Courses Descriptions

5.1. Computer Science

The Required Courses:

CS-501 Advanced Artificial Intelligence

An in-depth study of Artificial Intelligence topics. State of the art approaches to Artificial Intelligence. Knowledge Engineering. Planning. Natural Language Understanding. Speech Understanding. Computer Vision.

CS-502 Advanced Software Engineering

Advanced topics selected from current journals of Software Engineering that deal with theoretical development or applications in the field. Topics include: Reusable Software Architectures, Software Engineering, Experimentation, Concurrent Software Systems, Software Metrics Software Engineering for the World Wide Web, Formal Methods and Models in Software Engineering, etc.

CS-503 Intelligent Computer Algorithms

Learning Systems. Concept Learning. Computational Learning Theory. Instance-Based Learning. Learning sets and Rules. Analytical Learning. Inductive Learning. Reinforcement Learning.

CS-504 Distributed Computing

Introduction to parallel and distributed computation models. Mapping a parallel solution to a distributed computing platform. Programming issues. Operating system support for distributed computing. Message passing environments such as PVM and MPI. Load balancing. Migration. Agent architectures. Performance and complexity measures. Services. Service driven design of distributed applications. Timing and Synchronization. Remote procedure invocation. Project(s).

The Elective Courses:

CS-510 Programming Languages Concepts

Principles of functional, imperative, object-oriented and logic programming languages. Semantic specification including axiomatic, operational and denotational semantics. Fundamentals of type systems such as abstract data types, polymorphism, and inference. Concurrent systems. Case studies of contemporary programming languages.

CS-511 Computer Security

Introduction to cryptography and its application to information, network and systems security; security threats; secret key and public key cryptographic algorithms; hash functions; basic number theory; authentication; security for Electronic mail, the Internet and computer networks; real world security applications.

CS-512 Computer Vision

Vision perception and visual illusion. Edge detection. Primal sketch. Line-drawing interpretation. Shape from shading. Stereopsis. Shape from contour. Texture. Motion perception and optical flow. 2.5D and 3D maps. Object representation. Object recognition.

CS-513 Parallel Algorithms

Introduction to parallel computational models (PRAM, Meshes, Trees, Hypercubes, Shuffle-Exchange, Mesh-of-Trees) and complexity measures. Parallel algorithms design techniques: divide-and-conquer, parallel prefix, pointer jumping, list ranking, Euler's path technique, and ear decomposition. Parallel algorithms for selection, merging, sorting, searching, and graph problems. Computational geometry. Graph embedding. Parallel computational complexity: equivalence of Boolean circuits and the PRAM models, the NC class, and P-complete problems.

CS-514 Advanced Compiler

Study classical compiler optimizations and the trade-offs between hardware assisted and compiler assisted instruction level parallelism. Explore the integration of recent architectural advances with compiler design, including control and data speculation, predication, and multi-threading. Study dynamic re-compilation and feedback-directed compilation.

CS-515 Advanced Computer Graphics & Animations

Graphics systems. Two dimensional concepts and methods. Geometrical transformations. Modeling 3D scenes. Curve and surface design. Approaches to infinity. Rendering faces for realism. Color theory. Visible-surface determination. Illumination models and shading. Project(s).

CS-516 Advanced Image Processing & Pattern Recognition

Illumination and imaging techniques. Planar and stereo-vision, pixel representation, preprocessing, smoothing, enhancement, and equalization. Edge detection, gradient, Laplacian, and thresholding. Segmentation, linear, polygonal, and Fourier descriptors. Introduction to 3D structures. Shape matching, search approaches, interpretation, and recognition.

Various methods of pattern recognition, extraction methods, statistical classification, minimax procedures, maximum likelihood decisions, data structures for pattern recognition, case studies.

CS-517 Advanced Natural Language Processing

Components of a natural languages processing system. Natural language models: Mathematical, psychological. Lexical, syntactic, and semantic analysis. Phrase-structured grammars. Transformational grammars. Transition networks. Semantic networks. Conceptual parsing. Conceptual dependency. Systemic and case grammars. Scripts, plans and goals. Knowledge representation. Sentence generation. Recent trends.

CS-518 Ontology Engineering

This course will explore theoretical techniques for the design and analysis of formal ontologies. Topics will include the design of verified ontologies, methodologies for proving properties about ontologies. The course focuses on comprehensive study of the state of the art and future perspectives of the scientific field of ontology engineering for computer systems. The purpose of this course is to reflect four aspect of dealing with ontologies: ontology representation and reasoning, ontology design, ontology infrastructure, and ontology applications as well as the role of ontologies in software engineering and related engineering disciplines.

CS-519 Robotics

Introduction to Robotics. Motion coordination, configuration space and task space. Mathematical operators, direct and inverse geometric method, direct and inverse variational method. Robot programming, effector-level and object-level, and applications. Practice of robot programming. Introduction to sensors systems and robotics vision. Architectural aspects of robotics systems.

