ST. PETERSBURG STATE
POLYTECHNICAL UNIVERSITY

INSTITUTE OF INTERNATIONAL EDUCATIONAL PROGRAMS

international semester

«Advanced Information Technologies for Enterprises»

PREFACE

You are welcome to participate in the international semester «Advanced Information Technologies for Enterprises» offered by the Distributed Intelligent Systems Department of St. Petersburg State Polytechnical University (SPbSPU).

The Distributed Intelligent Systems Department provides education in Information Computer Technologies to the students of Specialist's, Bachelor's and Master's degree programmes. A wide range of lectures is delivered by the staff of the Department on the subjects of artificial intelligence; intellectual systems for enterprises; distributed intellectual systems management; information and computer engineering. The Department participates in a number of joint educational programmes together with the universities of Finland and Great Britain.

The programme has been developed to provide students with contemporary information about Intelligent Systems and Technologies as well as their application in science and industry.

This brochure presents the programme description and the syllabus of the courses delivered within the programme framework.

PROGRAMME DESCRIPTION

Admission procedure: The information about the admission procedure and the application form is available on the web-page
http://www.imop-spbspu.ru/texts/admission
Deadline for the application: August 15, each year
Financial terms: Payment can be made in cash or by credit card
Registration fees: are included into the tuition fees.
Accommodation: rooms for three persons in a two-roomed apartment with shared facilities and a kitchen in a comfortable students' hostel.
Programme duration: The programme starts annually in the middle of September, lasts for 17 weeks and ends in the middle of January.
Participants: international and Russian students
Admission requirements: undergraduate students having studied the programme for Specialist's or Bachelor's degree in Computer Technologies, Economics and Enterprise Management for at least two years. Students should possess intermediate or advanced level of English as a foreign language.
Teaching staff: professors and associate professors of St. Petersburg State Polytechnical University
Methods of instruction: lectures, work in a laboratory, group discussions, practical training, visits to industrial enterprises.
Credits: 30 ECTS
Tuition fees: 1950 conventional units per semester (each unit being equal to 35 roubles per academic year). The tuition fees cover study expenses, library services and the costs of supplementary material.
Program syllabus: compulsory courses, elective courses and an interdisciplinary project. Compulsory lecture courses and an interdisciplinary project are included into the syllabus of a student. Students will have to choose one of the elective courses from the list below to get 30 ECTS to complete the programme.
Compulsory courses:

1. Business Operations Research and Management Science (2.5 ECTS).
2. Internet Programming for Enterprises (2.5 ECTS).
3. Programming Technologies (2.5 ECTS).
4. Neuroinformatics: Theory and Applications (3.5 ECTS).
5. Knowledge Engineering (3.5 ECTS).
6. Enterprise Resource Planning Systems (SAP ERP case) (2.5 ECTS).
7. Modern Operating Systems (2.5 ECTS).
8. Foreign Language (English or Russian) (3 ECTS).

Elective courses:

9. Information Security Systems (2.5 ECTS).
10. System Modelling in Engineering and Economics (2.5 ECTS)

Interdisciplinary project: (5 ECTS)
The interdisciplinary project is to be individually performed by a student. The project should be based on theoretical knowledge and practical skills, mastered during the semester.

BUSINESS OPERATIONS RESEARCH AND MANAGEMENT SCIENCE

Objectives: The course introduces modern approach to practical modelling of optimization problems in management.

Content: The course gives a complete overview of different types of modern optimization techniques which are important to deal with a company problems: cooperative genetic algorithms, linear fractional programming, application map planning, navigation planning. Students will acquire theoretical knowledge and practical skills in the following aspects:

• Algorithms of forecasting in econometric research based on neural networks (traditional approach to supervised neural networks; genetic search for neural network weight optimization; flexibility in the criteria choice ; forecasting future directions of share market prices; research and practical applications) ;

• Catastrophe theory algorithms for investigation of economic systems structural adaptability (dynamic processes; degenerate and non degenerate critical points; transversality and structural stability; normal, splitting and conflicting factors; attractive surface; 2-and 3-parameter models of structural instability; successful applications);

• Cluster method in a company activity modelling (the construction and use of input-output models; cluster identification techniques using employment and input-output data; modelling of agglomeration forces; geographical and functional dimensions of specific cluster identification; empirical approach to specific cluster identification; practical applications).

Teaching and learning methods: The process of education includes lectures on modern algorithms and their practical applications. Interactive lecturing method promotes student participation. Numerous practical examples provide clear understanding and profound knowledge of the subject. Case studies enable student active participation.

ECTS Credits: 2.5

Assessment: Examination
Class participation
Group work

INTERNET PROGRAMMING FOR ENTERPRISES

Objectives: The objective of this course is to provide students with the knowledge of methodology and philosophy of the Internet programming. Practical applications are presented with the Java programming language for business processes modelling.

