TOMSK INTERNATIONAL SCIENCE PROGRAM

Course Catalogue 2019-2020

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Disclaimer

The course and skills descriptions provided herein are for the guidance of prospective students of the Tomsk International Science Program (TISP) and every effort is made to ensure their accuracy. However, the TISP reserves the right to make variations to the content and pre- and co-requisites, to discontinue courses and to merge or combine courses without prior notice.

	ECTS	1 period (12 ECTS)	2 period (12 ECTS)	3 period	4 period (12 ECTS)	5 period (12 ECTS)	6 period
1 year	5	Introduction to Natural Sciences: Calculus	Introduction to Liberal Arts and Sciences	Life Safety 6 ECTS	Applied Statistics	Introduction to Natural Sciences: Biology	Field Research Skills 6 ECTS
	5	Introduction to Neuroscience	Commercializing Science and Technology		Elements of Physics	Introduction to Natural Sciences: Chemistry	
	2	Intercultural communication	Research, Data Analysis and Presentation Academic Skills		Basic Physics Laboratory	Research Methods	
2 year	5	System Analysis	General History	Project 1 6 ECTS	Philosophy	Management in innovative industries	Project 2 6 ECTS
	5	Introduction to Biomedical Engineering Statistics Biobased Material and technology Mathematics for the Natural Sciences	Human Anatomy and Physiology Inorganic Chemistry General Botany Classical Mechanics		Inorganic Chemistry General Zoology Cognitive Neuroscience: Biological Foundation of Behavior Organic Chemistry Linear Algebra	Physical Chemistry Cell Biology Thermodynamics and Statistical Physics	
	2	Physical Education and Sports	Exploring the World of Plants Human Anatomy and Physiology Inorganic Synthesis Physics Laboratory: Classical mechanics		Inorganic Synthesis Practical Zoology Cognitive Neuroscience: Biological Foundation of Behavior Chemical Synthesis Topics in Scientific Computing	Physical Chemistry Applied Cell Biology Physics Laboratory: Thermodynamics	
3 year	5	Industrial Technologies and Science	Creativity and Concept Development of New Business	Project 3 6 ECTS	Science and Sustainable Development	Ecology	Project 4 6 ECTS
	5	Statistics Vegetation science Basic Principles of Pharmacology Differential Equations	General Botany Soil science Cognitive Neuroscience: from Sensation to Perception Spectroscopy Electromagnetism		General Zoology Cell Biology Genetics Modern Catalytic Chemistry Vibrations and Waves	Programming Part 1 Human Anatomy and Physiology Neuropsychopharmacology	
	2	Computer-Aided Design	Exploring the World of Plants Plant Breeding and Physiology Cognitive Neuroscience: from Sensation to Perception Spectroscopic Methods Physics Laboratory: Electromagnetism		Practical Zoology Applied Cell Biology Genetics Advanced Organic Synthesis Physics Laboratory: Vibrations and Waves	Programming Human Anatomy and Physiology Neuropsychopharmacology	
4 year	5	Mathematics for the NaturalSciences Siberian Ecology Electrodynamics	BiobasedMaterials and Technology Science in Action Biochemistry	Project 5 3 ECTS	Soil science Biological Diversity Mathematics for the Natural Sciences Transition Metal Chemistry Statistics	Science in Action Molecular Toxicology Introduction to Chemical Engineering Numerical Mathematics Landscape ecology	Thesis 9 ECTS
	5	Biomaterials Genomics and Proteomics Programming. Part 1 Programming Part 2 Analytic Geometry	Human Anatomy and Physiology Microbiology Organic Reactions Particle physics / High-Energy Physics		Cell Biology Molecular Biology Biomaterials Quantum Physics	Microbiology Spectroscopy Regenerative Medicine Statistics	
	2	Programming in the Life Sciences Genomics and Proteomics	Topics in Scientific Computing Microbiology Polymer Processing Advanced Physics Laboratory: Particle physics / High-Energy Physics		Programming in the Life Sciences Applied Cell Biology Molecular Biology Transition Metal Chemistry Advanced Physics Laboratory: Quantum Physics	Topics in Scientific Computing Microbiology Spectroscopic Methods	

Core for all tracks Bio-based materials Ecology Neuroscience Physics Chemistry

TABLE OF CONTENT

CORE COURSES FOR ALL TRACKS

MAT 1001 Introduction to Natural Sciences: Calculus

ECTS: 5.0

Course coordinator:
Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: diomedis@mail.ru

Pre-requisites: None
Co-requisites: None

Course objectives:
To become familiar with functions and limits. To become familiar with differentiation and integration. To understand how to use differentiation and limits/continuity of a function to sketch the graph of a function. To become familiar with sequences and series. To understand the basic of differential equations and Taylor series.

Full course description:
In this course, we will discuss, among others, the following topics: limits and continuity, integration and differentiation, inverse and transcendental functions, mean value theorem, sequences and series. In addition to the main facts and concepts, problem solving strategies will be discussed as well. Both the intuition behind the concepts and their rigorous definitions will be presented along with a number of examples and formal mathematical proofs so to better understand the concepts.
✓ Knowledge and understanding: Calculus offers an indispensable basis, in the contents as well as in the methodologies, for studying and applying exact sciences, which will be built on during the rest of the curriculum.
✓ Applying knowledge: The skills and facts which are taught in this course are of use for most of modern engineering or scientific problems. After the completion of the course, the students should be able to solve simple problems in the areas mentioned above and to judge the validity of a mathematical argument, which is related to the material of the course.
✓ Skills: After having passed the exam, the student will be able to tackle not only the standard type of problems (graph-drawing, calculation of maxima and minima of functions, computing limits, summing infinite series etc.), but also apply his knowledge to considerably more relevant problems.

Literature:
The sources will be added

Teaching methods:
Lecture(s), Skills, Assignment(s)

Assessment methods:
Written exam, Assignment

INT 1001 Introduction to Neuroscience

ECTS: 5.0

Course coordinator:
Zhukova I.A., SibSMU,
Contact: irzhukova@inbox.ru

Pre-requisites: None
Co-requisites: None

Course objectives:
To introduce the students to the field of neuroscience, the study of the nervous system. To provide fundamental basis of the anatomy, development, and physiology of the nervous system.

Full course description:
This course begins with the study of the nervous system structure, ranging from the macroscopical to microscopical level, and its development. Next, the fundamental mechanisms by which information flows within and between nerve cells will be addressed. This includes the aspects of membrane permeability, action potential generation and propagation, synaptic transmission, post-synaptic mechanisms of signal integration and the construction of neural circuits. Finally, the vascular system and the microenvironment of the brain will be discussed.

Literature:
The sources will be added

Teaching methods:
Lecture(s), PBL

Assessment methods:
Written exam, Presentation

PRA1001 Intercultural communication

ECTS: 2.0

Course coordinator:

Vaganova E.V., Tomsk State University
Contact: hailun@mail.ru

Pre-requisites: None
Co-requisites: None

Course objectives:

The course is aimed at the improvement of professional communication skills for successful business and academic interactions in English. One of the key priorities is making students competitive by improving their English through the subjects, and improving their subject knowledge thorough the language classes.

Full course description:

The main objective of the course is to prepare the students to use English as a working language of the program. It is intended to develop the following skills: thinking critically and making judgments, solving problems and developing plans, performing procedures and demonstrating techniques, accessing and managing information, demonstrating knowledge, designing, creating, performing, and communicating in English.

Each module focuses on a particular area of communication in English: writing essays and emails, speaking at meetings, interviews scientific events, giving presentations, and networking online. Special attention is paid to communication to potential employers, employees, partners or clients, and achievement of professional goals.

Topics: 1. Self-introduction 2. Lecture and classroom vocabulary. 3. Learning outcomes – activities – assessment 4. Presentation tools: types of effective visuals, strategies for a good beginning and conclusion 5. Academic correspondence.

Literature:

References available at National Research Tomsk State University.

1. David Cotton, David Falvey, Simon Kent, John Rogers, Lewis Lansford, Christine Johnson, Irene Barrall, Lizzie Wright, William Mascull Market Leader Business English Course Longman Pearson, 2013. – 161 p.
2. Wallwork A. CVs, Resumes, and LinkedIn : A Guide to Professional English [Electronic resource] / by Adrian Wallwork // Springer eBooks. – New York, NY: Springer New York: Imprint: Springer, 2014. – 200 p. – The electronic version of the printing publication. – URL: http://dx.doi.org/10.1007/978-1-4939-0647-5.
3. Wallwork A. Email and Commercial Correspondence : A Guide to Professional English [Electronic resource] / by Adrian Wallwork // Springer eBooks. – New York, NY: Springer New York: Imprint: Springer, 2014. – 164 p. – The electronic version of the printing publication. – URL: http://dx.doi.org/10.1007/978-1-4939-0635-2.

Teaching methods:

Blended learning based on flipped classroom methodology, including traditional and innovative educational technologies.

