SECTION 1: Principles of biochemistry, cell biology, physics and microelectronics

(Lecturers: Dr D.Mastellos, Prof. E.Eliopoulos, Dr S.Gardelis, Prof. Y.Shacham)

Lecture 1.1: Cell biology principles (Instructor: Dr Dimitris Mastellos, 2 hours)

- Introduction to the cell and its organization (from prokaryotes to eukaryotic cells, distinct cellular compartments, main organelles and related functions)
- Cell membranes - structure and topography
- Protein biosynthesis and turnover-regulation and degradation
- Cell signaling: relaying the signal from the cell membrane to the nucleus
- The cell cycle - deregulated cell division and cancer
- The immune system-General overview :
  - Innate and acquired immunity, target cells and main immune mediators
  - Antibody structure and function - B and T- cell receptors
  - Monoclonal antibodies - applications
- Towards model biological systems-Divergent signal integration within the cell

Lecture 1.2: Structure of biological macromolecules (Instructor: Prof. Elias Eliopoulos, 2hours)

- Introduction to building blocks of biological macromolecules
- Principles of protein structure
- Principles of DNA structure
- Sequence / Structure relationships. Structural motifs. Examples
- Introduction to in silico prediction of 3D-structure
- Structure / function relationships. Examples

Lecture 1.3: Microelectronic Materials and Device Technology (Instructor: Dr Spyros Gardelis, 2 hours)

- Semiconductors (What is a semiconductor? energy gap, conduction and valence band, electrons and holes, p-type, n-type)
- Basic Devices (p-n junction, bipolar transistor, MOS transistor, MOSFET, CMOS technology)
- Optical properties of semiconductors (direct and indirect band gap semiconductors, laser, photodetector)

Applications of microelectronics in every day life

- Integration - miniaturization revolutionize the way we live (Moore's law)
- Examples of devices used in every day life (logic devices, memories, lasers, displays, detectors, sensors (chemical, gas, bio-sensors)

Lecture 1.4: Introduction to nanobiotechnology (Invited speaker from N2L: Prof. Yosi Shacham-Diamand, Tel-Aviv University, 2 hours)

- Systems concepts- sources, signals, noise, sensors, front-end units, signal processing, storage and display
- Optical signals- fluorescence, bioluminescence, optical path design, sensors, solid state sensors, photon counters, system modelling
- Electrical and electrochemical sensing- DC and impedance methods, passive electrodes based interfacing, nano-electrodes, active electrodes - Field effect transistors interfacing
- Other sensing methods - magnetic sensors, magneto-optics, and more
- Examples - "cell on chip" toxicity bio-sensors

SECTION 2: Core Nanobiotechnology methods and practices

UNIT 2.1: Micro and Nano-fabrication science and technology

(Lecturers: Dr E.Gogolides, Dr A.Tserepi, Dr P.Argitis, Dr E.Makarona)

Lecture 2.1.1: Conventional patterning schemes for hard substrates for bioanalytic Microdevices (Instructor: Dr Evangelos Gogolides, 2 hours)

- The top-down approach in nano fabrication. History of microfluidics, and motivation for going micro and nano for life sciences and chemistry
- Lithography fundamentals: Light Sources, Lithography Systems, Photoresists, Lithographic Processes
- Wet etching and Silicon micromachining
- Plasma etching and its mechanisms. Isotropic and Anisotropic etching
- Deep etching processes for Si bioanalytic microdevices
- Glass micromachining
- Novel Deep etching processes for polymer bioanalytic microdevices

Lecture 2.1.2: Microfabrication technologies for plastic analytical microfluidics (Instructor: Dr Angeliki Tserepi, 2 hours)

- Why use plastic substrates?
- Master Fabrication for plastic patterning
- Injection molding
- Hot embossing
- Soft lithography and variations thereof
- Other/ emerging methods
- Surface modification and sealing
- Examples of analytical microfluidic devices / systems