Content: The Java language fundamentals. Objects, classes, fields, methods and access modifiers. Platform independent and native methods. Primitive type and object references converting and casting. Exception classes and exception processing. File input and output. Streams, readers and writers. Threads control. Suspending, sleeping, blocking and scheduling implementation. Object lock and synchronization. Graphical User Interface (GUI) programming. Layout managers, visual components, containers, menus. Events processing. Events delegation model and explicit event enabling model. Painting and graphics context. Clipping. The GUI thread and spontaneous painting. Images. Animation. Applets and frames. Drawing in applet. Open system interconnection model. TCP/IP protocols architecture. Internet addresses, DNS. Network programming. TCP-based client-server application. Servicing a set of clients. UDP-based client-server application. Distributed applications and RMI. URL in applet. Distributed and client-server database architecture. Hierarchical, relational and object-oriented databases. ODBC and JDBC interfaces. JDBC-based routines. Selection, projection and updating statements. Statement, prepared statement and query results processing. Web servers and browsers. Servlets for HTTP request and response, Http-session, cookies, Java server pages scripts. Security policy and security manager for Java applets and applications. Keys generation algorithms. Message digest algorithms and its implementation, data digital signature and digital certificates.

Teaching and learning methods: Students develop the following Java routines: object-oriented programme on computational mathematics; thread control programme; GUI application code; applet developing (drawing, images loading and sound playing); database interface programming; client-server TCP/IP-based application; information guarding and security providing. Lectures are combined with practical training in the computer class linked to the Internet and equipped with on-line electronic tutorials and knowledge testing facilities.

ECTS Credits: 2.5

Assessment: Examination
Class participation
Group work

PROGRAMMING TECHNOLOGIES

Objectives: This course is aimed at developing skills to create flexible data structures and methods of processing based on fundamental OOP concepts: abstract data types, encapsulation, inheritance and polymorphism. The course is based on the Microsoft.NET framework platform. It gives students the intermediate-level skills needed to write applications for the NET available in the Windows operating system. The NET framework is a set of technologies that are designed to transform the Internet into a full-scale distributed computing platform. The basic goal of the course is to reduce the time needed to build professional applications increasing the overall quality and functioning.

Content: The content provides new ways to build both the Windows-based and the Web-based applications. New approaches reside on the fundamentals that are covered in the principles of the Windows operating system. Message handling mechanisms. Standard Windows application structure based on API elements, such as functions, macro extensions, messages, interfaces. The run-time environment (CLR). The code execution management. Portable executables. C# console applications. Namespaces and classes of the.NET framework. Assemblies and CLR metadata. Tools for exploring namespaces. Managed and unmanaged code. Garbage collector and memory allocations. Value and reference types. Built-in data types. Class object as the super-class in the NET framework. Creating class hierarchy. Virtual functions and their overridden versions. Exception handling. Class array, its properties and methods. Overriding operators and functions. Interfaces implementation. Sorting the objects and IComparable. Enumerations and their usage. Properties as named members of a class. Indexer declaration and usage. Delegate declaration and usage. Delegates and system events. Handling and raising events. Dynamic data structures in the.NET framework class library. Windows forms-based Win32 desktop applications. GDI+ graphics classes. Device contexts and graphical primitives drawing. Main GDI+ instruments, their usage and management. Bitmap-image structures, management and animation using timers. Debugging technology, methods and tricks. Investigating the coordinate transformations. Model and modeless dialogs. Basic control elements. Data grid and its management. Creating file system and timer components. Overview of the Web forms applications. Platform-independence. Browser-neutral user interface. ASP.NET applications. Creating a simple ASP.NET distributed application using ASP.NET classes. Basics of Network programming.

Teaching and learning methods: The process of education includes lectures on modern algorithms and their practical applications. Interactive lecturing method promotes student participation. Numerous practical examples provide clear understanding and profound knowledge of the subject. Case studies enable student active participation.

Assessment: Examination
Class participation
Group work

NEUROINFORMATICS: THEORY AND APPLICATIONS

Objectives: With the phenomenal growth in the area of intelligent systems in the past years the subject of artificial neural networks and their introduction into information management has become very popular. The other prosperous direction of the intelligent theory concerns intelligent data analysis and decision making support systems. This course aims to combine two novel instrumentation concepts of neural net simulation algorithms for intelligent data analysis with virtual instruments engineering technology based on the LabVIEWR Graphical Programming Systems (National InstrumentsTM, USA). The course is oriented to provision of basic knowledge in neuroinformatics and artificial neural network, their application in industry and scientific experimentation. The course proceeds from a clear but concise exposition of neuroscience fundamentals in mathematical theory and such algorithms as medicine, intelligent security system, technical diagnostics, etc.

