

# **COURSES OFFERED FOR INCOMING STUDENTS**

## **(EU Erasmus, UNH etc.)**

### **FALL SEMESTER 2010**

**Budapest University of Technology and Economics**  
**Faculty of Natural Sciences ( [www.ttk.bme.hu](http://www.ttk.bme.hu) ).**  
**PHYSICS, MATHEMATICS, COGNITIVE SCIENCE, etc.**

**Notations:** (lectures / practical lectures / laboratory / f= term mark, v = exam / ECTS credit points)

## **MSC LECTURES IN COGNITIVE SCIENCES**

### **Neurobiology (2/2/0/v/5) BMETE47MC00**

Lecturer: Gyula Kovács

Modern experimental methods of the human brain. The physiology of the cell membrane, bases of functioning of neurons. Properties of excitable tissues and the synaptic transmission. General functioning of the central nervous system, neuronal classifying, signal conduction. The peripheral nervous system. The entheral nervous system. The autonomic nervous system. The cerebral cortex – general characteristics and types of receptors. The somatosensory system and the perception of pain. The visual system and the vision. The auditory system, hearing and the vestibular system. Olfactory and gustatory apparatus, smell and taste. The motor system. The limbic system, emotions and motivation. Neurobiological bases of memory and learning. Neuronal bases of higher level cognition – language, categorization, consciousness

### **Mathematics (2/0/0/v/3) BMETE92MC11**

Lecturer: János Tóth

The aim of the course is to give a nontechnical introduction into higher mathematics via lectures and via reading texts containing the use of mathematics in the different parts of cognitive science. Instead of calculation methods logical and philosophical connections will be emphasized.

Technical and geometrical aspects will not receive emphasis, however, we try to analyze the meaning of notions within and, if possible, outside mathematics. Instead of proofs examples will be shown together with applications and with historical remarks. A shortened introduction to the classical material of calculus will be followed by introductions to areas which cannot be absolutely neglected by someone interested in cognitive science: dynamical systems, graphs and networks, algorithms and the use of computers in mathematics.

Topics: Fundamental notions of set theory and logics. – A review of the notion of numbers. – Relations and functions. The connection between operations and relations and between functions. Operations on functions – Series and infinite sums. Convergence, limit. – Limit and continuity of real variable real valued functions. – Differentiability of real variable real valued functions. Tangent. Rules of derivation. – Applications of calculus: analysis of functions. Monotonicity, maxima and minima. – Integration: antiderivative, definite integral. The fundamental theorem of calculus. – Solving simple differential equations. – On discrete dynamical systems. Simple models with chaotic behaviour. – On graphs and networks. Their rules of modelling. – Algorithms. – Applying mathematical program packages.

### **Informatics (2/2/0/v/5) BMETE92MC12**

Lecturer: János Tóth

The aim is to provide an extremely powerful tool to solve calculation, simulations, drawing, presentation, etc. problems connected with the studies of the student, which will also come useful later in research. The tool Mathematica, Version 7, at the time of writing this syllabus, is also useful to show the latest developments in different fields of applied computer science, such as programming paradigms (with emphasis on functional programming). Parts of mathematics will also be presented or repeated in this course.

Topics: Mathematical program packages. - An intelligent calculator: application in elementary mathematics. - Kernel, front end, packages, demonstrations. - Numbers, solving equations. - Plotting, graphics. - Animation, manipulation, sound. - The language of Mathematica. Lists and generalized lists. - Functional programming. - Rule based programming. Rewrite rules. Pattern matching. - Procedural programming. - Applications in mathematics: discrete, continuous, stochastic. - Applications in linguistics. - Elements of image processing.

### **Statistics and Methodology (2/0/0/f/3) BMETE92MC13**

Lecturer: Márta Lázi

All the major areas of statistics (such as estimation, hypothesis testing, regression) will be treated with special reference to the assumptions usually assumed in introductory courses (such as normality, linearity, stationarity and scalar valuedness), which, however, are never fulfilled in real applications. How to test these assumptions and what to do if they are violated – these questions will act as guides in the course.

Topics: Random variables. Distributions. Generating random numbers. - Sampling. - Methods of estimation. - Confidence intervals. - Testing hypotheses. Independence, normality. - Regression and interpolation. - Getting and importing data. - Cluster analysis. - Experimental designs. - Applications. - Writing a report.

Depending on the circumstances the calculations will either be done using Mathematica, or EXCEL, or SPSS.

### **Introduction to Cognitive Science (2/0/0/f/3) BMETE47MC01**

Lecturer: Zoltán Jakab

Fundamental concepts of cognitive science: mental representation, computers, and information processing. Brain and cognition; the role of neuroscience. Cognitive architectures: modularity and domain-general systems. Propositional and schematic representation; schemas, mental images, and skill acquisition. Connectionism: artificial neural networks as models of the mind. Knowledge representation in artificial intelligence. Language and cognition; knowledge of language; the problem of meaning. The role of philosophy: the nature of mind, knowledge and consciousness. Interpreted Cognitive Science: neurobiology, evolution and social interpretation. Adaptation and knowledge. Skill, competences, and emotions in knowledge. Applied cognitive science: artificial intelligence; human information processing in human-machine interaction.

### **Cognitive Psychology 1 (2/0/2/v/5) BMETE47MC03**

Lecturer: Mihály Racsomány

In addition to the characteristics of human information storage, the course will reveal the links between neural, psychological and artificial systems.

The basic theories of sensation, neurobiological and psychological foundations. Receptive fields. Lateral inhibition. Cortical organization. Parallel pathways. Somatosensory perception. Details of the visual system.

Research methods and debates with respect to the link between language and thought. The problem of language and cultural relativism, the origin of categories, determinants of language development. Links between thinking, culture and nervous system.

## **Linguistics (2/0/0/f/3) BMETE47MC02**

Lecturer: Anna Babarczy

The course introduces the basic concepts and methods of theoretical and experimental linguistics and discusses some current competing approaches to human language as a cognitive and/or mathematical phenomenon. The theoretical discussion will centre around universal aspects of human language and cognition, while there will be practical examples and exercises involving interesting linguistic phenomena in the Hungarian language. The course also provides the foundations for the study of Psycholinguistics.

Topics: The prehistory of modern linguistics: Structuralism and the concept of scientific categorisation. Evidence, hypothesis and value judgement. – Modern approaches to language: language as a psychological and biological phenomenon. Human language versus animal communication. – The medium of language: sound, sign and writing systems. – The structure of language: phonemes, morphemes and syntactic units. Syntactic categorisation. – The formalist approach to language: generativity, recursion, the separation of form from meaning. Structural organisation. – Structure and meaning in Hungarian: constituent order and information packaging. – The semantic organisation of human language: event types, participant roles, deixis and anaphor. Semantic categorisation. – The cognitivist approach to language: language and thought, metaphor theory. – Child language and models of language acquisition. – Neurolinguistics: developmental and acquired disorders of language, the methods of neurolinguistics. – Sociolinguistics: dialectology, language in a social context.