Assessment methods:

1. Thinking critically and making judgments
(Developing arguments, reflecting, evaluating, assessing, judging)

- Essay
- Report
- Present a case for an interest group
- Prepare a committee briefing paper for a specific meeting
- Book review (or article) for a particular journal
- Write a newspaper article for a foreign newspaper
- Comment on an article's theoretical perspective

2. Solving problems and developing plans
(Identifying problems, posing problems, defining problems, analysing data, reviewing, designing experiments, planning, applying information)

- Problem scenario
- Group Work
- Work-based problem
- Analyse a case
- Conference paper (or notes for a conference paper plus annotated bibliography)

3. Performing procedures and demonstrating techniques
(Computation, taking readings, using equipment, following laboratory procedures, following protocols, carrying out instructions)

- Role Play
- Make a video (write script and produce/make a video)
- Produce a poster
- Lab report
- Prepare an illustrated manual on using the equipment, for a particular audience
- Observation of real or simulated professional practice

4. Accessing and managing information
(Researching, investigating, interpreting, organizing information, reviewing and paraphrasing information, collecting data, searching and managing information sources, observing and interpreting)

- Annotated bibliography
- Project
- Applied task
- Applied problem

5. Designing, creating, performing
(Imagining, visualizing, designing, producing, creating, innovating, performing)

- Portfolio
- Performance
- Presentation
- Projects

6. Communicating
(One and two-way communication; communication within a group, verbal, written and non-verbal communication. Arguing, describing, advocating, interviewing, negotiating, presenting; using specific written forms)

- Written presentation (essay, report, reflective paper etc.)
- Oral presentation
- Group work
- Discussion/debate/role play
- Presentation to camera
- Observation of real or simulated professional practice

The required attendance for this practicum is a full 100%.

INT 1002 Introduction to Liberal Arts and Sciences

ECTS: 5.0

Course coordinator:

Maslennikova O.G., Center for Joint International Academic Programs, Tomsk State University
Contact: pro-77@mail.ru

Pre-requisites: None
Co-requisites: None

Course objectives:

The objective of the course is to make you think about the natural sciences from a philosophical perspective: what is science; what is the scientific method?
The course also challenges you to develop your intellectual and generic skills further:
✓ how to integrate different perspectives; what is ethical in science;
✓ how to communicate in/about science?
✓ to achieve this, the course has the following sub-objectives:
✓ to deepen your understanding of natural sciences by introducing you to different perspectives on science and scientific methodologies.
✓ to make you aware of what is needed to be a 'good' natural scientist. You are introduced to norms and values in scientific environments and are challenged to think critically by offering diverging views on the topics discussed in the course.
✓ to equip you with the skills and knowledge required to communicate your knowledge and ideas effectively. You are stimulated to achieve these goals when working in teams.

Full course description:

Introduction to Liberal Arts & Sciences introduces you to the intellectual skills, the generic skills and the development of values and ethics inherent in the liberal arts & sciences tradition. The first part of the course aims at providing you with an understanding of the natural sciences from a philosophical perspective. What is science? What is the scientific methodology? What are the norms and values in a scientific environment? The variety of perspectives that you are introduced to when answering these questions will allow you to develop your critical thinking skills and will provide you with insights that you can use in your personal development as a scientist. After exploring the philosophy of science in the first part of the course, the second part of the course teaches you to apply and communicate your knowledge and ideas effectively by devoting attention to argumentation and science communication.

Literature:

Required: Watson, J.D. (Author) & Jones, S. (Introduction), The Double Helix, A Personal Account of The Discovery of the Structure of DNA, ISBN: 978-0-7538-2843-4.
Recommended: the articles and book chapters which will be made available online on a weekly basis.

Teaching methods:

Lecture(s), PBL, Assignment(s)

Assessment methods:

Three grades will be assigned in this course: 1. Written assignment [50% of final grade] 2. Written preparation debate [20% of final grade] 3. Final Debate [30% of final grade]

SFT 1001 Commercializing Science and Technology

ECTS: 5.0

Course coordinator:

Michail Kaz, Professor, Institute of Economics and Management
Contact: misk3@mal.ru

Pre-requisites: None
Co-requisites: None

Course objectives:

Understand how science-based research and technological inventions can be transformed into new business, either in the context of a start-up or in established companies
To foster an entrepreneurial spirit

Full course description:

The course Commercializing Science & Technology aims to help you understand and master core challenges of turning science into products and ultimately operating businesses. In so doing, we will adopt a strongly entrepreneurial lens. That means, we will look at important technology commercialization activities through the eyes of a potential technology entrepreneur. One of the most important tasks entrepreneurs have to perform is to understand the full range of potential opportunities that can be created based on their technological competences and to what extent they have freedom to operate (IP) within chosen markets. However, the identification and validation of market opportunities is only the beginning. Successful technology commercialization also requires an understanding of the different business model options and how to structure market entry strategies such that they support moving along the technology learning curve and the diffusion of innovative products. Therefore, this course puts major emphasis on the entrepreneurial competencies, tools, and methodologies, as opposed to technological competences, in early-stage commercialization processes. The competencies you will acquire throughout this course will be extremely valuable whether you choose an entrepreneurial career or a career in managing technology in an established firm or within a public or private research lab.

Literature:

The sources will be added

Teaching methods:

This course is taught through a combination of regular problem based learning, interactive case lectures and a field project that will challenge you to apply your newly acquired knowledge to realistic problem situations of technology entrepreneurs.

Assessment methods:

Participation, Field project reports, Final presentation on field project, Class facilitation & topical presentations on entrepreneurial methodologies, mind sets, and tools.

PRA 1002 Research, Data Analysis and Presentation Academic Skills

ECTS: 2.0

Course coordinator:
Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: diomedis@mail.ru

Pre-requisites: None
Co-requisites: None

Course objectives:
To familiarize students with the most basic skills required in science. These include: Common statistical data analysis skills Finding and selecting literature using Web of Science and Scifinder Referencing literature using Endnote Writing a scientific article

Full course description:
The academic world has its own strict set of rules with respect to collecting data, analysing them, and writing and reporting about them. This course will provide you an introduction into this academic skills set. The first step for any scientific investigation is to find out what is already known. Although you probably always have used Google to find information, this search engine is not the best tool to find peer- reviewed scientific knowledge. Therefore, you will be introduced into two common scientific search tools and shown how to use them: Web of Science and Scifinder. Once you have found literature, you will learn how to manage and use the citations with a bibliographic data management tool called Endnote. Next to literature searches, you will be introduced into the rules of writing a proper scientific article. Scientific writing is a branch of its own with particular and peculiar do's and don'ts. Scientific articles present content in a certain order and have a clear division into topics. They also require a particular writing style. Many students have at first problems with writing scientifically and therefore a substantial portion of this skill is devoted to this topic. A scientific article is mostly about data. However, these data are never presented in the form they were collected. Usually some form of statistical analysis is required. In this skill you will practice with the most basic descriptive statistical techniques available to explore data. Finally, the presentation training is designed to help you strengthen your abilities to present scientifically, effectively and efficiently at seminars and similar events.

Literature:
All students are required to read the book: Watson, J.D. (Author) & Jones, S. (Introduction), The Double Helix, A Personal Account of The Discovery of the Structure of DNA, ISBN: 978-0- 7538-2843-4. In addition students will study a variety of articles and book chapters which will be made available online on a weekly basis.

Teaching methods:
Lecture(s), PBL, Skills

Assessment methods:
Final paper, Assignment, Presentation

SFT 1002 Life Safety
ECTS: 6.0

Course coordinator:
Pleshkov M.O., Physics Faculty, Tomsk State University
Contact: pankerams@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:
To be able to perform basic chemical and biological laboratory research experiments in a safe and scientifically sound manner.
To understand the handling of materials and solutions (weighing, preparing solutions, working with pipettes and volumetric glassware).
To learn to setup and execute a scientific research experiment.
To provide an introduction to scientific research reporting.

Full course description:
This course focuses on experimental research methods and reporting. In addition, it teaches basic laboratory skills necessary to perform experiments in a chemical, biological, or physics laboratory. Students will learn to work in a safe manner, with respect for themselves, others, and the environment. Basic techniques will be taught, such as the accurate measurement of volumes and weights. Students will gain experience in the logistics of setting up and performing an experiment with the final goal of communicating their findings in a report. Typical topics, which will be covered in this skills training are:

- ✓ Chemical and biological separations and isolations (distillation, extraction, chromatography)
- ✓ Acids and bases (measuring pH, using buffer solutions, titrations)
- ✓ Chemical and biological kinetics (enzymes, reaction order)
- ✓ Thermodynamic properties of compounds and reactions
- ✓ Introduction into microscopy and imaging of biological samples

Literature:
The sources will be added

Teaching methods:
Lectures, PBL tutorials

Assessment methods:
Written exam, Assignment

MAT 1002 Applied Statistics

ECTS: 5.0

Course coordinator:
Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: ***diomedis@mail.ru***

Pre-requisites: None
Co-requisites: None

Course objectives:
To enhance students' understanding of the basics of inferential statistics. To broaden the scope of statistical methods that students are acquainted with by introducing a number of widely used applied tests that were not covered in PRA1002. To understand how researchers determine required sample sizes for a number of (simple) designs and to be able to apply these methods. To familiarize students with statistical software, so that they can independently run the analyses that are covered in this course and are able to correctly interpret the corresponding output.

Full course description:
At the end of this course, students should be familiar with the basic concepts of inferential statistics, and will be able to perform basic statistical analysis in a variety of scenarios. In most scientific research, researchers have to deal with the problem of drawing conclusions about some population characteristic of interest, relying only on a sample of observations from that population. Inferential statistics is a way to tackle this problem. This course starts by covering the foundations of inferential statistics, emphasizing the logic behind the statistical reasoning process. This logic is then employed to explain a number of widely used applied statistical methods: Chi-square, Nonparametric Wilcoxon tests and multiple regression. Students will learn how to run each of these applied tests using the statistical software package. Additionally, they will learn how to determine the minimal number of observations needed to be able to show, with a fixed probability, a specified research hypothesis.

Literature:
The sources will be added

Teaching methods:
Lecture(s), PBL

Assessment methods:
Written exam, Assignment

PHY 1001 Elements of Physics

ECTS: 5.0

Course coordinator:
Pleshkov M.O., Physics Faculty, Tomsk State University
Contact: pankerams@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:
To acquaint the student with the essential building blocks of Physics. To acquire a general understanding of the theoretical and practical methods in these fields and to be able to apply this knowledge to concrete problems. To serve as sufficient basis in physics for students in their future education.To be able to apply this knowledge to practical problems. To be able to read texts that build on the subjects of this course.