Content: Introduction. Preface to the problem. Artificial intelligence and intelligent data analysis. Brain computer and "brainware". Foundations of neural networks. Biological prototypes, artificial neurons and neuron models. Artificial neural networks: architectures and algorithms. Learning of neural networks: supervised and unsupervised training. Mathematical backgrounds of NN-theory. Algebraic formulation of neural networks learning via optimization problem. Unconstrained optimization and gradient descent algorithms. Stochastic gradient optimization. Genetic algorithms. The algorithm of dual functioning and back-propagation. Models, architectures and algorithms. Perceptions and threshold logic classification. Multilayer feedforward networks. Radial basis function (RBF) and RBF-networks. Supervised learning in multilayer feedforward networks. Backpropagation theory. Competitive learning rule and competitive dynamics. Kohonen self-organizing maps. Feedback recurrent networks and associative memories. Discrete Hopfield net and bidirectional associative memory. Information-theoretical approach to self-organizing neural networks. Overview of the emergent properties of non-linear self-organizing neural networks within the context of a blind signal separation problem and independent component analysis approach. Entropy-based criteria and independent component analysis. Application of neural networks. Knowledge-based system. Discussion working support system. Business processes of optimization.

Teaching and learning methods: Interactive lecturing promotes student participation. Group discussions are planned to activate students' involvement. Students work with the original LabVIEW toolkit, which is oriented to applications in industry and in science laboratories.

ECTS Credits: 3.5

Assessment: Examination
Group work
Class participation

KNOWLEDGE ENGINEERING

Objectives: Knowledge engineering is defined as an information structuring methodology for different domains. It provides students with knowledge engineering characteristics including principles, practices, issues, methods, techniques and programs involved with knowledge elicitation, structuring and formalizing.

Content: The course examines the following related topics:

- defining and identifying cognitive aspects of knowledge modelling and representation;
- relationship, roles, data, information and the knowledge of different applications including intelligent and tutoring systems. Various approaches needed to ensure effective introduction and deployment;
- the characteristics of theoretical and methodological topics of knowledge acquisition, including principles, methods, issues, and programs.

Students are introduced to major issues in the field of knowledge engineering and to the role of knowledge analyst in strategic information systems development. Attention is given to relating knowledge engineering to other professional areas, e.g., education, information management, business administration. Students gain knowledge engineering comprehension and knowledge management role understanding in companies and organizations, in decision-making realized by the members of an organization.

Teaching and learning methods: The course includes a theoretical part (lectures) and practical studies. Practical studies are held in a computer class where students work in small groups and then report the results in the classroom. The course project must be done before the exam.

ECTS Credits: 3.5

Assessment: Examination
Group work
Class participation

ENTERPRISE RESOURCE PLANNING SYSTEMS (SAP ERP CASE)

Objectives: This is an introductory course for university students. The course provides participants with an overview of enterprise resource planning concept, the introduction of the most powerful IT tool for enterprise management with the SAP ERP and offers a short period of practice on the system. The goal of the course is twofold:
a) to provide an excellent opportunity for the students who are new to the ERP tools to learn the basics of the ERP; b) to provide hands-on experience with the SAP ERP from basic navigation to an overview of each of the major functional areas of the SAP software. The new introductory course uses a motorbike manufacturer as the case company to explain organizational structure and business processes within the SAP framework.

Content: Introduction. What is the ERP?
Company SAP. Overview of the products. Navigation in the SAP ERP.
Basic conceptions, basic data and transactions in the SAP ERP.
Virtual demo-corporation IDES.
Introductory block of exercises.
Block of exercises №1. Production planning and control.
Overview of logistics processes, financial processes and processes of human capital management.
Block of exercises №2. Controlling.
Block of exercises №3. Logistics.

Teaching and learning methods: The course includes lectures and practical studies.

ECTS Credits: 2.5

Assessment: Final test
Group work
Class participation

MODERN OPERATING SYSTEMS

Objectives: This course is a base for system administrators. Students are trained in base operations with file systems and their reserve copying. They execute standard Solaris installation from CD, learn to operate the software and its updates, develop skills on users management, get acquainted with the process of Solaris loading and stopping and also with the services control system. Moreover, they get necessary knowledge of system security, processes management and a system printing process.

