FISICA CHIMICA E STATISTICA (DIU111)

1. language

Italiano.

2. course contents

Coordinator: Prof. PAPI MASSIMILIANO

Year Course: 1

Semester: 1

UFC: 6

Modules and lecturers:

- CHIMICA E PROPEDEUTICA BIOCHIMICA (DIU01A) - 2 cfu - ssd BIO/10

Prof. Giuseppina Nocca

- FISICA APPLICATA (DIU00A) - 2 cfu - ssd FIS/07

Prof. Massimiliano Papi

- STATISTICA PER LA RICERCA SPERIMENTALE (DIU02A) - 2 cfu - ssd SECS-S/02

Prof. Nicola Nicolotti

3. BIBLIOGRAPHY

D. Scannicchio, E. Giroletti,"*Elementi di Fisica Biomedica*", Edises, Napoli
Chimica e Propedeutica per scienze biomediche. Ed Piccin Autori Santaniello, Coletta, Malatesta, Zanotti e Marini.
La Torre G, Mannocci A. Statistica Medica. In AA.VV., Igiene, Medicina preventiva e sanità pubblica, Napoli: Idelson Gnocchi, 2013: 53-91.

4. LEARNING OBJECTIVES

- ***Knowledge and understanding*** *- The student must demonstrate knowledge and ability to understand: the physical principles underlying phenomena characteristic of applied physics in the biomedical context; the principles of descriptive and inferential statistics applied to the field of experimental research*
- ***Applied knowledge and understanding skills*** *- The student must demonstrate that they know how to interpret and understand adequately: the possible applications of the physical principles presented and the translational potential in the diagnostic and therapeutic field; the tabular and graphic representation of the data, the statistical parameters, the statistical tests and their application and appropriate reading in relation to the specific research question*
- *Autonomy of judgment - The student must be able to integrate the knowledge and skills learned to understand the biological mechanisms underlying the various pathologies and be able to identify the most appropriate investigation methods for the identification of the parameters of specific biomedical interest, for the study of phenomena; knowing how to apply statistical knowledge to describe data, explore relationships, make predictions, evaluate hypotheses, generate hypotheses*
- ***Communication skills*** *- The student must be able to communicate clearly and without ambiguity, correctly using the technical language, his own conclusions and the knowledge and rationale underlying them to specialist and non-specialist interlocutors.*
- ***Ability to learn*** *- The student must be able to keep up-to-date and broaden their knowledge*

by independently drawing on texts, scientific articles and online platforms and databases. Must gradually acquire the ability to attend specialized seminars, conferences, masters, etc.

5. prerequisites

It is necessary that students have acquired the knowledge of algebra, geometry and elementary calculus required in upper secondary school programs.

6. TEACHING METHODS

The teaching methodology is based on lectures provided by providing both the basic elements of the various disciplines and the applicative perspectives. The lessons are based on interactive methods, integrating activities based on active learning to standard teaching, such as: "problem-based learning", "self-learning", and "case studies".

7. OTHER INFORMATIONS

/

8. METHODS FOR VERIFYING LEARNING AND FOR EVALUATION

The exam consists of a written test, inherent to the contents of all the modules of the course (the number of questions given is proportional to the number of credits for each module), whose passing (minimum grade of 18) will give access to the possible oral exam. The student who correctly answers all the questions of the written test achieves the maximum score (grade: 30/30 with honors). The student who achieves a sufficient result in the written test will still be able to improve the result during the oral test; in any case, the student will be able to achieve the maximum score (30/30 cum laude) only if in the written test he has obtained a mark equal to or greater than 27/30.

9. program

<Applied Physics>
Physical quantities and their units of measurement. Kinematics of the material point. Speed. Acceleration. Gravity acceleration. Circular motion. Dynamics and Newton's laws. Strength, weight, mass. Friction. Fundamental equations of the statics of rigid bodies. Levers. Elastic properties of materials. Elastic deformations, traction, compression, shear and torsion stresses. Momentum and conservation principle. Work, energy and its conservation. Mechanical power. Fluidostatics. Density and pressure. Stevino's law. Pascal's law. Archimedes' principle. Torricelli's experience and blood pressure gauges. Blood pressure measurement. Sphygmomanometer. Fluid dynamics. Bernoulli equation. Torricelli's theorem. Venturi effect. Hydrodynamics of blood circulation. Surface tension. Capillarity. Diffusion. Fick's law. Membranes. Gases and solutions. Osmotic pressure. Osmosis processes in the biological field. Thermometric scales. Laws of perfect gases. Thermal capacity and specific heats. Phase changes, latent heat, heat propagation. Principles of thermodynamics. Electrostatics. Electrical properties of matter. Coulomb's law. Electric field and electric potential. Electric current and measuring instruments. Electrical resistance. Ohm's law. Operating principle of the electrocardiogram. Magnetic fields produced by electric currents. Electromagnetic radiation. Non-ionizing radiation. Ionizing radiation and interaction with biological matter.