Full course description:
Physics is the study of all aspects of Nature, covering the behaviour of objects under the action of given forces and the nature and origin of gravitational, electromagnetic, and nuclear force fields. This is an introductory course in Physics intended for a broad audience with a scientific interest, that comprehensively trains students to the basic, classical, and essential fundamentals of physics. As such it is a prerequisite for most courses in the further Physics curriculum. The course aims at an understanding of the fundamental principles of Nature and how to apply them in concrete practical situations. The emphasis is on intuition rather than mathematical rigour; this is addressed in the follow-up physics courses. In this course we address the principal corner stones of Physics: 1. Elements of classical mechanics; 2. Elements of thermodynamics; 3. Elements of electromagnetism; 4. Elements of optics and waves; 5. Elements of modern physics. Each of these subjects is taught on a theoretical level as lecture, and on a practical level with exercises in practical training sessions. This course is a good preparation for the physics lab skills involving experimental and practical physics.

Literature:
1. David Halliday, Robert Resnick, Jearl Walker. Fundamentals of Physics Extended, 10th Edition. ISBN: 978-1-118-23072-5. Aug 2013. 1448 pages
2. University Physics with Modern Physics, H.D. Young & R. A. Freedman, Pearson Education (US), 13th International edition, May 2011

Teaching methods:
Lecture(s), Working visit(s), PBL, Skills

Assessment methods:
Final paper, Written exam

PRA1003 Basic Physics Laboratory

ECTS: 2.0

Course coordinator:
Pleshkov M.O., Physics Faculty, Tomsk State University
Contact: pankerams@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:
To acquaint the student with the basis of experimental physics. To acquire understanding of practical methods in experimental physics. Being able to solve technical problems in a physical experiment. To be able to relate the experiment to the relevant physical theory. To be able to process empirical data in relation to the theoretical physical predictions using the adequate statistical and graphical tools. To be able to properly describe the experimental methods and results in technical reports.

Full course description:
The aim of this course is understanding what physics means by performing instructive physical experiments that reveal fundamental physical principles, and also to attain a level of dexterity with experimental devices. Physics is an empirical science and not a mere collection of mathematical laws. In this sense this practical is an appropriate counterpart for the more theoretic and mathematical Physics courses. Moreover, the aim of this training is to train your ability to report and summarize your experimental work in a few pages. The course lasts six weeks, and consists of one full day of experimentation per week. The required attendance for this practicum is a full 100%. The practicum consists of a collection of 12 different experiments. Students cooperate in couples (of 2 students) and each week perform a different experiment. Each experiment consists of a theoretical and methodological preparation: i. Reading about the theory behind the experiment; ii. Determining what should be done and in what order; iii. Writing a plan containing the required steps for carrying out the measurements. Topics: MECHANICS: Newton's Laws Experiment, Conservation of momentum and impulse, Projectile Motion, Mechanical waves. THERMODYNAMICS: Thermal Energy, Equilibrium Temperature, Specific Heat, Ideal Gas Law LIGHT and OPTICS: Reflection and Refraction, Snell's Law, index of refraction, Michelson's interferometer.

Literature:
There is no book directly associated to this course. Information on the individual experiments is provided in this syllabus and in separate detailed experiment descriptions. Additionally, this course relates to the introductory course Physics: Elements in Physics

Teaching methods:
This course takes place in the physics laboratory in TSU. Students work in couples during the skill. Each week each couple jointly studies a different experiment, 1. perform measurements, 2. process the experimental data, and 3. write a report. The final grade is based on these reports. During the course students also learn more about the basis theory of Experimental Physics, like sources of errors and error propagation.

Assessment methods:
Evaluation of student performance will be based on lab reports, peer review, fill-in sheets and the quality of their logbook.

BIO 1001 Introduction to Natural Sciences: Biology

ECTS: 5.0

Course coordinators:
Volkova I.I., Biological Institute, Tomsk State University
Solomina Ye., Tomsk State University
Contacts: volkovhome@yandex.ru, evgeniyasea27@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:
At the end of this course, aiming a deeper understanding of the basic characteristics of life, the student will be able to characterize: metabolism, growth, reproduction; the relation between structure and function of bio-molecules in living organisms; the cell as the unit of living organisms biodiversity, evolution & taxonomy; the basics of metabolism and photosynthesis; the principles and mechanisms underlying classical genetics; the basic principles of ecology population dynamic and how populations respond to environmental changes.

Full course description:
This course aims at introducing the students to the most fundamental biological principles of life. The cell as the basic unit of life will be studied as well as classification of organisms in order to understand the basic principles of the diversity of species. A basic understanding of photosynthesis and cellular respiration will be provided in this course. The ability to replicate, to multiply and produce offspring is studied in the field of genetics, and the basic Mendelean genetics will be studied. The basic principles of evolution will be introduced. How living organisms relate to each other will be explained and basic principles of ecology are presented.

Literature:
Campbell, Reece et al. (2015). Biology, A Global Approach (10th edition, global edition).

Teaching methods:
Lecture(s), PBL, Assignment(s)

Assessment methods:
Written exam, Participation, Final paper.

CHE 1001 Introduction to Natural Sciences: Chemistry

ECTS: 5.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: ***visaqam143@gmail.com***; gulnara.voronova@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:
✓ To gain an understanding of the nature of atoms and their organization in the periodic table.
✓ To apply basic chemical laws and calculations for chemical processes characterization
✓ To recognize various classes of chemical compounds and to understand their chemical and physical properties.
✓ To obtain an understanding of the physical chemistry fundamentally important to biological and chemical processes, with an emphasis on thermodynamics and kinetics.
✓ To use concepts acquired from kinetics, thermodynamics, acid-base chemistry, and electrochemistry, to predict the potential outcome of chemical reactions.
✓ To acquire sufficient background for more advanced courses in chemistry, biochemistry and the life sciences.

Full course description:
The emphasis of this course will be on a number of essential topics in contemporary chemistry. The first part of the course will provide an overview of the structure of atoms and their place in the periodic table, periodic law as well as the properties of various types of chemical bonds and chemical bonding theory. The second part will present an introduction to physical chemistry with important topics such as the characteristics of gases/liquids/solids, thermodynamics and reaction kinetics, chemical equilibrium. In the final part, the course focuses on a selection of important chemical subjects which form the basis of chemical studies in general. Typical topics in this part of the course are based on acid-base chemistry, properties of solutions and electrochemistry, corrosion and protection against corrosion.

Literature:
Silberberg, M. S. Principles of General Chemistry, 3rd International Edition; McGraw-Hill: New York, 2013; ISBN: 9780071317986

Teaching methods:
Lectures and tutorial group meetings, individual home tasks

Assessment methods:
A midterm examination consisting of multiple choice, short answer, calculation and explanation questions; weekly tutorials – contributions; a final (cumulative) examination consisting of short answer, calculation and explanation questions.

PRA 1004 Research Methods

ECTS: 2.0

Course coordinators:
Volkova I.I., Biological Institute, Tomsk State University;
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: volkovhome@yandex.ru; visagam143@gmail.com; gulnara.voronova@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:
To be able to perform basic chemical and biological laboratory research experiments in a safe and scientifically sound manner. To understand the handling of materials and solutions (weighing, making solutions, handling solutions, working with pipettes and volumetric glassware), making biological preparations. To be able to use laboratory equipment (such as microscopes) carefully. To learn to setup and execute a scientific research experiment. To provide an introduction to scientific research reporting.

Full course description:
This course focuses on experimental research methods and reporting. In addition, it teaches the students the basic laboratory skills to perform experiments in a chemical or biological laboratory as well as the physics laboratory. Students learn to work in a safe manner, with respect for themselves, others and the environment. Basic techniques will be taught, such as the accurate measurement of volumes and weights. The students will gain experience in the logistics of setting up and doing an experiment with the final goal of communicating their findings in a report. Typical topics, which will be covered in this skills training are:
✓ Chemical and biological separations and isolations (distillation, extraction, chromatography)
✓ Acid and bases (measuring pH, using buffer solutions, titrations).
✓ Chemical and biological kinetics (enzymes, reaction order)
✓ Thermodynamic properties of compounds and reactions
✓ Introduction into microscopy and imaging of biological samples
✓ Biological preparation of microbe, plant and animal samples
✓ Methodology of identification of biological objects, finding diagnostic features and work with identification keys on biological taxons
✓ Basics of bioetics

Literature:
1. "Practical skills in Biomolecular sciences" by Reed R, Holmes D, Weyers J, Jones a. (Pearson, 4th edition 2012; ISBN10 1408245523; ISBN13 9781408245521).
2. https://extension.unl.edu/statewide/antelope/Identifying%20Landscape%20Plants.pdf
3. Conard, H. S. and Redfearn, P. L. 1979. How to Know the Mosses and Liverworts. Wm. C. Brown Co. Publ., Dubuque, Iowa, 302 pp.
4. Schofield, W. B. 1985. Introduction to Bryology. Macmillan Publishing Company, New York, 431 pp.
5. Volkmann-Kohlmeyer, B. and Kohlmeyer, J. 1996. How to prepare truly permanent microscope slides. Mycologist 10: 107-108.
6. Malcolm, B. and Malcolm, N. 2006. Mosses and Other Bryophytes: An Illustrated Glossary, 2nd ed. Micro-Optics Press, New Zealand, 336 pp.

Teaching methods:

This practical course is organized as a series of laboratory sessions. Students will be required to prepare short reports on the various laboratory activities performed.