Content: The course examines a number of related topics. File system. Hierarchy of Solaris file system. The work with local disk stores. The work with external connected data carriers. Dynamic configuration stores. File system management in Solaris. Assembling file systems. Monitoring behind the use of file systems.
Reserve copying. The work from CD and DVD. Reserve copying and restoration performance. The use of instant pictures UFS (UFS Snapshots). Solaris installation. Principles of Solaris installation from CD. Installation planning. The information demanded for successful installation. Solaris installation performance from CD. Software and updating management. Software management. Software updating. Users management. Groups of users management. Passwords management. System loading and services starting. Loading process. Adjustment in the boot PROM (For SPARC). Systems loading and stopping. Services management by means of SMF. System security. Access rights to files. Checking of system access. Processes. Processes management. The essence of processes and their life cycle. Information reception on processes. Signals. Processes priority management. Postponed and regular tasks performance. Printing processes. Printing processes service. Printing processes performance.

Teaching and learning methods: The course includes theoretical (lectures) and practical parts. The practical part is held in a computer class where students work in small groups and then report the results in the classroom. The course project must be done before the exam.

ECTS Credits: 2.5

Assessment: Final test
Group work
Class participation

SYSTEM MODELLING IN ENGINEERING AND ECONOMICS

Objectives: Learning the theory, solving substantial problems and using computer tools are the foundations for achieving success in any field of engineering,especially in computer modelling. The lectures provide an introduction to modern visual technology of complex dynamic systems simulation.
The course is aimed at informing the students, who want to acquire basic knowledge of new visual technologies for modelling and simulation of hierarchical event-driven systems with a variable structure. Basic knowledge of the ordinary differential equations theory and object-oriented programming is recommended.

Content:
Topic 1. Mathematical modelling and computer experiment.
Topic 2. Modern tools for beginners
Topic 3. Dynamic systems
Topic 4. Open systems
Topic 5. Component modelling

Teaching and learning methods: Training practice provides a firm and clear understanding of visual modelling technology.Model Vision is used to illustrate the main steps of model design and investigation. Model Vision is a very popular graphical environment for modelling and simulation with expressive and intuitive object-oriented language. It is especially popular in Russia. The suggested way of design is compared with Matlab and its toolboxes means of modelling and simulation.

ECTS Credits: 2.5

Assessment:
Examination
Group work
Class participation

INFORMATION SECURITY SYSTEMS

Objectives: The objective is to introduce students to the basics of computer security. The reality reveals the importance of protected and reliable environment for every computer user. Starting with some introduction, students pass to the security standards and protocols overview, both de facto and de jure, as well as to the basics of the user program and data protection by means of the operating system with further assumption of business continuity ensuring. Then students pass to secure passwords usage and management, cryptographic methods and anti-virus tools. After theoretical background students get down to secure the work using the Internet and then they turn to the local and global network security. A focus is made on everyday real computer threats and adequate countermeasures.

Content: The main subject areas include:

- Introductory part: information security as an inseparable part of computer technologies;
- Standards and laws overview: world and national standards (ISO 17999-BS7799, CCITSE etc) ;
- Operating systems overview and administrative methods of protection; safety procedures scheduling;
- User program and data protection. Safe passwords, cryptography usage;
- Anti-virus tools and countermeasures;
- Business continuity ensuring: planning, responsibilities, roles, personnel trainings;
- Network security: secure web browsing and e-mail, firewall technology.

Conclusion.

Teaching and learning methods: The course includes a theoretical part (lectures) and practical studies.

ECTS Credits: 2.5

Assessment: Examination
Group work
Class participation

RUSSIAN LANGUAGE

Objectives:
- Acquaintance with the Russian language system.
- Training of speech behavior in the sphere of daily dialogues.
- Practical skills of reading and writing.

Content:

Phonetics. The Russian alphabet. Rules of pronunciation. Intonation speech formation.
Morphology. Parts of speech concept.
Nouns. Animate and inanimate nouns. The number of nouns. Case system and its usage.
Pronouns. Personal, interrogative, possessive, index, negative pronouns. Forms of change.
Adjectives. Full forms of adjectives. Adjectives and nouns combination. Declension of adjectives.
Verbs. The infinitive. Conjugation. Forms of a verb. The imperative. Verbal management.
Numerals. Quantitative and ordinal numerals. The coordination of ordinal numerals with nouns.
Adverbs. Adverbs of place, time, manner, frequency degree, predicative adverbs.
Auxiliary parts of speech. Pretexts, unions, particles: major importance and functions.
Syntax. Simple/compound and complex sentences. The subject and the predicate in an offer, their coordination. Ways of expressing attributive and objective relations. Time, place, reason, condition, purpose in simple and compound sentences. Direct and indirect speech. Replacement of direct speech into indirect one.
Conversational topics. My biography. My family. My friends. Studying. My free time. The sights of Saint-Petersburg. Moscow – the capital of the Russian Federation.
Conversational situations. Acquaintance. Employment. At the university. At the dean's office. At the library. Purchases. In the city.

Teaching and learning methods:

Practical training in class. Training in the language laboratory, video classes, computer classes. Individual work.

ECTS Credits: 3

Assessment:

Test
Group work
Class participation

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