CS-520 Advanced Neural Networks

The goals of the course are to provide a foundation for studying in these growing fields, to attempt to assimilate and synthesize the different models to general principles, and to provide an idea of both the strengths and weaknesses of neural and machine learning approaches to problem solving. Topics will include ensembles, recurrent networks, support vector machines, and manifold learning. As time allows, other topics that may be covered include PAC-learning, learning transfer, spectral methods, reinforcement learning, spiking neurons and other topics of interest.

CS-521 Advanced Expert Systems

Students learn how to build a rule-based expert system in a variety of application areas. They also learn advanced programming techniques which include topics of inexact reasoning, intelligent database management methods, and how to develop a community of expert systems which cooperate over a blackboard structure. Students are also given the opportunity to demonstrate their understanding of the technology by building a rule-based expert system that addresses a real-world problem. The course prepares students for graduate research in the area of expert systems.

CS-530 Advanced Selected topics in Computer Science

5.2. Information Systems

The Required Courses:

IS-501: Decision Support and Intelligent Systems

The course focuses on the new trends and future prospects of Intelligent Decision Support Systems. Large-scale, stochastic, fuzzy, and using of intelligent tools are some examples of the proposed topics. Real and practical applications and case studies of Operations Research and Decision Support Systems in different fields are recommended, examples of these fields are: computer applications, risk analysis, banking, logistics, military, chemical, oil industry, production, agriculture, airspace, education, naval transport, and others. Recent papers and publications in Operations Research and Decision Support Systems can be used to inform students about recent trends and to train them reading and understanding scientific writing.

Is-502: Advanced Database Management Systems

Implementation of database management systems, the impact of new technology on database management systems, back-end database computers, distributed database management systems, concurrency control and query execution in both distributed and centralized systems, implementation of multiple user views, roll-back and recovery mechanisms, database translation.

IS-503: Advanced Software Engineering

The aim of this course is to provide necessary background for research in software engineering. The course is offered in two parts. The first part deals with modern techniques in software development mainly used by practitioners. These include meta-modeling, domain-specific languages, model-driven development, program transformations, and software product lines. The second part has a more formal theme and covers various formalisms for modeling sequential and reactive systems including Alloy, Z, Petri Nets, and process algebra.

IS-504: Intelligent Information Retrieval Systems

The focus in this course is on the underlying retrieval models, algorithms, and system implementations. Also examined is how an effective information search and retrieval is interrelated with the organization and description of information to be retrieved. Topics include: automatic indexing; thesaurus generation; Boolean, vector-space, and probabilistic models; clustering and classification; information filtering; distributed IR on the WWW; intelligent information agents; IR system evaluation; information visualization; and natural language processing in IR. Throughout the course, current literature from the viewpoints of both research and practical retrieval technologies both on and off the World Wide Web will be examined.

The Elective Courses:

IS-511: Data Mining Techniques in Smart Business

This course provides students exposure to important developments in large-scale database systems and the analysis of this data to aid business decision making. Initial classes describe major data storage tools useful in data mining, to include data warehousing, data marts, and on-line analytic processing (OLAP). This course then discusses fundamental concepts relating to data mining, data mining applications in many business decision making contexts, and data mining software and procedure. Data mining techniques will be reviewed, with the opportunity for specific students to explore research opportunities in greater depth.

IS-512: knowledge Management

This course addresses the issues involved in creating, curating, managing and using knowledge in e-business applications. Topics covered in the course include: The knowledge management life cycle model; Leadership in dynamic e-business environments; E-business models and networks;

E-business modeling, ontologies and business rules; E-business security and reliability; E-business integration and protocols; XML, e-business Processes, web services and semantic web services.

IS-513: Advanced Management Information Systems

Overview of management information systems (MIS) within a business context, with emphasis on end-user computing. Covers MIS theory and practice as they relate to management and organization theories; current trends in MIS; managerial usage of information systems; computer hardware; software, and telecommunications; information systems for marketing, finance, accounting, and other business areas; systems development process; and the role of microcomputers. Provides experiential learning by exposure to various decision-support tools for microcomputers.

IS-514: Advanced Information Systems Design

This course presents an end-to-end view of the design life cycle for information systems and services. It explains how design problems are conceived, researched, analyzed and resolved in different types of organizations and contexts, including start-ups, enterprises with legacy-systems, non-profit and government entities. The course takes a comprehensive perspective on how these different contexts shape design activities and methods, including: Analyzing stakeholders and customers - Building new vs. extending legacy systems - Identifying customer segments and modeling different user types - Analyzing and collecting data to identify and verify requirements - Measuring usability and quality Prototyping and iterative implementation - Personalization and configuration - Designing for multiple channels (brick-and-mortar vs online) - Designing for multiple platforms (cellphones, PDAs, PCs).

