COURSE SYLLABUS

Biophysics and Medical Physics

University	**Alexandru Ioan Cuza University of Iaşi**	**Course title**	
Faculty	**Physics**	**System biophysics**	
Department	**Physics**		
Domain	**Physics**	**Course category** (SC):	**Term** (1-4):
Level	**Postgraduate (MA)**	**Course type** (El):	

I. Course structure

Number of hours/week				Credits	Total class hours/ semester	Total hours of individual activity	Examination type (C/Ex/CE[1])	Teaching language
Course	Seminar	Lab.	Project	**5**	**56**	**150**	**CE**	**English**
2	**0**	**2**	**0**					

II. Instructors

	Academic degree[2]	Scientific degree	Name and surname	Faculty position (tenure/ associate - organization)
Course	Professor	PhD	Dorina-Emilia CREANGA	tenure
Seminar				
Laboratory	Teaching assistant	PhD	Loredana MEREUTA	tenure

III. Prerequisites

Basic knowledge of atom and molecule physics, physics equations

IV. Course objectives

Physical approach of living systems physiology– from cellular level to ecosystems level; Mathematical models of metabolic and physiologic systems of human body based on compartmental models and the corresponding differential equations; Biophysical approach on the sensorial transduction; Cybernetic approach of nervous system; neural networks, perceptrons, cognitrons

V. Course content

Course	1. Mono-compartmental models and the study of renal functions; the concept of clearence; isotopic nephrograme; accumulation compartments; 2. Differential equation integration; iterrative injection compartments in the study of C vitamin kinetics; isotopic diluation and the assay of compartment size; 3. Bi-compartmental models for the study of liver pathology and physiology: ascitic liquid accumulation and endogeneous trigliceride synthesis; integration and interpretation of differential equations; 4. Tissue oxygenation, diffusion laws and Kroch's equation; 5. Interaction forces and energies (free energy, entalpy, entropy) within the antigen-antibody complex; rate constante determination from the differential equation integration; 6. Serial compartments in the study of blood flow; rheologic properties of blood, red blood cell membrane and blood vessels; histeresis elasticity of blood vessel walls; mecanic impedance; analogic model; haemoglobin and ferromagnetism; 7. Contractile molecules; muscle contraction thermodynamics; Fenn's effect; Hill relation; 8. Physical model of heart muscle contraction-integration of differential equation; coupling of excitation and contraction; the role of calcium ions; Elements of biomechanics of tendon, ligament, skin, cartilage, bone tissue; 9. Vestibular system and its differential equation; Laplace transformation of Riemann's type aand the transfer function of inner ear; hairy cells of inner ear, bioelectrogenesis and action potential propagation; 10. Physical and subjective parameters of auditive perception; von Bekesy's model for the wave propagation within the cohlea; 11. Photoreceptor cell bioelectrogenesis; neural visual cells and action potentials; cornean projection of visual biopotentials: electroretinogram; the eye transfer function and modulator

[1] C – colloquium, Ex – exam, CE – colloquium AND exam

[2] Professor / Associate professor / Lecturer / Assistant professor / Teaching assistant

	role of horisontal cells; 12. Formal neuron concept; deterministic and stochastic neural networks; perceptrons and cognitrons. 13. Photosynthesis biophysical aspects; chlorophyll intermolecular interactions in the chloroplast membrane; 14. Interactions within biocenoses – the integrations of the differential equation systems and solution interpretation
Seminar	
Laboratory	(1) Rheological properties of blood – measuring the viscosity of total blood and blood serum Experimental study on the haemoglobin transport function based on electronic absorption spectra; (2) Measurements on the blood proteinemia (refractometry) and blood serum superficial tension; (3) Complex patterns of pathological erythrocytes analyzed by numerical means, applying fractal theory; (4) Fractal dimension and fractal measure in the electrographic images of hand and leg; (5) Recording and analysis of heart muscle activity by means of computational tests developed from chaos theory (the fractal dimension of the system attractor and the Fourier transformation); (6) Complexity analysis of the electroretinographic signal recorded for various parameters of the light stimulus (Lyapunov's exponents and the return maps); (7) Electrodermal activity measurement on the hand skin; (8) Brain electric activity investigated by applying power spctra and wavelet transformation to both raw data and smoothed ones; (9) The influence of some physical factors of the photosynthesis efficiency; measurements on the chlorophyll absorption in the visible and ultraviolet range of electromagnetic radiation; (10) The influence of some optical stimuli on the psychic – personality features revealed by Lusher test.

VI. Minimal required references

Hope, Lohman et al., Biophysics, Acad. Press. New York, 1980, Gheorghe V., Popescu A.,Introducere in Bionica, ed. St. 1990, Popescu, A. (1994), Fundamentele biofizicii medicale, Vol. I, Editura ALL, Bucuresti
Popescu, A. (2001), Fundamentele biofizicii medicale, Vol. II, Editura ALL Universitar, Bucuresti, Neacsu, I., Creanga, D., Proprietati electrice ale membranelor celulare, Ed. Univ. Al. I. Cuza, Iasi, 2003, Creanga, D., Lucrari de biofizica sistemelor, Ed. Univ. Al. I. Cuza, Iasi, 2003

VII. Didactic methods

Subject presentation using video slides; interactive discussions with students. Experiments discussion by means of numerical data processing and graphical plotting; student project presentation and discussion

VIII. Assessment

Pre-conditions	The students must attend all laboratory classes, must have active participation to class activities, and must obtain the minimal grade 5 for each ongoing assessment (either courses or laboratory assessment).	
Exam dates	**1st Assessment**	8th week
	2nd Assessment	16th week

	Assessment means and methods	**Percentage of the final grade**
Exam/Colloquium	Written exam	50%
Seminar	-	-
Laboratory	Laboratory colloquium, presentation of a project	50%