Lecture 2.1.3: Patterning of biomolecules and other biological substances (Instructor: Dr Panagiotis Argitis, 2 hours)

- The necessity for the patterning of biomolecules and other biological substances on solid surfaces
- Chemical /physical binding of biomolecules on surfaces
- Patterning methods :
    - microspotting, mechanical methods for delivery and synthesis, dip-pen lithography
    - microcontact printing methods (soft lithography related methods)
    - photochemical modification of SAMs, light guided DNA and protein synthesis
    - photochemical modification of polymeric films, photoresist-based methods
    - other / emerging methodologies

  Potential applications and comparison

Lecture 2.1.4: Molecular Bioelectronics (Instructor: Dr Eleni Makarona, 2 hours)

- Definition of “Molecular Bioelectronics”
- Goals - Motivation
- Challenges
- Historical background
- Discussion of electronic transport mechanisms in molecular systems
- Recent Advances and Applications:
    - Molecular Electronics
    - Biosensors / Biochips
    - Neuronal Interfaces
- Future Perspectives - Discussion

UNIT 2.2 : Nanomaterials for bio-applications, Characterization, Imaging

(Lecturers: **A.** Dr D.Vourloumis, Prof. S.Antimisiaris
B. Dr A.Mitraki, Dr I.Rabias, Prof. G.C.Papaefthymiou
C. Dr M.Bennink, Dr S.Pagakis)

A. DRUG DELIVERY METHODS/ MATERIALS

Lecture 2.2.1: Targeting RNA with small molecules: a Pharmaceutical Industry Study
(Instructor: Dr Dionysios Vourloumis, 1 hour)

- Pharmaceutical requirements for project initiation
- Multidisciplinarity of the approach
- RNA and Aminoglycosides
- The Bacterial ribosome
- Evaluating advantages and disadvantages
- Development of specific biological assays based on crystallographic information
- Chemical simplifications of natural binders
- Successful bridging of different disciplines

Lecture 2.2.2 & 2.2.3: Nanosized Drug Delivery (and Targeting) Systems (DDS) - Methods and Applications: Liposomes, Nanoparticles (Polymeric Nanoparticles [PN] or Solid Lipid [SLN])
(Invited speaker: Prof. Sophia Antimisiaris, University of Patras, 2 hours)

Why controlled release? Therapeutic Background and Rationale for Time control and Place control requirements. Liposome Technology. Applications in Therapeutics.

- Pharmacokinetic / Therapeutic Based considerations for type of control required
- General Methods to control Drug Release Kinetics (time) from Nanosized DDS (Liposomes or PN). Kinetics of drug release. Membrane - Matrix - Swelling controlled systems - Environmentally sensitive hydrogels, etc.
- Liposomes (Technology, Drug Release mechanisms, In vivo fate - Routes of Administration, Targeting)
- Comparison of Lipid-based and Polymer based systems; Special constructions
- Examples of Therapeutic applications (Targeting cancer, Brain targeting possibilities, Development of Drug-eluting Biomaterials)

B. NANOSTRUCTURED MATERIALS FOR BIOAPPLICATIONS

Lecture 2.2.4: Bioengineered nanomaterials
(Invited speaker: Dr Anna Mitraki, University of Crete, 1 hour)

- Why use Nature as a “model for new nanotechnology-based processes”?
- Principles of structure and self-assembly of natural biomaterials
- Natural composite materials and interfacing role of proteins
- How natural building blocks can be used for the rational design of artificial nanoscale objects
- Design of biological nanofibers, nanotubes, and closed-caged nanoassemblies
- Application fields and “interfacing” with other disciplines

Lecture 2.2.5: Magnetic Nanoparticles for Bioapplications. Experimental techniques for magnetic characterization of ferrofluids and Applications of ferrofluids in medicine (Instructor: Dr Ioannis Rabias, 1 hour)