IS-515: Multimedia Information Systems

Multi-dimensional data structure (K-D tree, Point trees, M-X trees and R trees). Image database and the different techniques of compression and segmentation. An overview about the text/document database, Video database and Audio one. Architectures for Multimedia Systems, Digital Audio, Video Technology and Image Compression, Computer Graphics, Multimedia Information Systems, Multimedia Communication Systems. Structure of the Internet, Methods of Storing and Accessing Data on the Internet.

IS-516: Advanced Information Retrieval

Data management on internet: data extraction, integration, indexing, searching, clustering, and peer-to-peer; data management on wireless networks: indexing, caching, scheduling and broadcasting of data on wireless channels, modeling, indexing and querying in location-based information systems. Information Retrieval. Wireless Data Access and Dissemination. Information Retrieval on the Web. Search Engine Log Analysis. Peer-to-Peer Search. Caching in Wireless Data. Indexing Broadcast Data. Location-dependent Information services.

IS-517: Geographic Information Systems and Spatial Data Base

The fundamentals of database design and data management to support GIS and other spatial applications. Topics include modeling spatial data, spatial database design, spatial query languages, spatial database storage and indexing, and spatial query optimization.

IS-518: Geophysics

IS-519: Quality assurance of information systems and programming

This course studies the key facets of information security, from theory to applications in a networked environment. Topics to be covered include symmetric key cryptosystems, number-theoretical foundations, public key cryptosystems, authentication, key exchange, access control, Internet security architecture, and emerging security standards. Access Control Categories and Types, Access Control Threats, Access to Systems/Data, Access Control Technologies, Assurance Mechanisms. Cryptography, Physical Security, Layered Defense Model. Infrastructure Support Systems, Equipment Protection. Security architecture and design. Security Models and Architecture Theory, Security Evaluation Methods and Criteria. Business Continuity Planning and Disaster Recovery Planning. Telecommunications and Network Security.

IS-530: Advanced Selected topics in Information systems

5.3. Scientific Computing

The Required Courses:

SC-501 Approximation Algorithms

This module provides knowledge on specific algorithms of the Scientific Computing and their implementation. The students learn how to apply that knowledge in the solution of practical tasks.

SC-502 Statistical Signal Processing

Introductory graduate level course in statistical signal processing. This course focuses on the roles that stochastic signals play. Some interesting signals, e.g. communication and neural signals, are by their very nature stochastic. Deterministic signals, when measured in the presence of random noise, can also be modeled as stochastic signals. Statistical signal processing develops optimal algorithms to extract information from or in the presence of stochastic signals. These algorithms hinge on fundamental results in estimation and detection.

SC-503 Grid Technologies

Students acquire theoretical and practical knowledge in the field of grid technologies, distributed databases, the Data Grid and the application of these technologies in Scientific Computing.

SC-504 Robotics Computational Techniques

Introduction to robotic applications and research, spatial representation, robot kinematics, Jacobian matrix, motion trajectory, sensor and data fusion, sensor placement, imaging for robotics, object identification, wireless communication. Micro-controllers, real-time operating systems and computer interfacing.

The Elective Courses:

SC-510 Scientific Database

Learn data management for the purpose of facilitating research and application development using open source DBMS packages and large-scale scientific data sets.

SC-511 Computational Physics

Overview of numerical methods for the simulation of problems involving solid mechanics and fluid dynamics. The focus is on practical tools needed for simulation, as well as the necessary continuous mathematics involving nonlinear hyperbolic partial differential equations. Possible topics include the finite element method, highly deformable elastic bodies, plasticity, fracture, the level set method, Burgers' equation, compressible and incompressible Navier-Stokes equations, smoke, water and solid-fluid coupling.

SC-512 Advanced Operation Research

Linear programming: Formulations and graphical solution. Algebraic solution: the simplex method and dual-simplex method. Sensitivity analysis. Transportation and assignment problems. Integer programming: cutting-plane algorithms, branch and bound method. Dynamic programming: Examples of the dynamic programming. Models and computations, solution of linear programs by dynamic programs. Project scheduling by PERT-CPM.

SC-513 Spatial (Advanced) Signal Transformations

This module provides knowledge about transformation systems, in particular, Short-time Fourier transformation and Wavelet transformation. Case studies can be, images, videos, and hyperspectral images.

SC-514 Parallel Architectures and Programming Models

Skills: This module provides knowledge in the field of parallelization of programs on parallel architectures and programming models. The students learn how these skills in the solution of practical tasks to implement.

SC-515 Molecular Modeling

Skills: This module provides knowledge in computer applications from the field of molecular modeling. Thematically, will be the accounting treatment of molecules, including computer graphics covered.

SC-516 Advanced Computational Physics

The aim of the module is the acquisition of skills for computer processing of physical problems in applications selected from different areas of physics (statistical mechanics, quantum mechanics, hydrodynamics).