Assessment methods:

Assignment, pre-lab quizzes, post-lab reports, scientific drawings assessment, questionnaire sheets, and a practical lab exam during exam week.

BIO 1003 Field Research Skills

ECTS: 6.0

Course coordinator:

Volkova I.I., Biological Institute, Tomsk State University
Contact: volkovhome@yandex.ru

Pre-requisites: None
Co-requisites: None

Course objectives:

At the end of this course the student will be able to apply the field methods of biology and ecology to its own research; will know main local plant and animal species; will be able to identify the species in the field conditions as well as in the laboratory; will be able to use the identifying keys and atlases.

Full course description:

The Field Research Skills is a practical course that includes at least 5 field excursions in the vicinities of Tomsk or to the field research and educational stations of TSU. The general aim of this skills course is to obtain detailed knowledge about the field biological and ecological techniques that can be applied to own research work of the student. The students will have the opportunity not only to visit local deciduous and coniferous forests, meadows, mires, lake and river banks to meet more then 500 local animal and plant species, but also to get to know the diagnostic features of separate species. Also the students will get main skills to survive and stay healthy in the local wild and semi-urban environments. Additionally, students will get the knowledge on local medical, edible, protected and invasive plants.

Literature:

1. Assessment and Management of Plant Invasions (Springer Series on Environmental Management) by James O. Luken and John W. Thieret
2. Edible Wild Plants: Eastern/Central North America (Peterson Field Guides) by Lee Allen Peterson and Roger Tory Peterson
3. Trees of North America: A Guide to Field Identification, Revised and Updated (Golden Field Guide from St. Martin's Press) by C. Frank Brockman and Rebecca Marrilees
4. Mosses, Liverworts, and Hornworts: A Field Guide to Common Bryophytes of the Northeast
5. by Ralph Pope Sphagnum Mosses The Stars of European Mires by Jukka Laine, Kjell Ivar Flatberg, Pirkko Harju, Tuuli Timonen, Kari Minkkinen, Anna Laine, Eeva-Stiina Tuittila, Harri Vasander

Teaching methods:

Work in subgroups, Research, Skills, Collecting the field materials and data, Basic laboratory processing of the collected field materials and data

Assessment methods:

Assignment, Brief research report

MAT 1006 System Analysis

ECTS: 5.0

Course coordinators:
F.P. Tarasenko, professor, Faculty of Mechanics and Mathematics, Tomsk State University
Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: diomedis@mail.ru

Pre-requisites: None
Co-requisites: None

Course objectives:
Upon completion of this course the student is able to
✓ formulate decision problems that arise from practice in a coherent and mathematically correct way
✓ formulate assumptions that ease the problem solving process, while maintaining practical validity, and to test those assumptions
✓ search literature and identify approaches, modelling constructs and solution procedures that may serve as a starting point for solving a problem from practice
✓ design new algorithms and/or heuristics, based on existing methods from literature that will be able to find solutions for practical problems
✓ write software code to implement proposed solution methods - present (intermediate) results both in writing and orally.

Full course description:
In this course students will learn to find solutions for unstructured problems from practice for which no solution methods are available from literature. During the course students will go through all stages of the design process. First creating a proper mathematical representation of the problem, followed by searching literature for solution approaches for related problems, identifying opportunities, designing solution approaches, implementing the approaches in software, benchmarking of performance, and reporting of results.
This course format will bring to light various methods from current Operations Research literature that have not been treated in other courses before. Students will learn the skills to identify promising avenues and instrumental usage of available scientific knowledge for solving problems at hand.

Literature:
The sources will be added

Teaching methods:
Lectures and tutorials (lectures, tutorials, student presentations)

Assessment methods:
Assignment(s), paper, presentation(s) (Individual and group assignments, presentations, paper).

SFT 1006 Physical Education and Sports

ECTS: 2.0

Course coordinator:
Solomina Ye., Tomsk State University
Contact: evgeniyasea27@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:
Fundamental motor skills and core values provide a strong foundation for the learning, Participation and enjoyment of a wide variety of physical activities and sports. The purpose of physical education is to enable students to demonstrate individually and with others, the physical skills, practices and values to enjoy a lifetime of active, healthy living.
✓ Acquire a range of motor skills to participate in a variety of physical activities
✓ Enjoy and value the benefits of living a physically active and healthy life

Full course description:
Physical education is about movement. Movement is fundamental and essential to life, work, and play. Movement competency facilitates participation and allows individuals to derive pleasure and satisfaction from physical activities. An individual who can move proficiently has the skills and knowledge related to movement and values purposeful moving for life. Physical education, therefore, is responsible for helping students take on the responsibility of learning by providing them with the capacity to make reasoned and wise choices through a lifelong process of change.
Successful participation in specific physical activities requires the acquisition and mastery of appropriate fundamental and specialised skills (e.g. overhead strike with a racket, backhand throw with a disc, in-step kick with a ball, front-crawl swimming stroke, a specific dance step). Therefore, the physical education programme develops in students:
✓ A range of skills through participation in regular and varied physical education experiences. These skills enable students to enjoy movement, discover interests and achieve personal goals related to participation in physical activity.
✓ Competency in movement. This provides the foundation for continual skill acquisition and facilitates future successful participation in physical activity resulting from changing life patterns.

Literature:
none

Teaching methods:
Physical activities classes

Assessment methods:
Attendance of all classes

SFT 1005 General History

ECTS: 5.0

Course coordinator:
Dmitry Konjkov, Faculty of Historical and Political Studies
Contact:

Pre-requisites: None
Co-requisites: None

Course objectives:
To understand the changing relationship between culture and society throughout history To understand core concepts in cultural studies To understand research methods used in cultural studies To engage in active discussion about all of the above To use academic language and adopt an intellectual 'attitude'

Full course description:
This course will discuss how the study of culture has a history in the field of the humanities and social sciences. We will explore how older historical methodologies are replaced by new approaches of research, with a focus on interdisciplinary scholarship, thus presenting a wide scope of new possibilities as well as new challenges. In the last decades the so-called "cultural turn" in the humanities has stimulated heated controversy among scholars about its methods and results. From the viewpoint of several disciplines, we will consider cultural history in both its "old" and "new" varieties, with special attention to the different academic traditions, European as well as American, and the impact of non-Western scholars on the study of culture as a global concept.

Literature:
The sources will be added

Teaching methods:
Teaching is provided through a combination of lectures and seminar classes and tutor supervisions. On average, you attend eight to 10 lectures/classes per module.

Assessment methods:
Your weekly supervisions, for which you typically write an essay, give you the opportunity to debate and develop your ideas with a senior historian and expert supervisor.

SFT 1004 Philosophy
ECTS: 5.0

Course coordinator:
Tomsk State University
Contact:

Pre-requisites: None
Co-requisites: None

Course objectives:
The course aims at giving the students an overview of the main theoretical approaches within the philosophy; and teaches them skills to apply these approaches to the study of a concrete scientific discipline:
To teach students to think critically about the social, political and ethical impacts of science on the contemporary world.
To introduce a number of key thinkers, approaches and themes in the philosophy.
To grasp the important contribution philosophy can make to understanding scientific developments.

Full course description:
During the four weeks of the course students will study the philosophy of science hand in hand with its application to a scientific case study: paleontology, or the study of fossils. Each week one tutorial will be devoted to the philosophical discussion of scientific issues and one tutorial to the implications of these discussions for how science is done in the context of fossil research.
Week 1. An introduction to the philosophy of science will be given that will also address the empirical study of objects, logical positivism, the problems of inductivism, and issues concerning the (un) certainty of scientific claims. Parallel to that, students will investigate (in small groups) what kind of information different scientific disciplines (biochemistry; radiology; biology) can generate with respect to certain objects (fossils). Visits will be made to the Natural History Museum.
Week 2. The idea of the theory-dependence of scientific observation and the philosophical concept of paradigms. Parallel to that, students will study the history of the (scientific) investigation of fossils, in order to investigate what role conflicting paradigms played in the past and present of fossil research.
Week 3. A broader view on the production of scientific knowledge will be offered, placing science in a social context. The philosophical discussion will look at the role of worldviews in science and the 'social turn' that characterizes many of the recent approaches in the philosophy of science. Parallel to that, students will read primary sources that reveal the religious, political and epistemological presuppositions that shaped some of the most important developments of fossil research in the 19th century. In the fourth week students will write a short essay that should synthesize the insights gained during the first three weeks

Literature:
The sources will be added

Teaching methods:
Lecture(s), PBL

Assessment methods: Preparation of reading material and active participation in group discussions. Participation in a debate that will take place in class. A final written exam on issues, literature and perspectives discussed in the course.

SFT 2004 Management in innovative industries

ECTS: 5.0

Course coordinators:

Elena Rozhdestvenskaya, PhD, Institute of Economics and Management, Tomsk state University
Contacts: elena.rojdestvenskaya@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:

After successful completion of this course, the students are able to:
✓ Demonstrate a clear understanding of process industries and its main characteristics.
✓ Recognize the fundamental issues of operations management in process industries.
✓ Analyze the performance of a typical process-oriented company.
✓ Address planning and scheduling problems faced in process industries.
✓ Acquire the ability to read, interpret, and analyze scientific papers specifically related to process industries.
✓ Design and conduct simple experiments on planning and scheduling in process industries using mathematical tools, and write research reports on the results obtained.

