COURSE SYLLABUS

Biophysics and Medical Physics

University	**Alexandru Ioan Cuza University of Iaşi**	**Course title**	
Faculty	**Physics**	**The action of electromagnetic field on the complex systems**	
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**	**84**	**150**	**CE**	**English**
3	**0**	**3**	**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 biophysics, physics of atom and molecule, physics equations

IV. Course objectives

The study of the main electromagnetic phenomena from living tissues with focus on the medical applications (methods of clinical diagnosis and treatment) of the electromagnetic fields: (i) the electromagnetic field generation within the human body tissues and organs (ii) biophysical mechanisms triggered by the electromagnetic waves absorption on the living bodies (iii) the electric impedances of living tissues: dielectric and conductive properties of biological media. The study of physical methods and devices for medical diagnosis and therapy based on electromagnetic fields

V. Course content

Course	1) The bioelectrogenesis in the human body excitable tissues and organs 2) The tissue electric impedance; blood impedance; the models of spherical and ellipsoidal cells; bioelectric sources and conductors; thorax modeling and cranian modeling 3) The hypothesis of bi-domain tissue with isotropic features and punctual sources of current –the application of Maxwell's equations 4) The human body exploration by recording the electromagnetic activity of tissues and organs: electro- and magnetocardiography, electro- and magnetoencephalography, electro- and magnetoretinography 5) Biomagnetometric techniques based on laser phenomenon 6) The emission of electromagnetic radiation of the human body; bioelectroluminescence ; electrographic methods in medical imagistic 7) Living bodies and their sensitivity to the terrestrial magnetic field; Earth magnetic pole migration and life evolution ; life in zero-magnetic field – experiments on plants, animal cell cultures, microorganisms; laboratory investigation of magnetic field bioeffects 8) The cellular response to the action of electromagnetic fields: rotation, polarization, alignment, fusion, chain formation ; solar activity maxima and human mortality and morbidity 9) Bioeffects specific to microwaves (MW) and radiofrequency (RF) waves; SAR (specific absorption rate) and penetration depth and their dependence on various parameters; non-thermal effects upon the microorganisms, vegetal and animal organisms; 10) Electroreception in the living world; ampullary and tuberous electrocytes; electric scheme of the skin provided with specialized electric organs 11) The molecular bases of magnetosensitivity in the living world; iron containing molecules;

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

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

	biogenic magnetite and biomagnetism; ferric versus ferrous iron metabolization; iron bacteria 12) Therapy with electrostatic fields, low frequency electromagnetic field utilization in some skin disease treatment; electric applicators; microelectro-therapy; micro-electro puncture; therapy with milliamper direct current pulses or alternate current pulses in neuropsichological diseases (depression, memory lost etc.) – the biophysical phenomena underlying the medical procedure 13) Biological effects of electric discharges in atmosphere; air ionization and the atmospheric ions effects on the human body; ozonization phenomenon and its biological influence; laboratory applicators 14) Magnetic fields in therapy; physical principle, indications and contra-indications; application in the pain therapy; therapy with electro-magnetic field pulses in the treatment of prostatites and spondiloses; generators and applicators of magnetic field in medicine
Seminar	
Laboratory	(1) The geo-magnetic field influence on the microorganisms; the assay of the resistance against antibiotics; (2) The evidence of the radiofrequency field exposure on the blood red cells; hemolysis assay; (3) MW/RF waves influence on DNA synthesis; nucleic acid spectrophotometric assay; (4) MW influence on the bacterial cultures; biomass dynamics measured by turbidimetry; (5) Weak electromagnetic field effects on the catalase like enzymes activity in microorganisms; (6) Bactericidal effects of electromagnetic field and ions from electric discharge; (7) Magnetic fluid influence on the photosynthesis pigment; spectrophotometric assay; (8) Electric discharge effects on the young plants during early ontogenetic stages – spectrophotometric assay; (9)Atmospheric plasma biological impact on the bacterial cultures – measurements on the growth inhibition zones.

VI. Minimal required references

Malmivuo, J., 2006, Video lectures on bioelectromagnetism, Ragnar Granit Institute

Bioelectromagnetism, Principles and Applications of Bioelectric and Biomagnetic Fields, J. Malmivuo & R. Plonsey, Oxford University Press,1995

Bazele biomagnetismului , Creangă, D., Ed. Univ. Al. I. Cuza Iaşi, 2009

*** Electromagnetic Biology and Medicine, 1999-2006

Moraru, O., Lascu, V., Electricitatea atmosferica si organismul uman, Ed. Medicala, Bucuresti, 1980

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**	November
	2nd Assessment	January – February

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