitidos/as al RUM
Retención	Mantener un alto índice de interés y motivación en areas de ciencia e ingeniería de computación o ingeniería de software	Un promedio de un 85% de retención en los primeros cuatro años, con al menos un 80% de retención en el primer año
Tasa de Graduación	Mantener un alto índice de éxito en el progreso académico de los estudiantes	90% de los/las estudiantes originalmente admitidos/as graduándose en cinco años
Empleos	Mantener un alto índice de colocación de graduados en industrias o empresas a nivel nacional e internacional, o en el servicio publico. Fomentar la iniciativa empresarial	85% de los/las egresados/as recibirán ofertas de trabajo en campos afines a la ciencia e ingeniería de computacion o la ingeniería de software, o establecerán su propia empresa
Estudios Graduados	Mantener en alto el interés de los estudiantes en carreras academicas y de investigación en Ciencia e Ingeniería de Computación o Ingeniería de Software	10% de los/las egresados/as son admitidos/as a universidades reconocidas para proseguir estudios graduados en Computación
Facultad	Contar con una masa critica de facultad con doctorados en Ciencia de Computacion y en Ingenieria de Software, comprometidas con la sustentación y desarrollo del programa	Contratación de tres especialistas en Ingenieria de Software y cuatro en areas de Ciencia e Ingenieria de Computación, durante los primeros cinco años desde la implantación del programa

16. INFORMACIÓN ADICIONAL

16.1. Historial de Fondos Externos

Además de ingresos por concepto de matrícula, el Colegio de Ingeniería frecuentemente recibe donaciones de compañías privadas para desarrollar laboratorios académicos, didácticos y de investigación. Se espera que el programa que se propone atraiga un número significativo de fondos por este concepto lo cual reduciría las la cantidad de fondos institucionales necesarios para ofrecer el programa.

La actividad de investigación que realiza la facultad disponible para el nuevo programa ha permitido allegar una cantidades substanciales de fondos externos. Estos fondos tienen un impacto en los programas de bachillerato pues proveen recursos para la infraestructura y para actividades académicas y de investigación. En la Tabla 14 se presenta un desglose de las propuestas más significativas que se han sometido recientemente para obtener fondos externos y que impactarían los programas propuestos. Todas estas propuestas generarán ingresos adicionales considerables a la UPR por concepto de costos indirectos ("overhead"). Al momento de redactar esta propuesta el por ciento de costos indirectos con agencias federales como NSF y NASA es de alrededor de 49% del monto total del presupuesto con excepción del losa dineros destinados a equipo y salarios de estudiantes.

La agencia gubernamental PRIDCO aprobó una propuesta sometida por el RUM titulada: *El Recinto Universitario de Mayagüez: Eje Académico del Corredor Tecnológico del Oeste*. Mediante esta dádiva PRIDCO contribuyó \$359,862 para el desarrollo del programa de Bachillerato en Ingeniería de Software. En adición, esta dádiva de PRIDCO ha contribuido \$1,000,000 para la construcción de facilidades físicas para ofrecer los programas que fueron incluidos en la propuesta original. Al presente no se ha determinado que porción de esos fondos corresponderá al programa de ingeniería de software pero se espera que sea alrededor de una cuarta parte ya que la propuesta a PRIDCO incluía cuatro programas académicos.

(A continuación la Tabla 14: Propuestas de Fondos Externos Sometidas en los Ultimos 10 Años.)

Project Title	Funding Agency	Amount Requested	Amount Awarded	PI RUM
TCESS/CenSSIS: Dynamic Image Retrieval System	NASA-NSF	-	\$ 150,000	B.Velez
The Open Source Operating Systems (O2S2) Project	IBM	\$ 56,571	\$ 56,571	B. Velez
Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks	NASA/EPNES	\$ 100,000	\$ 400,000	M. Rodriguez
Terrascope: Distributed Satellite Image Repository Integrating Heterogeneous Data Centers	NASA/AIST	\$ 1,393,056		M. Rodriguez