Full course description:

The course presents an introduction to operations management in process industries and provides the students with concepts and tools to analyze and improve operational capabilities of process oriented organizations. It includes lectures, guest lectures, individual and group assignments, and a day long plant visit which all together provide a considerable amount of experience on process industries. The content of the course is closely related to past and current research in the Department of Operations. The course gives an overview of the characteristics of process industries. It provides the knowledge and skills to adapt planning and scheduling to deal with industry-specific aspects such as sequence dependent setups, limited intermediate storage, perishability of materials, and tracking and tracing. It also places an emphasis on how seemingly general applicable concepts such as lean manufacturing can be made suitable for process industries. The course has a research oriented approach with a strong focus on scientific writing and appropriate use of the literature in individual and group assignments. It offers an excellent start for students that aim for a master project and/or career in the process industries.

Literature:

The sources will be added

Teaching methods:

Computer practicals, lectures and tutorials, self-study
(Lectures, Guest lectures, Computer practicals, Tutorials and an plant visit)

Assessment methods:

Assignment(s), written exam with open questions
(Individual Assignments, Group Assignments and Individual Exam with open questions).

SFT 2002 Industrial Technologies and Science

ECTS: 5.0

Course coordinator:
Solomina Y, Tomsk state University
Contact: evgeniyasea27@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:
Industrial technologies and science course helps students acquire basic knowledge and skills of various industrial fields and understand their significance and function in industry within society. It also helps students acquire creative abilities and practical behavior to develop society through solving various problems of industrial technology independently and rationally while considering our environment. Industrial technology education helps students acquire basics thoroughly.

Full course description:
Now, society and the economy are changing rapidly: change of industrial structure and working structure, the advance of science and technology, the information-oriented society, internationalization, and the aging society that is occurring along with the declining birth rate. Considering these social changes, the society of the future will require specialists who can think, judge, and act independently, and who can acquire professional knowledge and skills. Therefore, it is expected that the Industrial technologies and science helps students acquire basic technical knowledge and skills necessary to work as specialists in the future.

Literature:
All material, including lecture notes and computer project manuals will be posted

Teaching methods:
Lectures and PBL tutorials, self-study

Assessment methods:
Assignment(s), written exam with open questions

PRA 1005 Computer-Aided Design

ECTS: 2.0

Course coordinators:

Tomsk State University

Contact:

Course objectives:

1. Distinguish current approaches to computer-aided design.
2. Analyze approaches to design in specific fields of application.
3. Select the appropriate design approach as necessary.
4. Prove selection of design approaches.
5. Apply appropriate mathematical and scientific principles to engineering and technology applications.
6. Demonstrate proficiency in technical fundamentals to analyze and resolve technology problems.
7. Apply knowledge and skills to develop, interpret, and select appropriate technological processes.

Full course description:

Computer Aided Design (CAD) is a good example of technological innovation that has had a significant impact on the design and manufacturing industry and other fields. **Topics:** Introduction to programs for computer-aided design. Concept of design for manufacture and assembly. Review and comparison of available programs. Parametric modeling of parts and assemblies based on features. Modelling complex surface models. Use of libraries. Making a presentation views: shading and animation.

Literature:

1. Lee, K.: Principles of CAD/CAM/CAE Systems, Addison-Wesley, Reading, Massachusetts, 1999.
2. Shah J. J.; Mäntylä, M.: Parametric and Feature-Based CAD/CAM, Wiliey-Interscience Publication, New York, 1995.

Teaching methods:

Lectures will be interspersed throughout the laboratory sessions to introduce the concepts necessary for the computer projects, including technical drawing and the finite element method. Emphasis will be placed on the validation of FEM results with analytical theory. SolidWorks will be used for all computer laboratory sessions.

Assessment methods: Continuous evaluation, seminars and design of a task on a computer

SFT 2003 Creativity and Concept Development of New Business

ECTS: 5.0

Course coordinator:
Evgenia Kaz, PhD, Institute of Economics and Management, Tomsk State University
Contact: ***gk123a@mail.ru***

Pre-requisites: None
Co-requisites: None

Course objectives:
To be able to apply creativity techniques to problem solving. To understand how creativity can be used to transform technology into product concepts. To be able to draft value propositions and business models that result from product ideation.

Full course description:
A key role of corporate R&D-labs is to translate novel technology into new products and new business. Customer feedback may also trigger product and business development. Envisioning how novel technology can be used to develop and market new products is an inherently creative process that should not only be mastered by entrepreneurs and business developers, but also by scientists and technologists. This course is focused on developing your competence at two important tasks for the creation of new business: [1] discovering (technological) opportunities, [2] developing product concepts, value propositions and business models. During this course we will touch upon important aspects of creative problem solving. But, most of all, we will provide you with insights that will help you to develop your own creative skills. The starting point of the course is our belief that creativity is a skill that can be learned and trained. We will follow different paths to help you investigate your own creativity skills and to find the best way to improve them.

Literature:
The sources will be added

Teaching methods:
Lecture(s), Working visit(s), PBL, Skills

Assessment methods:
Final paper, Written exam.

SFT 2001 Science and Sustainable Development

ECTS: 5.0

Course coordinator:
Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: diomedis@mail.ru

Pre-requisites: None
Co-requisites: None

Course objectives:
To gain a basic understanding of the concept of sustainable development from an interdisciplinary and integrative perspective, and of the possible contribution of science to sustainable development. To explore two of the most pressing (and interrelated) sustainability issues: climate change and (material) resource use. To apply this knowledge in a 'sustainability assessment' case study.

Full course description:
Achieving sustainable development is one of the greatest challenges of the 21st century. Sustainability issues, such as climate change or resource scarcity, typically refuse to sit neatly within traditional academic disciplines. This common factor makes these challenges difficult to grapple with, whether as researcher, businesses, or governments, and therefore for societies as a whole. This course introduces students to the concept of sustainable development, focusing in particular on the relation with the natural sciences. The first part of the course aims at developing the students' understanding of the main concepts underlying the complex issue of sustainable development. Departing from an interdisciplinary and integrative perspective, they will explore topics including the Tragedy of the Commons and biogeochemical cycles. In this context, we will focus on two of the most pressing (and interrelated) sustainability issues: climate change and (material) resource use. Key terms discussed are, for example: climate system (feedbacks), enhanced greenhouse effect, carbon footprint, and life cycle assessment. Subsequently, students will work on a case study. The case deals with the sustainability of electric cars can how they may become a successful technological innovation for a sustainable society.

Literature:
The sources will be added

Teaching methods:
Lecture(s) PBL

Assessment methods:
Final paper, Written exam.

INT 2006 Ecology
ECTS: 5.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University
Contact: volkovhome@yandex.ru

Pre-requisites: None
Co-requisites: None

Course objectives:
To understand what ecology as a discipline encompasses and its relevance for humanity. To understand the different levels of organization that ecology is studied at from the level of the organism up to the level of the entire planet, and how studies at these different levels interact. To understand concepts, theories, and evidence about the ecological processes that determine the distribution and abundance of organisms. To understand the impact that humans exert on natural processes and the ecological consequences of anthropogenic activity.

Full course description:
Ecology is the study of the interactions of organisms with each other and with the abiotic environment. It covers many levels, including individuals, populations, communities and ecosystems. In this course we will examine the ecological patterns and processes that operate at these various levels and how they interact. Particular focus will be placed on the role that humankind plays in ecology today and on how factors such as deforestation, eutrophication and invasive species have affected natural systems.

Literature:
1. Odum, E. (2008) Ecology. Oxford and IBH Publisher.
2. “Ecology: The Economy of Nature” Seventh Edition by Robert Ricklefs, Rick Relyea
3. Chapin FS, Matson PA, Mooney HA (2002). Principles of Terrestrial Ecosystem Ecology. New York: Springer. pp. 97–104. ISBN 978-0-387-95443-1

Teaching methods:
Lecture(s), PBL, Skills

Assessment methods:
Final paper, Written exam.

VARIABLE COURSES IN ACCORDANCE TO TRACK

INT 1004 Introduction to Biomedical Engineering

ECTS: 5.0

Course coordinator:

Pleshkov M.O., Physics Faculty, Tomsk State University
Contact: pankerams@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:

To provide an overview of the different fields of biomedical engineering.

Full course description:

Biomedical engineering is a highly interdisciplinary field at the interface between engineering and medicine and biology. In biomedical engineering, principles and methodologies typical of engineering are applied to solve problems from the medical and biological sciences. This course will introduce (some of) the subdisciplines within biomedical engineering, including systems physiology, bio-instrumentation, bio-medical signal analysis and bio-medical imaging. General issues of each of the subdisciplines will be illustrated together with selected examples and neuroscience applications

Literature:

The sources will be added

Teaching methods:

Lecture, lab visits and tutorial meeting

Assessment methods:

Participation during tutorials, midterm exam and final written exam.

MAT 2001 Statistics

ECTS: 5.0

Course coordinator:
Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: ***diomedis@mail.ru***

Pre-requisites: None
Co-requisites: None

Course objectives:
To have deep understanding of fundamental concepts in probability and statistics, including how these concepts are derived, why they are useful, what assumptions you have to pose when applying them, etc. To be familiar with the most frequently used probability distributions/densities and statistical procedures (statistical estimation and hypothesis tests), here again with focus on the deep understanding as opposed to approaching these concepts as a "black box" or a "recipe". To develop a critical thinking when deciding whether certain statistical procedure is the most suitable for a certain problem, as opposed to blindly applying a pre-specified procedure. To be able to read and summarize scientific articles in applied probability/statistics.