SC-517 Advanced Statistical Analysis Techniques

This course is oriented to applied mathematics. Basic linear algebra. Equations for equilibrium, discrete and continuous. Minimization and duality, discrete and continuous. Calculus of variations. Some qualitative theory for ordinary differential equations, phase plane and stability. Perturbation techniques and numerical methods for nonlinear equations and ordinary differential equations. Computer labs.

SC-518 Advanced Computational Models of Neural Systems

SC- 519 Computational Methods in Image Analysis

SC-520 Computational Optimization Techniques

SC-521 Advance Methods in Computer Simulation

SC-522 Research Seminar in Scientific Computing

Skills: Research, analysis, preparation of relevant scientific questions in the area of Scientific Computing. Qualifications for the scientific way of working, as in the master's thesis is required.

SC-530 Advanced Selected topics in Scientific Computing

5.4. Computer systems

The Required Courses:

Csys-501 Wireless communication

The course covers the following topics: Evolution of wireless communications. Mobile radio channel modeling. Modulation techniques and their performance. Multiple access techniques (F/TDMA, CDMA, SDMA, MU-MIMO, OFDMA). Capacity enhancement methods (Power control, receiver design) Wireless system design fundamentals Cooperative communications. Introduction to wireless networks Cross-layer design. Current and upcoming wireless systems: 3G, 4G, 802.11a/b/g, 802.16, WiMAX, 802.22.

Csys-502 Embedded real time systems

This course covers the following topics: Introduction to R/T embedded systems. System Requirement, Specification, Design, Implementation. Real-Time Systems. Model Taxonomy. Specification Languages. Embedded Processors. The Embedded Computing Platform. Real-time interfacing & exception handling. System Performance. IP- and Platform-Based SoC Designs. System-Level Design Space Exploration. Static and Dynamic Performance Exploration. Behavior-Architecture Co-Design. Real-time scheduling. Hardware Accelerators (hw/sw co-design). Power issues in embedded systems

Csys-503 Cryptography and Network Security

Mathematical Tools for Cryptography. Conventional Symmetric Encryption Algorithms. Modern Symmetric Encryption Algorithms. Stream Ciphers and Pseudo Random Numbers. Public Key Cryptography. Hashes and Message Digests. Digital Signatures, Certificates, User Authentication. Authentication of Systems. Electronic Mail Security. IP and Web Security. Electronic Commerce Security

Csys-504 Advanced Distributed and parallel architecture

The course covers the following topics: Instruction set architecture. Pipeline and superscalar microarchitecture. Dynamic scheduling. Instruction level parallelism. Storage hierarchy principles and caches. Symmetric multiprocessors and multithreading. Distributed shared addressing machines. Interconnection network. Clusters of workstations/servers.

The Elective Courses:

Csys-510 Grid Computing

Grid Architecture. Networking Infrastructure, Protocols and Quality of Service. Computing Platforms. Operating Systems and Network Interfaces. Compilers, Languages and Libraries for the Grid. Grid Scheduling, Resource Management, Resource Brokers, Resource Reservations. Instrumentation and Measurement, Performance Analysis and Visualization.

Security, Accounting and Assurance. Open Grid Service Architecture and Data Grids Portal Development.

Csys-511 Robotics Techniques

The course covers the following topics: Robot Design. Direct and Inverse Kinematics. Path Planning and Motion Control. Navigation Algorithms and Sensor-Based Navigation. Robot Vision and Other Sensors. Multi-Agent Robotics.

Csys-512 Sensor Networks

The course covers the following topics: Introduction of ad-hoc/sensor networks. Media Access Control (MAC) Protocols. Routing Protocols. Networking Sensors. Sensor tasking and control. Transport layer and security protocols. Sensor Network Platforms and Tools. Sensor network programming challenges. Embedded Operating System. Simulators. Applications of Ad-Hoc/sensor Network and Future Directions.

Csys-513 Mobile and High Performance Computing

The course covers the following topics: Mobile Communication and Mobile Internet technologies, Mobile and Wireless Security, Mobile Development Environments, Parallel Computing Paradigms, Message Passing Interface, OpenMP, OpenCL, Solving Computationally Intensive Problems, Mobile Commerce Applications (e.g. mobile banking, mobile ticketing, mobile payment, mobile infotainment, etc.), location tracking and location-based services, RFID, mobile social software applications, mobile enterprise and mobile government applications, context awareness, pervasive computing.

Csys-514 Optical Communication

The course covers the following topics: Optical fibers. Optical components overview (transmitters (lasers, LEDs), detectors (PIN, APD), optical amplifiers and optical regeneration, multiplexers, filters, couplers, isolators, circulators, wavelength converters, optical switches. Modulation and demodulation Optical System Design Optical networks (client layers, WDM network elements, topology design, routing and wavelength allocation, network management/performance monitoring, network survivability, access networks, OTDM and optical packet switching).