- **A study in ferrofluids and their uses in nanotechnology**
  - A review on what is a ferrofluid?
  - The origin of their magnetism, their stability as magnetic colloids
  - Synthetic methods and applications
  - Nature, properties and their high technological value
- **Synthetic Routes for Hydrosol and Organosol colloidal fluids**
  - Differences and similarities in these two approaches
- **Applications of ferrofluids in medicine. Two case studies: 1) Hyperthermia and 2) Contrast Agents for Magnetic Resonance Imaging (MRI)**

  Two applications of ferrofluids in medicine will be discussed:

  - Hyperthermia covers a wide variety of techniques in which elevation of temperature in ferrofluids is achieved using low-frequency electromagnetic radiation. In this way, hyperthermia is a promising approach for cancer therapy, by locally heating a tumor without damaging the healthy tissues in the tumor surrounding
  - Magnetic Resonance Imaging (MRI) is one of the most powerful diagnostic techniques in medicine. The use of superparamagnetic contrast agents based on ferrofluids, which enhance image contrast, will be discussed

Lecture 2.2.6: Biomimetic Materials Synthesis, Principles and Applications (Instructor: Prof. Georgia C. Papaefthymiou, 1 hour)

- The soft/hard interface: Biomineralization - integrating inorganic materials within biological systems
- Nano-templating within genetically engineered protein cages
- Biomimetic core/shell nanoarchitectures
- Magnetic Nanoparticle assemblies within protein or polymeric supports
  Characterization: TEM, Mössbauer Spectroscopy, SQUID Magnetometry
  Applications: *in vitro* applications to genomics and proteomics; *in vivo,* applications to biomedicine
  Safety Issues of nanoparticle applications in medicine

C. IMAGING OF BIOMATERIALS

Lecture 2.2.7: Imaging with Scanning Probes (AFM, STM, SNOM) (Invited speaker from N2L: Dr Martin Bennink, University of Twente, 2 hours)

- Scanning probe techniques
- Scanning tunneling microscopy
- Atomic force microscopy
- Near-field optical microscopy
- Optical tweezers force spectroscopy

Lecture 2.2.8: Fluoresence imaging and 3D image visualization using confocal microscopy (Instructor: Dr Stamatis Pagakis, 1 hour)

- Principles of fluorescence
- Most microscopy samples are 3-dimensional. Examples
- Commonly used fluorescent probes
- Basic optical design of a confocal microscope
- Different types of Confocal microscopes
- Application Examples

UNIT 2.3 : Molecular and Cellular biology and Applications

(Lecturers: **A.** Dr A.Vlahou, Dr S.Garbis
B. Dr S.Kakabakos, Dr C.Mastichiadis, Dr P.Petrou
C. Dr M.I.Klapa, Dr S.Kossida, Dr G.Spyrou)

A. PROTEOMICS AND ANALYSIS

Lecture 2.3.1: Gel-based protein analysis methods (Instructor: Dr Antonia Vlahou, 2 hours)

- Definition and significance of proteomics research
- Introduction to protein separation methodologies: Principle of two-dimensional electrophoresis (2DE) and liquid chromatography
- Steps of analysis by 2DE : isoelectric focusing , vertical polyacrylamide gel electrophoresis, protein spot detection and quantification
- Principles of matrix-assisted laser desorption ionization mass spectrometry (MALDI-MS)
- Identification by peptide mass fingerprinting
- Coupling of 2DE with MALDI
- Protein profiling with MALDI MS analysis
- Applications of 2DE-MALDI MS in biomedical research
- Limitations-Avenues for improvement

Lecture 2.3.2: Non-gel based protein analysis methods (Instructor: Dr Spiros D. Garbis, 1 hour)

- Separation of proteins and peptides with high performance liquid chromatography (HPLC)
- Combining two or more chromatographic chemistries for peptide/protein separation (multi dimensional HPLC approaches)
- Introduction of principles of electrospray ionization (ESI)
- Coupling micro- and nano-bore LC with mass spectrometry ionization sources (MALDI; ESI; nano-ESI)
- Introduction to the principles of tandem mass spectrometry using ion-trap, time-of-flight, quadrupolar mass analyzer designs and their variants
- Protein identification by tandem mass spectrometry of their peptide products
- Protein quantification by LC-MS analysis of isotope-labeled peptide products
- Applications of LC-MS to biomedical research
- Limitations-Avenues for improvement