Full course description:
Many real-life situations involve uncertainty and give rise to problems in the fields of probability theory or statistics. In this course, the focus will be on the deep understanding of tools which are necessary to analyse such situations. Firstly, we will address (or refresh) basics of probability theory and the underlying combinatorial principles, because it is impossible to properly understand statistical concepts without understanding probability and its mathematical foundations. Subsequently, we will focus on (both discrete and continuous) random variables, concepts of expectation, mean, variance and independence, proceeding to probability distributions (e.g. discrete uniform, binomial, multinomial, hypergeometric, geometric, Poisson, continuous uniform, normal, gamma, exponential). Here we will learn for what problems these distributions are useful and under which assumptions they can/should be applied, stressing also common misconceptions when trying to apply certain concept blindly (which unfortunately happens very often among applied scientists). We will extend our scope to multi- dimensional random variables and joint, conditional, and marginal probability distributions. We will also discuss random sampling, sample distributions of means and variances, and the central limit theorem, again focusing on common misconceptions related to these topics. We will address also statistical estimation (point estimation and interval estimation; confidence intervals). Finally, we will discuss various hypothesis tests (and related errors) and goodness-of-fit tests. In their presentations, students will focus on selected statistical topics and how these can be applied in practice, using scientific articles in applied probability/statistics as their study source.

Literature:
The sources will be added

Teaching methods:
Lecture(s), PBL

Assessment methods:
Written exam, Assignment, Presentation

INT 3002 Biobased Materials and Technology

ECTS: 5.0

Course coordinators:
Visakh P. M., Institute of Smart Materials and Technologies, Tomsk State University
Voronova G., Institute of Smart Materials and Technologies, Tomsk State University
Contacts: ***visaqam143@gmail.com***, gulnara.voronova@gmail.com

Pre-requisites: CHE2001 Organic chemistry (strongly recommended)
Co-requisites: None

Course objectives:
To understand what Biobased Materials are and what their impact is on society
To create an understanding of sources of Biobased intermediates, building blocks and materials
Get an insight in the synthesis and production methods of intermediates, building blocks and Biobased Materials
To deepen understanding of the relation between material composition, properties and material applications
To study the added value (if any) of Biobased Materials
To study the impact of Biobased materials and technologies on the environment (biodegradation, sustainability, CO2 footprint)

Full course description:
Presently, a transition from petrol-based to a more sustainable and biobased society is taking place. This change is driven by the predicted depletion of oil-reserves. This creates an opportunity to not only replace currently made plastics and polymers with sustainable Biobased alternatives, but also to produce new materials with additional useful functionalities derived from biological renewable sources. This requires a multidisciplinary approach in which production of biological resources, its processing and possible modification are first steps. New technologies may be required to indeed obtain the right methods and synthesis routes to produce the new Biobased materials for applications in healthcare, consumer products and other applications. In this course the different aspects of the field of Biobased Materials will be studied. The aim is to create a critical, but also creative attitude towards Biobased materials and technologies in general. The students should be able to recognize the challenges and possibilities with respect to materials in the transition towards a Biobased economy and society.

Literature:
The sources will be added

Teaching methods:
Lectures, guest lectures and tutorial group meetings

Assessment methods:
A written exam. Presentation + discussion session on a particular Biobased material/technology; (at least 45-60 minutes) Peer assessment of assigned presentation.

MAT 1005 Mathematics for the Natural Sciences

ECTS: 5.0

Course coordinator:
Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: diomedis@mail.ru

Pre-requisites: None
Co-requisites: None

Course objectives:
To provide an introduction to the main topics of calculus. To provide students with the necessary knowledge and skills to successfully study other advanced science courses. To introduce complex numbers, functions, differentiation and integration – for functions of a single variable and for functions of several variables. To demonstrate methods for solving linear differential equations. To enable students to develop the insight to solve certain problems in science and engineering through functions, (differential) equations and other techniques of calculus (such as integration, differentiation and optimization).

Full course description:
Mathematics is inextricably linked to the understanding of science and this course is designed to cover the mathematical concepts that will prove fundamental tools for the natural science courses you will encounter at TISP. As new students to the TISP come from a diverse range of backgrounds, your knowledge of mathematics will vary considerably. As such, each of you will find that some of the material from this course acts as revision whereas some topics are completely new – please bare in mind that it's what you know at the end of the course that counts! It is important to note that maths is only useful if it can be implemented, and this skill is acquired by attempting to solve problems and perform calculations; this is the main aim of the weekly tutorials. The course will address complex numbers, differentiation, differential equations, integration, functions of two variables and multiple integrals. This course is part of the academic core in the natural sciences.

Literature:
The sources will be added

Teaching methods:
Lecture(s), Skills, Assignment(s)

Assessment methods:
Written exam, Assignment

INT 2003 Human Anatomy and Physiology

ECTS: 5.0

Course coordinator: ***Zhukova I.A., SibSMU,***
Contact: ***irzhukova@inbox.ru***

Pre-requisites: None
Co-requisites: None

Course objectives:
The course is aimed to study membrane physiology, electrophysiology, cardiac vascular physiology, hormonal and neuronal control, fluid and salt balance, gastrointestinal physiology.

Full course description:
While Mathematics is seen as the father of science, Physiology is the mother. Physiology attempts to explain the physical and chemical factors that are responsible for the origin, development, and progression of life. Human physiology investigates the mechanisms of the human body making it a living being (Guyton). In the healthy human body it is of the utmost importance that the working conditions for all cells are kept "constant". In this respect it is worthy to note that essentially all organs and cells of the human body perform functions that help to maintain this constant nature or homeostasis. We will begin by discussing the physiology of the cell, and the function of the membrane in it. Furthermore, we will discuss renal, respiratory, and cardiovascular physiology, followed by endocrinology and gastrointestinal physiology, control and feedback.

Literature:
Anatomy & Physiology (https://cnx.org/contents/FPtK1zmh@12.16:zMTtFGyH@7/Introduction.)

Teaching methods:
Lecture(s), PBL

Assessment methods:
Final paper, Written exam

CHE 2002 Inorganic Chemistry

ECTS: 5.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: visagam143@gmail.com, gulnara.voronova@gmail.com

Pre-requisites: None
Co-requisites: PRA2003 Inorganic Synthesis

Course objectives:
✓ To introduce the student to the general principles of inorganic chemistry
✓ To provide an understanding of the basic bonding relationships amongst atoms in inorganic compounds
✓ To introduce the student to d-block chemistry
✓ To provide a descriptive survey of non-carbon elements and their properties
✓ To provide the basis for the further studies of inorganic chemistry

Full course description:
This survey course will introduce the students to the world of chemistry beyond carbon. As an introductory course it will focus on the principles of bonding and interaction between atoms, both of the main group and the d-block elements. Topics covered include but are not limited to molecular orbital theory, main group elements, acids and bases, coordination chemistry, and the solid state. An introduction to group theory and organometallic chemistry is also included.

Literature:
1. Chemical Reactions, Denise Walker - 2007
2. Chemical Reactions, Materials and Particles, Gill Murphy 2006
3. Kinetics of Chemical Reactions. Guy B. Marin, Gregory S. Yablonsky, Denis Constales, 2019
4. Chemical Reactions. Eve Hartman, Wendy Meshbesher - 2016

Teaching methods:
Lecture(s), seminars, labs

Assessment methods:
Written exam, Participation, Presentation, pre-lab quizzes, post-lab reports.

BIO 2002 General Botany

ECTS: 5.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University
Contact: volkovhome@yandex.ru

Pre-requisites: None
Co-requisites: PRA2008 Exploring the World of Plants

Course objectives:
During this course you will gain insight in the importance of plants for life on earth and the unique adaptations that plants have. The course will illustrate all major aspects of plant form and function (from the cellular level to the level of the organism), and plant development.

Full course description:
Plants are a vital part of anyone's life. However, many people suffer from plant blindness: the inability to notice the plants in one's own environment. This blindness can lead to the inability to recognize the importance of plants in the biosphere, and in human affairs. However, it also leads to a lower appreciation of the aesthetic and unique biological features of the life forms belonging to the Plant Kingdom. Finally, the blindness contributes to the misguided and anthropocentric ranking of plants as inferior to animals. This course is designed to show the general importance of plants and illustrate their unique adaptations. Topics that will be covered fall into two main categories: plant structure, and plant physiology and development. Topics of plant structure include: growth and division of cells, primary growth of stems (the herbaceous plant), leaves, roots, secondary growth (the woody plant), and flowers and reproduction. Plant physiology and development will include plants and energy (e.g. photosynthesis, respiration), nutrition and transport in plants (soils, mineral uptake and water flows), and plant growth and development.
Also course covers the diversity, taxonomy, and evolutionary trends observed among the cyanobacteria, algae, fungi, and plants, with special emphasis on higher plants; the comparative anatomy and physiology of higher plants; and general ecology, including population, community, and ecosystem dynamics.

Literature:
1. "Raven Biology of Plants" by Ray F. Evert and Susan E. Eichhorn
2. "Textbook of Botany" by E. Strasburger
3. "General Botany" online lectures by Dana Krempels
http://www.bio.miami.edu/dana/226/226F09.html
4. "Advances in Photosynthesis" by Mohammad Najafpour
5. https://www.intechopen.com/books/advances-in-photosynthesis-fundamental-aspects

Teaching methods:
Lecture(s), Assignment(s), PBL

Assessment methods:
Assignment, Written exam

PHY 2001 Classical Mechanics

ECTS: 5.0

Course coordinator:
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contact: dmitriy.bezrodnyy@gmail.com

Pre-requisites: None
Co-requisites: PRA2005. Physics laboratory

Course objectives:
The course is aimed to acquaint the student with the basics of Classical Mechanics; to acquire general understanding of theoretical and practical methods in Classical Mechanics; to serve as sufficient basis for future education, to be able to apply this knowledge to concrete practical problems; to be able to read texts that build on the subjects of this course.