Csys-515 Visualization

The course covers the following topics: Discrete models. Volume rendering: ray-tracing, splatting, texture based. Iso-surface reconstruction. Transformation of discrete volume data to polygonal representations. Mesh topologies and mesh simplification. Visualization techniques. Visual aspects based on perception. Particle rendering. Algorithms for programmable graphics hardware. Applied visualization.

Csys-516 Computer Vision

The course covers the following topics: Image Sensing. Image Analysis. Edge/Line Detection. Segmentation/Morphological Filtering. Fourier Transform. Feature Extraction/Analysis. Pattern Classification.

CSYS-517 Advanced Digital System Design

Sequential circuit design, asynchronous sequential circuit design, fault diagnosis and testability algorithms, synchronous design using programmable devices, new generation programmable logic devices

CSYS-518 Advanced Embedded Systems

Introduction to embedded hardware and software, system modelling with hardware/software partitioning, hardware /software co-synthesis, memory and interfacing, concurrent process models and hardware software co-design.

CSYS-519 Advanced Microprocessors & Micro Controllers Design

Microprocessor architecture, high performance cisc architecture – Pentium, high performance risc architecture, Motorola 68hc11 micro controller, pic micro controller.

CSYS-520 Reconfigurable Computing

Introduction to fpga, fpga design, parallel processing, RC Application Design - Parallelism - Systolic arrays -Pipelining - Optimizations - Bottlenecks - High-level Design - High-level synthesis - High-level languages - Design tools, ARCHITECTURES, CASE STUDY Case Studies- Signal and image processing - Bioinformatics - Security - Special Topics - Partial Reconfiguration - Numerical Analysis -Performance Analysis/Prediction - Fault Tolerance

CSYS-521 Real Time Operating Systems

Review of operating systems, overview of RTOS, real time models and languages, real time kernel, RTOS application domains

CSYS-530 Advanced Selected topics in Computer systems

5.5. Bioinformatics

The Required Courses:

BIO 501 Biostatistics

Knowledge of biostatistical methods is fundamental to the planning, execution, and analyses of biomedical experiments. It is also required for the planning of observational studies and for mathematical modelling of biological phenomena. This core course aims to provide students with sufficient knowledge of biostatistics to handle biomedical projects. Coverage includes: Introduction to biostatistics, analyze univariate, bivariate and multivariate data; Introduction to probability and probability distributions, sampling distributions, point and interval estimations, confidence intervals; Hypothesis testing, testing hypotheses involving means and proportions, examining relationships using correlation and regression, sample size and power estimation;

BIO 502 Evolutionary Computing

The course will introduce the graduate students to the evolutionary algorithms, genetic algorithms Evolution Strategies and programming and genetics programming, Learning Classifier Systems, Parameter Control in Evolutionary Algorithms, Multi-Modal Problems and Spatial Distribution, Hybridization with Other Techniques: Mimetic Algorithms, Theory Constraint Handling, Special Forms of Evolution, Working with Evolutionary Algorithms

BIO 503 Biological Sequence Analysis: Probabilistic Models

This course is an introduction to hidden Markov models and context-free grammar methods in computational biology. This course will introduce students to hidden Markov models and how it can be used to perform sequence analysis. An overview of probabilistic modeling is given; Bayesian parameter estimation is introduced as well as maximum likelihood estimation. Treatment of pairwise alignment, which begins with substitution matrices. Global alignment via the Gotoh algorithm and local alignment via the Smith-Waterman algorithm, are both discussed very effectively. Finite state machines with accompanying diagrams are used to discuss dynamic programming approaches to sequence alignment. The BLAST and FASTA packages are briefly discussed, along with the PAM and BLOSUM matrices. Hidden Markov models are treated thoroughly with the Viterbi and Baum-Welch algorithms playing the central role. Hidden Markov models are then used for pairwise alignment. Profile hidden Markov models, application of Voronoi diagrams from computational geometry to weighting training sequences will be discussed. Several different approaches, such as Barton-Sternberg, CLUSTALW, Feng-Doolittle, MSA, simulated annealing, and Gibbs sampling are applied to multiple sequence alignment methods. Phylogenetic trees are covered with emphasis placed on tree building algorithms

using parsimony. Connections between the sequence alignment algorithms with evolutionary models will be introduced.

BIO 504 Advanced Topics in Computational Biology

This course introduces the basic techniques of bioinformatics research and its grounding principles in the scientific method. A committee of instructors assists each student in the design and execution of an advanced research project in computational biology. General focus for independent student projects will be chosen by the faculty committee, usually focused on a systems biology question. Student projects must incorporate programming and database-focused integration and management of empirical data, and involve two or more of approaches in systems modeling, sequence analysis (genomics/proteomics), artificial intelligence/pattern detection, discrete mathematics and statistics, or phylogenetic.

