DEREE COLLEGE SYLLABUS FOR: BI 2121 BIOPHYSICS	3/2/4
(Created: Fall 2024)	**UK LEVEL: 4** **UK CREDITS: 20**
PREREQUISITES:	MA1024 Algebra and Trigonometry (can be bypassed via a waiver test) or MA 1008 College Algebra
CATALOG DESCRIPTION:	An introductory course focusing on the biological applications of physics. It covers a wide range of topics such as kinetics and dynamics of biological systems, conservation of energy, thermodynamics, statics and viscoelasticity of living systems, oscillations and waves, cell mechanics, molecular motors and dynamics, optics and bioimaging, electromagnetic and ionizing radiations, radioactivity and nuclear physics. The course provides an overview of modern applications of physics in biomedicine and a focus on modeling of biological systems.
RATIONALE:	This course aims at helping students acquire general theoretical knowledge and practical skills in physics, so as to be able to understand the physics laws, methods and technologies applied in biology and medicine.
LEARNING OUTCOMES:	*As a result of taking this course, the student should be able to:* 1. Illustrate knowledge on principles of physics that are essential in understanding modern therapeutic and diagnostic methods. 2. Distinguish between different applications of physics in modern biomedical technologies and bioinformatics. 3. Assess the basic principles of physics, focusing on biological systems and the human body. 4. Take part in collecting, assessing and analyzing experimental data. 5. Apply the scientific method through laboratory activities.
METHOD OF TEACHING AND LEARNING:	In congruence with the teaching and learning strategy of the college, the following tools are used: • Class lectures, interactive learning (class discussions, group work) video presentations, and practical problems solved in class. • Exercises and primary source documents are assigned as homework, the solutions of which are reviewed in class. • Laboratory work (laboratory reports). • Office hours: students are encouraged to make full use of the office hours of their instructor, where they can ask questions, see their exam paper, and/or go over lecture/lab material. • Use of a blackboard site, where instructors are free to post course documents, timely announcements, as well as additional resources
ASSESSMENT:	Summative: 1st assessment: 40% a) Laboratory report-1 full lab report 10% b) In-class midterm examination (1-hour), 30% (Multiple choice and/or problem solving, short answers, matching, essay questions, combination) 2nd assessment: 60% a) Laboratory report-1 full lab report 10%

	b) In-class final examination (2-hour, comprehensive), 50% (Multiple choice and/or problem solving, short answers, matching, essay questions, combination)	

Formative:

Diagnostic tests (In class or to take home)	**0**

For the course to be considered completed and for the student to earn the right to sit exams, ALL experimental work and reports for every single experimental exercise must be handed within defined deadlines. However, only two will be evaluated.
The first (midterm) assessment tests all learning outcomes of the course. The second (final) assessment tests all learning outcomes and it is comprehensive.

The final grade for this module will be determined by averaging all summative assessment grades, based on the predetermined weights for each assessment. If students pass the comprehensive assessment that tests all Learning Outcomes for this module and the average grade for the module is 40 or higher, students are not required to resit any failed assessments.

INDICATIVE READING:	**REQUIRED READING:** Paul Davidovits, Physics in Biology and Medicine, Elsevier, Latest edition **RECOMMENDED READING:** - Serway and Vuille, College Physics, Cengage, latest global edition - Jay Newman, Physics of the life sciences, Springer, latest edition - Andrey Rubin, Fundamentals of biophysics, Wiley, latest edition - Phillips, Kondev, Theriot and Garcia, Physical biology of the Cell, Routledge, latest edition - Other sources, including journal and newspapers' articles, research papers etc. recommended by the instructor throughout the semester.
INDICATIVE MATERIAL: *(e.g. audiovisual, digital material, etc.)*	**REQUIRED MATERIAL:** N/A **RECOMMENDED MATERIAL:** N/A
COMMUNICATION REQUIREMENTS:	Verbal and written skills in English
SOFTWARE REQUIREMENTS:	MS Office and Blackboard
WWW RESOURCES:	http://physicsworld.com/ https://www.biophysics.org/education-resources
INDICATIVE CONTENT:	**Biomechanics** 1. Units, Physical Quantities, and Vectors 2. Kinematics, Dynamics and Statics in biological systems 3. Work and Kinetic Energy 4. Potential Energy and Energy Conservation 5. Momentum, Impulse, and Collisions 6. Equilibrium and Viscoelasticity of living systems

	7. Fluid Mechanics 8. Applications on cells, tissues and the human body **Waves and Acoustics** 9. Mechanical Waves 10. Sound and Hearing 11. Ultrasounds and biological applications **Thermodynamics** 12. Temperature and Heat 13. Thermal Properties of Matter 14. Laws of Thermodynamics 15. Thermo-biological applications **Optics** 16. The Nature and Propagation of Light 17. Interference and diffraction 18. Electromagnetic radiation 19. Laser systems and biomedical applications 20. Microscopy and image analysis **Electromagnetism** 21. Electric Charge and Electric Field 22. Electric Potential 23. Biopotentials and properties of neurons 24. Electrograms 25. Magnetic Field and Magnetic Forces 26. Electromagnetic Waves **Modern Physics** 27. Photons: Light Waves Behaving as Particles 28. Particles Behaving as Waves 29. Nuclear Physics 30. Radioactivity, dosimetry and radioprotection 31. X-rays, NMR, Ionizing radiation and biological effects 32. Physical approaches to biology: AFM, optical and magnetic tweezers, cantilever biosensors
INDICATIVE LAB CONTENT:	1. Experimental uncertainties – Measures of Errors, Graphs, Data Analysis 2. Linear Velocity - Vectors – Resultant Force 3. Hook's law and stiffness 4. Viscoelasticity of polymers and cells 5. Diffusion 6. Expansion-Contraction OR Pressure – Volume Relation of Gases 7. Viscosity of liquids 8. Magnetic fields and forces 9. Reflection / Refraction / Diffraction or Wave Interference 10. Photoelectric Effect 11. Radioactive Decay 12. X-rays: characteristics and absorption studies 13. Spectroscopy 14. Light absorption 15. Microscopy