< Chimica e Propedeutica Biochimica>

Tavola periodica degli elementi. Nomenclatura inorganica. Concetto di mole; numero di Avogadro. Particelle elementari, Isotopi, Elettroni e configurazione elettronica. Numeri quantici e orbitali. Aufbau. Il legame chimico: covalente, ionico; elettronegatività. Strutture di risonanza. Ibridizzazione. Legami deboli.

Stati di aggregazione della materia, Equazione di stato dei gas perfetti. Miscele gassose: legge di Dalton. Tensione di vapore.

% in peso, frazione molare, molalità, g/L, molarità. Passaggi di concentrazione, diluizioni, Titolazioni. Tensione di vapore. Proprietà colligative: variazione della tensione di vapore, della temperatura di fusione e di ebollizione, osmosi e pressione osmotica. Binomio di Van't Hoff, Elettroliti.

Acidi e basi: definizioni di Arrhenius, Brönsted e Lowry, Lewis. Dissociazione dell'acqua. Kw. Legge di diluizione di Ostwald. pH. Calcolo del pH in acidi e basi forti e deboli; idrolisi salina; soluzioni tampone. Indicatori di pH. Diagrammi di distribuzione ionica. Titolazioni acido-base. Acidi e basi poliprotici. Amminoacidi e loro pI. Soluzione satura. Costanti di solubilità ed effetto ione a comune. Reazioni di ossido-riduzione e bilanciamento, potenziali elettrochimici Potenziali standard di riduzione.

Reazioni esotermiche ed endotermiche. Energia libera, entalpia ed entropia. Spontaneità e velocità di reazione. Teoria del complesso attivato. Energia di attivazione. Catalizzatori. Composti del Carbonio

Acidi carbossilici e derivati, esteri, ammidi. Polialcoli. Composti polifunzionali, acidi tricarbossilici. Ossiacidi. Chetoacidi. Amminoacidi. Urea. Peptidi e proteine. Legame peptidico, strutture delle proteine: primaria, secondaria, terziaria, quaternaria. Acidi nucleici. Basi puriniche e pirimidiniche, nucleosidi e nucleotidi, ADP, ATP.

Lipidi. Definizione, proprietà e classificazione. Acidi grassi: saturi, insaturi, polinsaturi. Lipidi di riserva: Triacilgliceroli. Lipidi strutturali di membrana: glicerofosfolipidi, sfingolipidi, cerebrosidi e gangliosidi. Steroli: colesterolo e derivati. Cere. Eicosanoidi.

Glucidi. Monosaccaridi. Reazioni di ossidazione, acidi aldonici, uronici e saccarici. Emiacetali, glicosidi, zuccheri riducenti, anomeri, epimeri, mutarotazione. Dissaccaridi, Polisaccaridi. Proteoglicani.

< Statistical Analysis for Experimental Research >

Definition and introduction to statistics. Descriptive and inferential statistics. Nomenclature: population, sample, statistical unit, character, modality. Sampling. Classification of statistical variables: categorical or qualitative (nominal; ordinal; binomial); numerical or quantitative (discrete and continuous). Single and double entry tables. Charts: pie; histogram; bar chart; frequency polygon; scatter plot. Frequency measurements (ratios, proportions and rates). Incidence and prevalence (punctual and periodic). Real and theoretical frequency distributions, Gaussian distribution. Indices of shape and kurtosis. Measures of association and impact. Central trend indices: definition, meaning and calculation of mode, mean (average) and median. Sample variability. Variability: definition, meaning and calculation of variance; standard deviation; ranges and percentiles. Introduction to inferential statistics. Statistical inference. Correlation coefficient. Statistical significance; alpha and beta error. Hypothesis test, the null hypothesis, the alternative hypothesis, the alpha level and the p value. Chi-square test; t test for paired data and t test for 2 independent samples; analysis of the relationship between quantitative, qualitative and mixed variables; simple linear regression.