The Elective Courses:

BIO 511 High Performance Computing for Bioinformatics

This course covers practical programming methods and skills for development of bioinformatics software, especially with high performance computing (HPC) systems. Introduction: bioinformatics data processing, algorithm design for sequence and structure analysis, programming language, bioinformatics software packages and toolkits; Infrastructure of HPC systems: client / server architecture, compute cluster, resource management system; Parallel and distributed programming: Amdahl's law, message passing interface, parallel programs for genomic sequence and structure data analysis; Imaging and visualisation: visualizing 3D protein structures, interactive 3D graphics programming. Case studies and hands-on sessions are conducted in the Bioinformatics Research Centre to help the participants for their individual thesis projects.

BIO 512 Methods and Tools of Proteomics

Proteomics, as a rapidly emerging field, has now established itself as a credible approach for furthering our understanding of the biology of whole organisms. Proteomics study and identify protein structure, interactions of protein/protein and protein/DNA and biology of organisms. We will further introduce the newly developed technology for the quantitative analysis of protein expression and function on a genome-wide scale.

BIO 513 Statistical Genetics

This course covers the statistical models and methods that are used to understand human genetics. This course Starting with Mendel’s first experiments to genome-wide association studies, the course describes how genetic information can be incorporated into statistical models to discover disease genes. All commonly used approaches in statistical genetics (e.g. aggregation analysis, segregation, linkage analysis, etc), are used, but the focus of the course is on modern approaches to association analysis. This course covers the statistical models and methods that are used to understand human genetics Starting with Mendel’s first experiments to genome-wide association studies, the course describes how genetic

information can be incorporated into statistical models to discover disease genes. All commonly used approaches in statistical genetics (e.g. aggregation analysis, segregation, linkage analysis, etc), are used, but the focus of the book is modern approaches to association analysis. The course will help students in learning about statistical methods for genetic analysis, whether to better analyze genetic data, or to pursue research in methodology.

BIO 514 Molecular Modeling and Simulation

This course introducing graduate students to the wide range of bimolecular problems being solved by computational techniques and to those computational tools. The course is intended for beginning graduate students in Bioinformatics, computational biology, medical schools, biology, chemistry, physics, mathematics, and computer science. The course surveys three broad areas: bimolecular structure and modeling: current problems and state of computations; molecular mechanics: force field origin, composition, and evaluation techniques; and simulation methods: geometry optimization, Monte Carlo, and molecular dynamics approaches.

BIO 515 Genetic Algorithms in Search, Optimization, and Machine Learning

The course covers topics in the field, including crossover, mutation, classifier systems, and fitness scaling, This book brings together - in an informal and tutorial fashion - the computer techniques, mathematical tools, and research results that will enable both students and apply genetic algorithms to problems in many fields.

BIO 516 Molecular, Cell and Developmental Biology

The course covers the basic concepts of molecular, cell and developmental biology. Concepts addressed include the anatomy of cells, its building blocks and their function; genetic information, how it is stored, replicated and translated into proteins; inheritance and genetic variation; DNA technology and relevant experimental methods; communication between cells and their environment; regulation and pathways; development and cancer. The course also covers how this knowledge is applied in biotech and pharmaceutical companies, and the related bioinformatics challenges.

BIO 517 Biological Data Mining and Modeling

The development of new bioinformatics tools typically involves some form of data modeling, prediction or optimization. This course introduces various modeling and prediction techniques including linear and nonlinear regression, principal component analysis, support vector machines, self-organizing maps, neural networks, set enrichment, Bayesian networks, and model-based analysis.

BIO 518 Drug Discovery and Development

There are high expectations for bioinformatics to contribute to drug discovery. This course explores issues faced during drug discovery and development. Topics include the drug discovery process, its major players and its origins; scientific principles behind drug properties and actions; target product profiles; disease and drug target selection, sources of

drug-like molecules; assays and screening; medicinal chemistry; pharmacology; toxicology; and clinical trials.

BIO 519 Biological Database Systems

BIO 520 Nanobiotechnology

The aim of the course is to introduce students to the emerging nanotechnology tools and techniques that are expected to have in the next future a profound effect also on Bioinformatics. At the same time taking advantage of the strongly interdisciplinary character of Nanobiotechnologies the course will provide the opportunity to strengthen and enrich the student background in basic chemistry, biochemistry and biophysics with connections between these different disciplines that are not commonly settled in other courses.

BIO 521 DNA/RNA Dynamics

The student will learn the basic knowledge that gene transcription is intrinsically a dynamic process based on chromatin remodeling and a complex RNAs pool mediating the transcript regulation. At the end of the course, the student will be acquainted with the most up-dated high throughput technologies (microarrays and deep sequencing) from two points of view such as biological and statistics. Data mining and cluster analyses will be acquired by the student.