Full course description:
Classical mechanics forms the central part of all physical science and engineering. It accurately describes the dynamical effects of forces under all conditions. It can be divided into statics: the study of equilibrium, and dynamics: the study of motion caused by forces. Though classical mechanics fails on the scale of atoms and molecules, it remains the framework for much of modern science and technology. This is an intensive course that comprehensively trains the students to the basic, classical, and essential fundamentals of classical mechanics. The course aims at an understanding of the fundamental principles of Classical Mechanics and how to apply them in specific situations. Here we address the major parts of Classical Mechanics: statics and kinematics, Newton's laws, work and energy, momentum and collisions, rotational dynamics, and gravitation. Each of these subjects is taught on a theoretical level as lecture, and trained on a practical level with exercises and practical training sessions.

Literature:
Classical mechanics, an undergraduate text, R. Douglas Gregory, Cambridge University Press 2006, isbn-13 978-0-521-82678-5

Teaching methods:
Lecture(s), PBL, Assignment(s)

Assessment methods:
Written exam, Assignment

PRA 2008 Exploring the World of Plants

ECTS: 2.0

***Course coordinator*:**
Volkova I.I., Biological Institute, Tomsk State University
Contact: ***volkovhome@yandex.ru***

Pre-requisites: None
Co-requisites: BIO2002. General Botany

Course objectives:
Gaining knowledge about plant taxonomy, classification of plants, and how to identify plant families, genera, and species, as in the lab so in the field. Also students will become familiar with native plants of West Siberia as well as their ecological relationships, historical uses and conservation status.

Full course description:
The course familiarizes students with recent advances in botany, while maintaining a strong emphasis on the basic facts and principles necessary for a sound foundation in the plant sciences. This practice complements General Botany theoretical course.
A plant collection and a minimum of 10 field trips/foot routes are required. Field trip locations may include Tomsk vicinities, Kireevsk field biological educational station of TSU and other locations where plants can be observed in their natural surroundings.

Literature:
Laboratory Topics in Botany" Eighth Edition by Ray F. Evert , Susan E. Eichhorn and Joy Perry

Teaching methods:
Research, Skills, PBL, Laboratory works, Sketch drawings

Assessment methods:
Assignment, Quizzes

PRA 1005 Human Anatomy and Physiology

ECTS: 2.0

Course coordinators:
Volkova I.I., Biological Institute, Tomsk State University
Solomina Y. Tomsk State University
Contacts: volkovhome@yandex.ru

Pre-requisites: None
Co-requisites: INT 2003 Human Anatomy and Physiology

Course objectives:
The course is aimed to study membrane and electrophysiology, cardiovascular function, hormonal and neuronal control of blood pressure, organ function in energy balance and volume control, integrative physiology of the circulatory system

Full course description:
Anatomy describes the form of (all subunits of) a living being. Physiology comprehends the physical and chemical processes that are responsible for the origin, development, and progression of life (Arthur Guyton). As form and function are closely interrelated, we will study anatomy and physiology in this course hand in hand. We will start with the smallest living subunit of the human body – the cell – and will subsequently learn about the different organ systems. Finally, we will integrate all information to the level of the complete human body. As the circulation is the central part of the human body by maintaining the condition for all cells constant ("homeostasis"), and as this course is too short to discuss all items of anatomy and physiology in detail, we will especially focus on the cardiovascular system. Also, cardiovascular physiology is an important basis for understanding cardiovascular disease, one of the two most common causes of death in the Western society. This further enhances the importance of understanding the cardiovascular system. This course will provide a solid fundament for those who pursue an academic career in Life Sciences, Biometrics, Biomaterials, Biochemistry, or even Medicine.

Literature:
Anatomy & Physiology (https://cnx.org/contents/FPtK1zmh@12.16:zMTtFGyH@7/Introduction.)

Teaching methods:
Laboratory works, Sketch drawings

Assessment methods:
Professional Conduct, Collaboration, Paper, Written Test

PRA 2003 Inorganic Synthesis

ECTS: 2.0

Course coordinators:

Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: ***visagam143@gmail.com***, gulnara.voronova@gmail.com

Pre-requisites: None
Co-requisites: CHE2002 Inorganic Chemistry

Course objectives:

The course is aimed to implement principles seen in class in a laboratory setting; to learn the basic synthetic techniques in inorganic chemistry; to synthesize and study a range of inorganic compounds

Full course description:

This skills will focus in the synthesis and analysis of inorganic compounds, focusing primarily on coordination compounds and their spectroscopy.

Literature:

The sources will be added

Teaching methods:

Skills, PBL

Assessment methods:

Assignment, Written exam.

PRA 1006 Physics Laboratory: Classical Mechanics

ECTS: 2.0

Course coordinators:
Pleshkov M.O., Physics Faculty, Tomsk State University
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contacts: pankerams@gmail.com, dmitriy.bezrodnyy@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:
This practical is aimed at obtaining a deeper understanding of physics by performing various key experiments in the areas of Classical Mechanics. Examples are angular momentum, pendulum motion, ballistic motion. The focus will be on the design and execution of the experiments and their relation to the fundamental laws and principles of physics. Another objective is the further training of physical laboratory techniques and procedures. Furthermore, attention will be paid on data analysis and reporting. This lab relates to level 200 physics courses such as Classical Mechanics.

Full course description:
This skill will contain: Design, use and measurement in physical experimentation; Gathering data using automated processes; Data manipulation and analysis using modern tools such as MATLAB or python; Experiments in mechanics (Gyroscope dynamics, Driven Damped Harmonic Oscillator and some others).

Literature:
There is no book directly associated to this course. Information on the individual experiments is provided in this syllabus and in separate detailed experiment descriptions. Additionally, this course relates to the course in Physics: Classical Mechanics.

Teaching methods:
In this skill participants work together in a small team and each of the six weeks perform a different physical experiment. Each experiment is thoroughly planned, executed, and analysed by the team, and each week a report is submitted. The final grade is based on these reports.
Participants are expected to more independent that in the PRA1003 Basic Physics Lab, but staff are available for support.

Assessment methods:
Evaluation of student performance will be based on lab reports, peer review, fill-in sheets and the quality of their logbook.

BIO 2003 General Zoology

ECTS: 5.0

Course coordinators:
Volkova I.I., Biological Institute, Tomsk State University
Solomina Ye., Tomsk State University
Contacts: volkovhome@yandex.ru, evgeniyasea27@gmail.com

Pre-requisites: None
Co-requisites: PRA2009. Practical Zoology

Course objectives:
The course is aimed to characterise the defining biological features of the animal kingdom; to provide an overview of the characteristics of the major animal groups, to explain the systematics and phylogenetics of major groups within the animal kingdom; to place the morphological, anatomical and behavioural aspects of animal groups in an evolutionary context; to examine in more detail particular biological adaptations using specific animal groups as examples.

Full course description:
Animals are everywhere, on land, in water and in the air. They comprise an extremely diverse kingdom, with all species being a mixture of shared and unique biological characteristics. These characteristics are a product of evolutionary history and adaptation to particular features of the abiotic and biotic environment. In this course you will focus on the major groups within the animal kingdom, what defines them, how they are organized and how they are related to each other; you will also examine the specific adaptations of certain animals in more depth. The question "What is an animal?" will be considered as will the issue of how animals are grouped and related to each other. This will be done in the context of the major phyla, their defining morphological, anatomical and physiological features and the sorts of adaptations and behaviours that they exhibit. You will also examine certain adaptations such as bright colouration, feeding or parental care in greater depth, using particular animal groups as a source of examples.

Literature:
“General Zoology: Investigating the Animal World” by Dennis Holley

Teaching methods:
Lecture(s), Assignment(s), PBL

Assessment methods:
Participation, Final paper, Written exam

INT 2007 Cognitive Neurosciences: Biological Foundations of Behaviour

ECTS: 5.0

Course coordinator: ***Zhukova I.A., SibSMU,***
Contact: ***irzhukova@inbox.ru***

Pre-requisites: MAT2001. Statistics, INT 2004; INT2003.Human Anatomy and Physiology
Co-requisites: PRA2011. Cognitive Neurosciences: Biological Foundations of Behaviour

Course objectives:

✓ Students will have a basic understanding of biological foundations of behaviour, such as sleep/wake behaviour, language, memory, eating and drinking, and emotion.
✓ Comprehension of chemical control (neurotransmission and hormones) by the brain and dysfunctional control (e.g. addiction or anxiety disorders)
✓ A basic understanding of how to study the biological foundations of behaviour

Full course description:

Why do some people develop into a male and some into a female? Why we are hungry in the morning? Why do people become addicted to drugs? Is our brain active during sleep? How do mood disorders originate? These and other questions will be addressed in this course. The most important part of our body to explain behaviour is our brain. This course will provide basic knowledge of neuroanatomy (how certain parts of the brain are connected) and neurophysiology (how neurons operate to communicate) in order to understand several themes of behaviour (e.g. eating, addiction, sleep) and disorders.

Literature

Required:
1. Neuroscience: Exploring the Brain – Bear, 4th edition.

Recommended:
1. Biological psychology – Breedlove, 2013
2. Biopsychology 10th ed – Pinel, 2018
3. Physiology of Behavior – Carlson, 2013

Teaching methods:

The course is made up out of a combination of Lectures and PBL tutorial groups.

Assessment methods:

To do justice to the objectives of this course, students will be assessed in two different manners. Students will take part in an exam (80%), and a practical assignment (20%).

CHE 2001 Organic Chemistry

ECTS: 5.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: visagam143@gmail.com, gulnara.voronova@gmail.com

Pre-requisites: CHE2002. Inorganic chemistry; PRA2003. Inorganic Synthesis
Co-requisites: PRA2001.Chemical Synthesis

Course objectives:
The course is aimed to give the ability to recognize and name common organic compounds; to know the basic physical and chemical properties of common organic compounds; to understand stereochemistry and its impact on the properties and applications of organic molecules; to enable you to understand the most important organic reactions and be able to apply these reactions to obtain well defined organic compounds.