B. ASSAYS AND ARRAYS

Lecture 2.3.3: Binding Assays and Immunosensors

Part 1: Binding assays (Instructor: Dr Sotirios Kakabakos, 1 hour)

- Binding assay principles
- Binder molecules
- Antibodies: structure and production
- Labels and labelling procedures
- Standard solutions for quantities determinations
- Surface immobilization of biomolecules
- Configurations of binding assays
- Signal amplification systems

Part 2: Immunosensors (Instructor: Dr Christos Mastichiadis, 1 hour)

- What is a (immuno)sensor?
- Main immunosensor configurations
- Principles of optical immunosensors
- Examples of optical immunosensors developed at NCSR “Demokritos”

Lecture 2.3.4: DNA and Protein arrays: fabrication, detection and applications (Instructor: Dr Panagiota Petrou, 1 hour)

Part 1: DNA arrays

- What is a DNA array?
- The DNA molecule: structure and biological significance
- DNA analysis by conventional methods (Southern Blotting)
- DNA arrays versus DNA chip
- Fabrication of DNA arrays and chips
- Target DNA amplification and labelling by PCR
- Hybridisation and detection formats
- Main applications of DNA arrays
- Limitations of DNA arrays
- Perspectives

Part 2: Protein arrays

- What is a protein array?
- Protein structure & sources
- Formats and surfaces for protein arraysImmobilization of proteins onto solid surfaces
- Fabricationof protein arraysDetection schemes for protein chipsAntibody arrays: specificity and cross-reactivity Areas of application
- Challenges and bottlenecks
- Perspectives

C. BIOINFORMATICS AND METABOLOMICS

Lecture 2.3.5: Metabolomics in the Post-Genomic Era (Invited speaker: Dr Maria I. Klapa, FORTH, 1 hour)

- High-Throughput vs. Conventional Biology
- The need for a metabolic fingerprint in the post-genomic era
- Metabolomic profile as a metabolic fingerprint
- Flow chart of metabolomic analysis
- Methods of metabolite extraction
- Technological Platforms for metabolomic measurements: advantages and limitations
- GC-MS metabolomics: the problem of derivatization, new strategy
- Metabolomic Data Normalization
- Multivariate Statistical Analysis of metabolic data / connection with the metabolic networks
- Metabolomic Analysis as part of integrated -omic studies

Lecture 2.3.6: Introduction into Bioinformatics (Instructor: Dr S. Kossida, 1 hour)

- Bioinfromatics – A Rapidly Maturing Science
- Biological Databases
- Genome Analysis
- Proteome Analysis
- The Bioinformatics Revolution in Medicine

Lecture 2.3.7: Applied Bioinformatics in BioNanoTechnology (Instructor: Dr Georgios Spyrou, 1 hour)

- Simulation methods as part of the applied Bioinformatics field
- Molecular Dynamics
- Simulations of biomolecular interactions with inorganic material
- Molecular Modelling in Bionanotechnology
- Bioinformatics insights for designing biomaterials
- Practical considerations in requirements for computing power - supercomputers and GRID architectures

SECTION 3: Towards Integrated Nanobiotechnology systems

(Lecturers: Dr K.Misiakos, Dr J.Rossier, Dr E.Gizeli)

Lecture 3.1: Principles of Integrated Biosensing Devices
(Instructor: Dr Konstantinos Misiakos, 2 hours)

- ISFETs
- Impedance Spectroscopy Devices
- SAW Devices
- Enzymatic Detection
- SPR Resonance
- Interferometric Devices

Lecture 3.2: Lab on chip devices: Principles, applications, opportunities
(Invited speaker from N2L: Dr Joel Rossier, diagnoSwiss, 2 hours)

- Flux of materials: Migration driven systems, Pressure driven systems
- Capillary electrophoresis with Fluorescence detection
- Capillary electrophoresis with MS detection
- Capillary electrophoresis with Electrochemical detections
- HPLC with MS detection
- Immunoasseys with Mass spectrometry detection
- Immunoasseys with Electrochemical detections
- Fully integrated Lab on a chip
- Stand alone, remote control device?