Bioinformatics Management System to Integrate and Federate Heterogeneous Biological Databases	NSF/BIO	\$ 2,504,062		M. Rodriguez
Multidisciplinary E-Government Research and Education as a Catalyst for Effective Information Technology Transfer to Regional Governments	NSF/EIA	\$ 1,810,559		B. Velez
ITR Collaborative Research: GaiaNET a peer-to-peer web service composition database system for scientific applications	NSF/ITR With U of Maryland College Park	\$ 5,000,000		M. Rodriguez
VeriLab: The Verizon Broadband Mass Market Services Research Center	Verizon Foundation	\$ 2,490,673		I. Couvertier
Computational Method for Nonparametric Supervised Classifiers	NSF/ITR	\$ 422,693		W. Rivera E. Acuna
BTeV Braking Down Barriers in Physics	NSF/ITR With FermiLab	\$ 4,000,000		A. Lopez W. Rivera J. Seguel
WPI Systems Security Research Lab	NSF/ITR	\$ 10,000,000		B. Velez
Crystallographic FFT package	NIH		\$ 480,000	J. Seguel
CISE Software Engineering Mejoras permanentes	PRIDCO		\$ 250,000	B. Velez
CISE Software Engineering Facultad y recursos humanos	PRIDCO		\$ 400,000	B. Velez
CISE PhD Mejoras permanentes	PRIDCO		\$ 250,000	J. Seguel
CISE PhD Facultad y recursos humanos	PRIDCO		\$ 400,000	J. Seguel
Enabling Large-scale Simulation of Highly Nonlinear Problems	DoE	\$ 325,000		W. Rivera
PRECISE: Program for Research in Computer Information Sciences and Engineering	NSF/CISE	-	\$ 3,000,000	D. Rodriguez
CAREER: NetTraveler: A Database Middleware System for Ubiquitous Data Access on Wide-Area Network	NSF/CAREER	\$ 581,708.00	\$ 499,445	M. Rodriguez
SEI: Intelligent Power Routers: Robust Computational Support for Self-Healing Electric Energy Networks	NSF/IIS	\$835,171.00	-	M. Rodriguez

Lockheed Martin Cloud Computing	Lockheed Martin	\$350,000	\$350,000	J. Seguel
MRI: Development of a Versatile Service-Oriented Wireless Mesh Network for Disaster Relief and Environmental Monitoring in Puerto Rico"	NSF/CCR	\$586,000	\$586,000	K. Lu
UPRM Center of Excellence in Computing Education	NASA/MUREP	\$675,254	-	M. Rodriguez
Resilient Clouds	DARPA	\$1.5M	-	M. Rodriguez
Hyperspectral Data Management in Open Source Clouds	NASA/AIST	1.5M	-	M. Rodriguez
Indusoft	PRIDCO	\$1M	\$1M	B. Velez
eGovernment	NSF	\$750,000	\$750,000	B. Velez
TOTALS		\$ 35,880,747	\$ 8,572,016	

Tabla 14: Propuestas de Fondos Externos Sometidas en los Ultimos 10 Años

Apéndice A. Definición de Ciencia de Computación según CAC/ABET

Computer science is a discipline that involves the understanding and design of computers and computational processes. In its most general form it is concerned with the understanding of information transfer and transformation. Particular interest is placed on making processes efficient and endowing them with some form of intelligence. The discipline ranges from theoretical studies of algorithms to practical problems of implementation in terms of computational hardware and software. A central focus is on processes for handling and manipulating information. Thus, the discipline spans both advancing the fundamental understanding of algorithms and information processes in general as well as the practical design of efficient reliable software and hardware to meet given specifications. Computer science is a young discipline that is evolving rapidly from its beginnings in the 1940's. As such it includes theoretical studies, experimental methods, and engineering design all in one discipline. This differs radically from most physical sciences that separate the understanding and advancement of the science from the applications of the science in fields of engineering design and implementation. In computer science there is an inherent intermingling of the theoretical concepts of computability and algorithmic efficiency with the modern practical advancements in electronics that continue to stimulate advances in the discipline. It is this close interaction of the theoretical and design aspects of the field that binds them together into a single discipline.

Because of the rapid evolution it is difficult to provide a complete list of computer science areas. Yet it is clear that some of the crucial areas are theory, algorithms and data structures, programming methodology and languages, and computer elements and architecture. Other areas include software engineering, artificial intelligence, computer networking and communication, database systems, parallel computation, distributed computation, computer-human interaction, computer graphics, operating systems, and numerical and symbolic computation.

A professional computer scientist must have a firm foundation in the crucial areas of the field and will most likely have an in-depth knowledge in one or more of the other areas of the discipline, depending upon the person's particular area of practice. Thus, a well educated computer scientist should be able to apply the fundamental concepts and techniques of computation, algorithms, and computer design to a specific design problem. The work includes detailing of specifications, analysis of the problem, and provides a design that functions as desired, has satisfactory performance, is reliable and maintainable, and meets desired cost criteria. Clearly, the computer scientist must not only have sufficient training in the computer science areas to be able to accomplish such tasks, but must also have a firm understanding in areas of mathematics and science, as well as a broad education in liberal studies to provide a basis for understanding the societal implications of the work being performed.