Course (UE) 3.01: General course 3 (N.EVRARD et D.ONIDAS ; 7 credits)

1- Information and communications technology: Continued preparation of the C2i. Content is scientific and computer based (2 credits).
2- Separative methods: introduction to analytical chemistry. Electrophoresis and chromatographies (3 credits).
3- Competences: define the project and chose a track adapted to it. Start developing a sense of reflection on the material and skills acquired in class.

Course (UE) 3.02: Biology 3: Cell biology and Physiology 1 (D.MEFFRE et O. BIONDI: 6 credits)


Course (UE) 3.03: Chemistry 3 (K. LE BARCH et D. ONIDAS. 6 CREDITS)

- General chemistry: Equilibria in aqueous solution, physical state of matter.

Course (UE) 3.04: Biochemistry 3 - Enzymology and metabolism (X. COUMOUL; 5 credits)

* Enzymology: kinetics and mechanisms of enzymatic reactions (Michaelis-Menten, allostery, regulations)
Course (UE) 3.06: Mathematics applied to science 3 (S. MOREAU / B. C. FORGET; 3 credits)
Linear systems, Fourier series, notion to transform from Fourier; spectral representation of signals. Resolution of linear equation systems. Probability

1 Course to be chosen: Course (UE) 3.05 or 3.08 (3 credits)

Course (UE) 3.05: Physics 3: Physics of waves (B. FORGET)
Harmonic oscillator, wave notion and characterization, wave equation.
Wave combinations
Acoustic waves. Notion of: band width, energy; intensity, impedance.
Reflection and transmission of waves. Application of ultrasounds.
Light waves. Interference. Microscope with phase contrast; holographic principle.

Course (UE) 3.08: Genetics 1 (M. VIDAUD et J.-P. BONNEFONT)
Expand basic knowledge in the field of molecular genetics and chromosomal genetics (organization and dynamics of the human genome, gene notion/ ENCODE project, Mendelian inheritance and nontraditional inheritance, principal mechanisms of hereditary illnesses, chromosomal genetics, methods of genome analysis.

SEMESTER 4

Course (UE) 4.01: General formation 4 (C. CHANOINE; 9 credits)
1-Transdisciplinary Trans1: Spectroscopy (3 credits)
2-Scientific English (3 credits)
3-Student has to choose between the following (3 credits):
   a- The professional project of the student (PPE): discover and explore a professional field and job through a research documentary and interviews of professionals (to be done in groups).
   b- Sensibilisation aux Métiers de l’Enseignement (SME): to get the students acquainted with teaching on a professional level
   c- Engagement Etudiant (EE)
   d- Sport

3 Courses (UE) to be chosen according to the track picked by the student (for a total of 18 credits)
All combinations are not possible
Course (UE) 4.02: Biology 4: Cellular and molecular basis of development (A.-S. ARMAND; 6 credits)
The establishment of 3 embryonic axes. Development model. Differentiation model: the muscular tissue. The objective is to acquire solid knowledge in the field of mechanisms controlling the establishment of the embryonic axes in models of upper organisms, models of study of development.

Course (UE) 4.03: Chemistry 4 (D. OVER; 6 credits)
- Inorganic chemistry: Introduction to metals of transition, study of the metal-ligand liaison. Introduction to the theory of the crystalline field and ligand field.
- Organic chemistry: Sear on benzene and a few other simple heteroaromatics. Methods for the formation of C-C liaisons (first approach of organometallics, malonic synthesis, and aldolization within orbital borders.

Course (UE) 4.04: Biochemistry 4: Molecular biology (M.-A. SARI et F. DARDEL; 6 credits)

Course (UE) 4.05: Physics 4: Mechanics of fluids and biomechanics (M-C FAURE; 6 credits)
I. Introduction to mechanics of fluids:
   Fluids static, the notion of pressure and energy density. Dynamics of perfect fluids: notion of debit, conservation of energy density, Bernoulli.
   Dynamics of real fluids: friction and power loss, Poiseuille law.
II. Introduction to transport in biological fields

Course (UE) 4.06: Physiology 2 (J.-P. DE BANDT; 6 credits)
Hydro-electrolytic homeostasis, energetic homeostasis, Calcium-phosphate and acidic-basic, interaction heart-lungs, hypothalamo-hypophyso-thyroid axis and adrenal axis, growth, puberty, physiology of movement and sensor-mobility.

1 course (UE) to be chosen (3 credits) amongst UE 4.08, UE 4.013, UE 4.14, UE 4.16 or UE 4.17

Course 4.08: Biostatistics 1 (V.LASSERE)
Descriptive statistics- Discrete and continuous random variables; a few basic laws in statistics-
Statistics: inferential approaches (estimators, confidence intervals), hypothesis tests; parametric tests (proportions, mean, variances).

Course (UE) 4.13: Chemistry of natural substances (B. DEGUIN)
Metabolism and secondary metabolites: communication, chemical ecology and co-evolution (chemical communication between individuals of different species, between individuals of a same species, between cells of the same individual: hormonology compared); chemical evolution and molecular origins of life.

Course (UE) 4.14: Introduction to Quantum Mechanics (P.GIRARD)
Fundamentals of quantum mechanics: the problem of the back body, photoelectric effect, Compton Effect. Quanta theories.
Atom structure: Rutherford model, spectral rays, Bohr model, wave-corpuscles duality (experience of Young’s slits).

Course (UE) 4.16: Regulation of gene expression (J.GRENIER)
Structure/function of a eukaryotic promoter, transcription factors, siRNA; miRNA; coactivators; corepressors, chromatin structure, role of acetylation and methylation, base in epigenetics, translational regulation and post-translational, spatial organization of the nucleus.

Course (UE) 4.17: Crystallography (P.NIOCHE)
Symmetry, diffraction theory, crystallization. Illustrations: 1 small molecule, 1 big molecule (prot).
Introduction to structural biology.