Lecture 3.3: Acoustic wave sensors: from device fabrication to biological applications
(Invited speaker from N2L: Dr Elektra Gizeli, FORTH, 2 hours)

- Acoustic waves in solids: physical explanation and propagation characteristics
- Acoustic wave devices: description of two main device-types, i.e. quartz crystal microbalance (QCM) and surface acoustic wave (SAW)
- Fabrication of SAW devices supporting Rayleigh and shear horizontal waves
- Principle of operation of QCM sensors in dry and liquid samples
- Principle of operation of SAW sensors in dry and liquid samples
- Applications of acoustic biosensors to biology and biotechnology (detection of protein-protein, protein-cell and membrane-ligand interactions)
- Acoustic wave sensors advantages and limitations in comparison with optical techniques

HANDS ON EXPERIENCE - LABORATORIES

SESSION 1
Choose 4 out of 5 laboratories

Laboratory 2.2.4: State of the art confocal microscopy of biological samples
(Instructor: Dr Stamatis Pagakis, Bioacademy, duration 2 hours/group)

Aim of the Lab:

- Familiarize students with a fluorescence microscope
- Demonstrate the design differences which characterize a confocal microscope
- Demonstrate Image processing and 3D visualisation software

Content:

- Two microscope workstations (one confocal) will be used
- Observation of fluorescent proteins (e.g YFP, GFP) and other fluorophores common in fluorescence microscopy
- Hands-on experience and data acquisition on a digital camera fluorescence microscope
- Demonstration of 3D data acquisition using a confocal microscope
- Imaging methods for image deconvonlution, 3D reconstruction and data analysis will be demonstrated on computer workstations with specialised software packages

Laboratory 2.3.1: Protein separation by two-dimensional electrophoresis
(Instructor: Dr Antonia Vlahou, Bioacademy, duration 2 hours/group)

Aim of the lab:

- Familiarize attendees with the isoelectric focusing technology and vertical polyacrylamide gel electrophoretic systems
- Familiarize attendees with automated technologies for spot picking and processing for peptide mass fingerpriniting
- Demonstrate the processing of a cell extract by the 2DE methodology

Content:

- Processing of cell extract on IPG strips for first dimensional separation
- Application of IPG strips on PAGE gels
- Gel staining, scanning and processing for spot excision
- Tryptic digestion of excised spots

Laboratory 2.3.2: Mass spectrometry
(Instructor: Dr Spiros D. Garbis, Bioacademy, duration 2 hours/group)

Aim of the lab:

- Familiarize attendees with mass spectrometry technologies (MALDI; ESI QqTOF; ESI QIT)
- Demonstrate tryptic peptide analysis by MALDI-MS; LC-ESI-QqTOF MS; LC-ESI-QIT)
- Familiarize attendees with database searches for protein identification
- Familiarize attendees with the custom preparation of capillary LC columns to be used for the LC-ESI-MS based methods

Content:

- Tuning and calibration of mass spectrometers (MALDI; ESI QqTOF; ESI QIT)
- Application of tryptic peptide extracts and proteins and matrix on MALDI targets
- MALDI MS analysis of peptide and protein samples
- Sample preparation for LC–ESI-MS
- LC-ESI-MS-MS analysis of peptide extracts
- Database search methods

Laboratory 2.3.3: Fabrication of protein microarrays using nanoplotter
(Instructor: Dr George Tsangaris, Bioacademy, duration 2 hours/group)

- Microspoting methods for the fabrication of microarrays : presentation of nanoplotter and familiarization with its use