BIO 530 Advanced Selected topics in Bioinformatics

5.6. Diploma in Information Technology and Entrepreneurship (DITE)

The Required Courses:

DITE 501 Programming Using Modern Languages

The course introduces modern programming languages (syntax, idioms, and patterns). Knowledge of the concepts and material presented in this course will give students practical know-how to write powerful programs and provide students with basic knowledge of the fundamental terms and know-how found in real-world programming. The course extends to cover classical data structures and algorithms in a programming perspective. Students will learn about tools and strategies that have proven useful in modeling real-world problems. Topics include: string searches, sorting algorithms, recursive backtracking, linked lists, stacks, queues, trees, and hash functions.

DITE 502 Database Fundamentals:

This hands-on course gives the student an introduction to applications of information technology. Mainly, it focuses on covering the foundation for the basic design concepts of relational databases. In addition, it introduces relational database management Systems (RDBMS), data models, and database design, data definition, data manipulation, and data retrieval techniques. This provides a foundation for designing and implementing databases to solve practical problems.

DITE 503 Computer Networks

This course deals with the use of computer networks, network structure, network architecture, the ISO reference model, examples of networks Network topology, connectivity analysis, delay analysis, backbone design, and local access network design. It also discusses the different layers of the ISO model; physical layer, data link layer, network layer, transport and session layers, presentation layer, and application layer.

DITE 504 Software Engineering

The course provides a study of the fundamental principles underlying Software Engineering. It covers the software lifecycle starting with requirements engineering, analysis, design, implementation, integration and testing. It also examines key cross-lifecycle activities such as project management, measurement, and quality assurance. A systematic approach to evolve software is emphasized recognizing the dependencies between software development and maintenance activities. Specific topics will focus on software process and project measurements, modularity; specification; data abstraction; object modeling; design patterns; and testing.

DITE 505 Developing Web Applications:

This course introduces the student to web application development using an enterprise application framework. Topics covered include an introduction to basic syntax, the development environment, state management, HTML server controls, Web controls, code behind data access, loading and manipulating XML documents, Web Services, and security. The current reference development framework consists of the Microsoft .NET framework, the C# language, and ASP.NET. Students will work in the Visual Studio .NET environment, using C# for assignment implementations.

The Elective Courses:

DITE 511 Introduction to Computer Systems

This course introduces the students to the concepts of computer definition, different computer types, Computer organization, computer hardware, input/output units, storage media, computer memory types, arithmetic and logical unit (ALU), computer software, computer programming, computers and networking, software development systems, Information management, database management systems and applications, operating systems. This course also introduces the concepts of software control over hardware and fault analysis (troubleshooting). Students will cover hardware installation and support, customizing PC systems and peripheral equipment, fundamental troubleshooting, supporting software, disaster recovery, maintenance plans, and virus protection. Students will analyze and configure hardware and software requirements.

DITE 512 Software Design and Data Structures:

This course continues the introduction to object-oriented programming begun in the Object-Oriented Programming course, with an emphasis on algorithms, data structures, software engineering and the social context of computing. Topics like Linked Lists, Queues, Stacks and Trees will be examined along with some common search and sort algorithms.

DITE 513 OO Programming:

Introduces object-oriented programming concepts and teaches fundamentals of programming language syntax. Prepares students to begin development of device drivers and network applications, provides basic knowledge of objects and provides hands-on experience. Learn key terms in an object-oriented environment and examine examples of objects, and their associated properties. Course intended for Technicians.

DITE 514 Programming Technologies 1:

This intensive hands-on course for Java Programmers focuses on problem solving, proper Object Oriented Programming techniques. Basic Java is explored including interfaces, exception handling, and user interfaces. Features of the latest Java Development Kit will also be examined.

DITE 515 Programming Technologies 2:

This course continues the course of Programming with Java Programmers 1. It addresses the design, coding and building of Java Web Applications. Student learn about Servlets, JavaServer Pages, HTTP, XML, Programmatic and Declarative security techniques, JSP Java scripting elements, and the deployment of Web applications. In addition, participants will configure a web server, and build actual Java Web Apps.

DITE 516 Operating Systems

The course introduces operating systems structures, system components, system services, virtual machines, system design and implementation, and system generation. This course discusses process concept, producer/ consumer problem, critical section problem, semaphores, language constructs, and interposes communication. CPU scheduling as a very important topic is studied including scheduling concepts, performance criteria, and scheduling algorithm. Memory management, and secondary storage management, as well as file systems are introduced.

DITE 517 Fundamental Web Technologies:

This course introduces the fundamental principles and techniques for designing and developing effective Web sites. Topics include: hand-coding pages with HTML; styling text and content; adding dynamic features with client-side scripting techniques; and, managing files and Web sites using FTP software. Students will learn to code Web pages both manually and with the assistance of the HTML editor Adobe Dreamweaver. The use of Cascading Style Sheets (CSS), interface design, XML, and DHTML, will be introduced.

DITE 518 Web Media Programming:

This course concentrates on using new media such as Flash to enhance Web pages. Furthermore, this course is designed to build on the introductory Flash skills to help students make their Flash animations more interesting and interactive. Topics include: controlling multiple timelines, changing movie clip properties, variables, conditional statements, preloaders, draggable objects, controlling the mouse, and Flash in HTML. By the end of the course students will be able to make fully interactive Flash movies and incorporate them into their HTML to bring their sites to the next level.

DITE 519 Web Publishing:

This course will introduce you to the fundamentals of creating dynamic, interactive Web pages using PHP technology. Topics will include: an introduction to PHP, PHP syntax, using variables HTML forms and PHP, doing math in PHP, using strings, basic control structures, using arrays, employing regular expressions, creating functions, working with files and directories, using databases in PHP, employing cookies, creating Web applications, and debugging PHP scripts.

DITE 520 Windows Application Development 1

This hands-on, elementary level course and labs are designed for experienced OO programmers who want to learn Microsoft industry standards and best practices. Students

who already know some C/C++/Java syntax are introduced to the C# language and the .NET Framework.

DITE 521 Windows Application Development 2

This intermediate level course continues the practices gained in C# part 1. the labs are designed for programmers who are already introduced to the C# language and the .NET Framework. The main focus of this course is Windows application development, building graphical user interfaces (GUIs) and designing Windows software applications with Visual Studio 2008. Topics include: Windows Forms and controls, event-driven programming and the MSDN Library for on-line help.

DITE 522 SQL Fundamentals:

This hands-on course introduces SQL syntax, data definition, data manipulation, data retrieval techniques. Database administration, security issues and data protection are also covered. This provides a foundation for designing and implementing databases to solve practical problems using Microsoft SQL server and open source database management programs (MySQL or others). A final project will involve the integration of a database backend and web server front end.

DITE 523 Developing Databases with Oracle:

The course covers the foundations of SOA-enabled applications, and standards that enable SOA implementations, Web Services, Adapters, Business Process Execution Language (BPEL) for process orchestration, Oracle Enterprise Service Bus (ESB), Oracle Rules for implement Decision Services, Oracle Web Services Manager (OWSM) for apply security to SOA-enabled processes.

DITE 524 Introductions to Computer Networks:

This course covers the basic concepts involved in the electronic transmission of data from one computer system to another utilizing local and wide area networks. The major types of network topologies, protocols, and infrastructures are also discussed. The course also presents various networking models and standards, including the International Standards Organization's OSI (Open System Interconnection) model and IEEE 802 Standard. Topics covered will include; the OSI model and industry standards, network topologies, ip addressing (including subnet masks), networking components and basic network design. Students will gain the knowledge and skills necessary to implement, administer, and troubleshoot basic networking systems and hardware.

DITE 525 Server Installations

This course provides an understanding of the planning, installation, configuration and maintenance of servers. The course covers advanced PC hardware issues, such as RAID, SCSI, multiple CPUs, storage subsystems, networking, data recovery and I/O subsystems. This course is designed to prepare a student to understand and apply the basics of networking hardware and router configuration. Topics covered include router concepts and theory, Routing Information Protocol (RIP), Interior Gateway Routing Protocol (IGRP),

TCP/IP transport protocols, access control lists (ACLs) and router configuration and management. Students will have hands-on experience with Cisco routers in a networked lab environment.

DITE 526 Computer Security Techniques

Computer security covers a lot of territory: locking your computer room and your machine, protecting your login accounts with passwords, using file protection to keep your data from being destroyed, encrypting network communications lines, and using special shields to keep electromagnetic emanations from leaking out of your computer. But when people talk about computer security, they usually mean what is called computer system security. Three topics are treated in more details: Confidentiality: protecting information from unauthorized disclosure; Integrity: protecting information from unauthorized modifications, and ensure that information is accurate and complete; and Availability: ensuring information is available when needed;

DITE 527 Bioinformatics

A Bioinformatics graduate course mainly aims at teaching student's current state-of-the-art bioinformatics status. Bioinformatics has recently been very important research topic. Since the completeness of the human genome project and the flood of the data make it possible to analyze such data and not only to annotate it. It is the combination of two main areas of research: computer science and biology. After teaching this course, the student will be able to master research topics as well as biological tools.

DITE 528 Communication Skills

This course covers the skills necessary for appropriate professional conduct and effective communication in a professional setting. It includes technical writing, making effective presentations, conducting effective meetings, conflict resolution, and decision-making skills.

DITE 530 Project

Students are allowed to choose among a number of projects suggested by the different staff members. The general aim of the project is to allow each student to utilize all the skills they have accumulated during the program to build, test and troubleshoot a unified chunk of application. On the behavioral side, students are allowed to work in groups to develop their teamwork, time management, report writing, and presentation.