Laboratory 2.3.6: Bioinformatics laboratory
(Instructor: Dr Sophia Kossida, Bioacademy, duration 2 hours/group)

Aim of the lab:

- Familiarize attendants with biological databases
- Familiarize attendees with software for genome analysis
- Familiarize attendees with software for proteome analysis

Content:

- Query and retrieve info from biological databases
- Analyze genes/ genomes with software packages
- Analyze peptides/ proteins with software packages

SESSION 2

Choose 4 out of 6 laboratories

Laboratory 2.1.1: Fabrication of microfluidic devices on plastic substrates by soft lithography
(Instructor: Dr Angeliki Tserepi, IMEL, duration 3 hours/group)

Aim of the lab:

- Familiarize attendants with conventional photolithography
- Familiarize attendees with replica molding / soft lithography
- Demonstrate the fabrication and sealing of a PDMS microfluidic device

Content:

- Fabricate mold on SU8
- Fabricate microfluidic channels by PDMS replica molding on SU8 mold
- Device Sealing

Laboratory 2.1.2: Fabrication of plastic microfluidic devices by Lithography and deep polymer plasma etching techniques
(Instructor: Dr Evangelos Gogolides, IMEL, duration 3 hours/group)

Aim of the lab:

- Familiarize attendees with the ICP plasma reactor, its operation and diagnostics, as a tool for microfluidics and surface modification
- Perform plasma etching of PMMA microchannels and observe results
- Surface property modification monitoring with contact angle (wetting)

Content:

- Lithography on a PMMA sheet
- Demonstration of the plasma reactor (ICP) and diagnostics
- Patterning of microchannels on PMMA using the ICP
- Measurement of the wetting properties of PMMA before and after etch
- Sealing of microfluidic channels and measurement of flow properties of the microfluidic

Laboratory 2.1.3: Electrical characterization of tunneling devices based on organic molecules or biomolecules (Instructor: Dr Eleni Makarona, IMEL, duration 3 hours/group)

Aim of the lab:

- Familiarize attendants with electrical characterisation methods of molecular systems
- Discuss how the electrical transport properties of the measured devices can be used in future nanoelectronic devices

Content:

- Demonstration of electrical measurements of hybrid Si/molecular devices containing organic molecules and biomolecules with different geometries (planar nanodistant electrodes, vertical structures, structures containing gold nanoparticles)
- Analysis of experimental data and extraction of information for the molecular systems

Laboratory 2.3.4: Fabrication of protein microarrays using lithography (Instructor: Dr Antonis Douvas, IMEL, duration 3 hours/group)

- Photoresist processing fundamentals : processing of chemically amplified photoresists
- Lift-off process : use of lift off process for the patterning of SAMs or proteins, and (optional)
- Patterning of different types of proteins on the same substrate by successive lithographic steps under biocompatible conditions

Laboratory 2.3.5: Fluorescence detection of protein arrays (Instructor: Dr Panagiota Petrou, IRRP, duration 3 hours/group)

Aim of the lab:

- Familiarize the attendees with optical detection of protein arrays
- Demonstration of the epifluorescence microscope
- Image processing for quantitative fluorescence measurements

Content:

- Immunoreaction of protein in spots created by photolithography with fluorescently labeled molecules
- Observation of protein spots with the epifluorescence microscope
- Capture of images of the arrays
- Image processing to receive quantitative results

Laboratory 3.1: Operation of a lab-on-a-chip optical device using model assays and real time measurements (Instructor: Dr Const. Misiakos, IMEL, duration 3 hours/group)

- Integrated biochip wafer alignment on wafer prober
- Protein/DNA spotting on integrated waveguides
- Washing and microfluidic device application on biochip
- Protein/DNA real time assays through photocurrent monitoring

SESSION 3

Choose 4 out of 6 laboratories

Laboratory 2.2.1: Drug inclusion in cyclodextrins: monitoring in situ by NMR spectroscopy X-ray diffraction characterisation of drug inclusion and 3-D visualisation (Instructors: Dr Konstantina Yannakopoulou, Dr Emmanuel Saridakis, Dr Anastasia Paulidou, IPC, 3.5 hours/group)

- Determination of the formation of an inclusion complex of β-cyclodextrin and the drug piroxicam in situ by NMR spectroscopy
- Determination of the formation of the same inclusion complex (β-CD/piroxicam) in the crystalline state by powder X-ray diffraction
- Molecular docking of the drug inside the cyclodextrin cavity

Laboratory 2.2.2: Liposomes: preparation and characterisation by dynamic light scattering and ζ-potential (Instructor: Dr Dimitrios Tsiourvas, IPC, 3.5 hours/group)

Aim of the lab:

- Familiarize attendees with liposome preparation
- Perform standart liposomal characterization techniques

Content:

- Preparation of anionic and cationic liposomes of 50 and 100 nm diameters employing the extrusion method
- Introduction to Dymanic Light Scattering (theory and applications)
- Dynamic light scattering experiments for the determination of the size and polydispersity of liposomal formulations
- Introduction to ζ-potential (theory and applications)
- ζ-Potential measurements for the determination of the surface charge of liposomal formulations

Laboratory 2.2.3: Video enhanced optical microscopy and Atomic Force Microscopy of Liposomes (Instructor: Dr Dimitrios Tsiourvas, IPC, 3.5 hours/group)

Aim of the lab:

- Familiarize attendees with optical microscopy and Atomic Force Microscopy experimental set-up
- Demonstrate the use of these techniques for the characterization of liposomal nanoparticles

Content:

- Optical microscopy – phase contrast optical microscopy
- Phase contrast optical microscopy imaging of liposomal dispersions
- Introducing the experimental set-up of Atomic Force Microscopy
- Atomic Force Microscopy (tapping mode) imaging of liposomal dispersions

Laboratory 2.2.5: Magnetic nanomaterials for bio applications (Instructor: Dr Ioannis Rabias, IMS, 3.5 hours/group)

Magnetic hyperthermia for Biomedical applications

- Calculation of the specific absorption power, i.e. the power absorption in Watts per gram of Fe, which is given by the following formula, will be measured using RF-induction heater. For the above use of prepared ferrofluids in magnetic relaxitivity measurements to optimize the conditions for enhanced signal registration.

$$SAR = \frac{W}{m_{Fe}} = \frac{\Delta Q}{\Delta t m_{Fe}} = \frac{c m_f}{m_{Fe}} \frac{\Delta T}{\Delta t} \quad , \quad \text{in W/gFe}$$

- Where c is the specific heat capacity of the ferrofluids, calculated as the mass weighted mean value of magnetite and water, mf is the mass of the ferrofluids, and mFe is the mass of the iron in the ferrofluids

Laboratory 2.2.6: Determining Magnetic Anisotropy at the Nanoscale (Instructor: Prof. Georgia C. Papaefthymiou, IMS, 3.5 hours/group)

- STEM image of Horse Spleen Ferritin to establish an average biomineral core size
- SQUID measurements to establish average blocking temperature
- Combine these two pieces of information to derive the average magnetic anisotropy density of the magnetic nanoparticles, an intrinsic parameter that is crucial in the design of tailored magnetic particles for specific applications
- Tour TEM, Mössbauer and SQUID Facilities

Laboratory 3.2: Demonstration of a capillary fluoroimmunosensor (Instructor: Dr Sotirios Kakabakos, IRRP, duration 3 hours/group)

Aim of the lab:

- Familiarize attendees with optical immunosensors
- Demonstration of multi-band capillary fluoroimmunosensor
- Real-time monitoring of the immunoreaction

Content:

- Creation of distinct reaction bands in a single capillary
- Performance of immunoreaction in the capillary
- Demonstration of fluorescent bands detection using the prototype optoelectronic set-up in real time or after assay completion
- Data processing and interpretation of the results