Full course description:
This course focuses on the basis of organic chemistry. In the first part of the course, important fundamental topics, such as nomenclature, atomic theory, bonding theory, hybridization, molecular orbital theory and resonance will be discussed. A special topic will be stereochemistry, which is an essential topic in organic chemistry and the life sciences, since stereochemistry often determines the activity of biological compounds or medicines. Subsequently, the course continues with an introduction into reactivity of organic molecules. Focus, will be on a selection of fundamental organic reactions, which form the basis for a wide array of other organic reactions. To this end, a logical review will be provided of the reactivity of the most important functional groups, as applied in organic synthesis.

Literature:
The sources will be added

Teaching methods:
Lecture(s), labs, seminars

Assessment methods:
Pre-lab quizzes, post-lab reports, scientific drawings, questionnaire sheets, Written exam.

MAT 1003 Linear Algebra

ECTS: 5.0

Course coordinator:

Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: diomedis@mail.ru

Pre-requisites None
Co-requisites None

Course objectives:

In this course we provide an introduction to the main topics of linear algebra. Emphasis is on an understanding of the basic concepts and techniques, and on developing the practical, computational skills to solve problems from a wide range of application areas.

Full course description:

Linear algebra is the branch of mathematics which is primarily concerned with problems involving linearity of one form or another. This is reflected by the three central themes of this introductory course. The first theme is concerned with what can be recognized without doubt as the most frequently occurring mathematical problem in practical applications: how to solve a system of linear equations. For this problem a complete algebraic solution procedure is developed which provides the student with a way to deal with such problems systematically, regardless of the number of equations or the number of unknowns. The second theme addresses linear functions and mappings, which can be studied naturally from a geometric point of view. This involves geometric 'objects' such as points, lines and planes, and geometric 'actions' such as rotation, reflection, projection and translation. One of the main tools of linear algebra is offered by matrices and vectors, for which a basic theory of matrix-vector computation is developed. This allows one to bring these two themes together in a common framework, in what turns out to be an exceptionally fruitful way. By introducing the notions of vector spaces, inner products and orthogonality, a deeper understanding of the scope of these techniques is developed, opening up a large array of rather diverse application areas. The third theme surfaces when the point of view is shifted once more, now from the geometric point of view to the dynamic perspective, where the focus is on the effects of iteration (i.e., the repeated application of a linear mapping). This involves a basic theory of eigenvalues and eigenvectors, which have many applications in various branches of science as will be discussed. For instance, important applications in problems involving dynamics and stability, and applications to optimization problems found in operations research. Many examples and exercises shall be provided to clarify the issues and to develop practical computational skills. They also serve to demonstrate practical applications where the results of this course can be successfully employed.

Literature:

The sources will be added

Teaching methods:

Lecture(s), PBL

Assessment methods:

Attendance, Assignment, Written exam

PRA2009 Practical Zoology
ECTS: 2.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University
Solomina Ye., Tomsk State University
Contact: volkovhome@yandex.ru, evgeniyasea27@gmail.com

Pre-requisites: None
***Co-requisites*:** BIO 2003. General Zoology

Course objectives:
The skills will include: Carrying out experiments on physiology, behaviour, biodiversity and other aspects of zoology. Analysing zoological data Writing up zoology experiments Knowledge of conservation of zoological samples

Full course description:
The skill aims to provide a greater insight into the different aspects of zoology and how they are studied in the laboratory. You will learn different experimental approaches used in zoology in including physiological testing, behavioural analysis and measures of animals diversity. This course aims to provide you with better skills in handling both live and dead animal samples and in interpreting what you see in a biologically relevant way. Please note that in this course you are required to carry out experimental work with live (invertebrate) animals, which may harm them.

Literature:
The sources will be added

Teaching methods:
Skills, Work in subgroups

Assessment methods:
Assignment.

PRA 2011 Cognitive Neuroscience: Biological Foundation of Behavior

ECTS: 2.0

Course coordinator:
Zhukova I.A., SibSMU,
Contact: irzhukova@inbox.ru

Pre-requisites: None
Co-requisites: None

Course objectives:
The objective of this course is to gain knowledge of and insight into the biological basis of perception, cognition, emotion and behaviour. Bio-psychological mechanisms will be discussed. 'The more you know about the brain from a neuroscience point of view, as well as a psychology point of view, the more you can do to remove blockers.'

Full course description:

Literature E
Required:
2. Neuroscience: Exploring the Brain – Bear, 4th edition.
Recommended:
4. Biological psychology – Breedlove, 2013
5. Biopsychology 10th ed – Pinel, 2018
6. Physiology of Behavior – Carlson, 2013

Teaching methods:
The course is made up out of a combination of Lectures and PBL tutorial groups.

Assessment methods:
Practical assignments, collaboration.

PRA2001 Chemical Synthesis

ECTS: 5.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: visagam143@gmail.com, gulnara.voronova@gmail.com

Pre-requisites: None
Co-requisites: CHE2001. Organic Chemistry

Course objectives:
The course is aimed at ability to perform organic synthetic experiments in a structured and safe manner; understanding specific separation and purification techniques commonly used in organic chemistry; gaining a practical understanding of the impact of the choice of reagents, solvents and conditions on the outcome of an organic reaction; gaining further skills in scientific research reporting.

Full course description:
This skills focuses on the development of a clear understanding of the synthesis of organic chemical compounds. It is important for the students to learn how to convert their theoretical knowledge on chemical reactivity to actual design and execution of synthetic chemical reactions. Typical topics, which will be covered in this skills training are: Safe handling of organic reagents and safe execution of organic experiments. Commonly used organic synthetic laboratory techniques. Synthetic chemistry of various organic reaction types (e.g. nucleophilic substitutions and eliminations, electrophilic reactions and radical chemistry). Stereochemistry in organic synthesis. Purifications and separations in chemistry. Spectroscopy and characterization of organic compounds.

Literature:
The sources will be added

Teaching methods:
Assignment(s), Work in subgroups, PBL, Paper(s), Skills

Assessment methods:
Observation, Participation, Assignment

PRA 3010 Topics in Scientific Computing

ECTS: 5.0

Course coordinators:
Pleshkov M.O., Physics Faculty, Tomsk State University
Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contacts: pankerams@gmail.com, diomedis@mail.ru

Pre-requisites: MAT1003 Linear Algebra. Part 1; MAT1004 Programming. Part 1
Co-requisites: None

Course objectives:
The course is aimed to acquaint the student with the basis of experimental physics; to acquire understanding of practical methods in experimental physics; being able to solve technical problems in a physical experiment; to be able to relate the experiment to the relevant physical theory; to be able to process empirical data in relation to the theoretical physical predictions using the adequate statistical and graphical tools; to be able to properly describe the experimental methods and results in technical reports.

Full course description:
Scientific computing concerns the use of computers to analyze and solve problems arising in biology, chemistry and physics. This generally involves the construction of a mathematical model of the scientific problem, and solving the mathematical problem using computational algorithms. The purpose may be to improve the understanding of natural phenomena or to make predictions of behaviour under different conditions. A broad range of scientific problems can be tackled computationally, including simulation methods (for dynamic systems); transform methods (for processing data and images) and optimisation methods (for learning models from data and improving technological processes). This course will focus on well-established algorithms which will each be applied to a realistic scientific case study. The methods are frequency- domain Fourier/wavelet analysis (for signal processing and quantum physics), principle component analysis and clustering algorithms (for classification of images), integrators for ordinary differential equations (for simulation and control of spaceships), finite-difference solvers for partial differential equations (for investigating pattern formation), and combinatorial optimisation (for phylogenetic reconstruction). The course will be entirely based on the use of Matlab, a high-level scientific programming language and interactive environment for numerical computation, visualization, and programming.

Literature:
Laboratory manual

Teaching methods:
Assignment(s), Lecture(s), Skills, PBL

Assessment methods:
Final paper, Participation

CHE2003 Physical Chemistry

ECTS: 5.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: visagam143@gmail.com, gulnara.voronova@gmail.com

Pre-requisites: None
Co-requisites: PRA2006. Physical Chemistry

Course objectives:
✓ To provide a molecular and mathematical understanding of basic concepts in physical chemistry on a more advanced level.
✓ To explain and describe the behaviour of systems when temperature and pressure is changed.
✓ To apply the general principles of thermodynamics in understanding and description of chemical and environmental processes like bookkeeping heat by means of enthalpy when solutions mix.
✓ To demonstrate how molecules interact in terms of electrostatics, from reacting to an existing field to inducing one.
✓ To present how these interactions apply in known (bio)systems and can predict physical properties of molecules.

Full course description:
This course focuses on advanced aspects in physical chemistry and how it contributes in solving problems encountered in biology, (bio)chemistry and the environment. Thermodynamics and electrostatics are two of the most important tools that can predict the behaviour of molecules, which can then lead to a broad spectrum of topics related to the life and environmental sciences, including (i) (bio)energetics, (ii) phase transitions, (iii) ion and electron transport, (iv) chemical reaction, (v) (bio)macromolecules and self-assembly, and (vi)physical properties. PBL tasks are embedded to create an understanding how to apply general principles of physical chemistry to biological, (bio)chemical and environmental problems. Development of plausible models for physical or chemical mechanisms, incl. numerical analytical methods to solve the models and testing against observations/experimental evidence, are essential throughout the course.

Literature:
Physical Chemistry. Third Edition. Gilbert W. Castellan. University of Maryland. Addison-Wesley, 2008, 1038 p.

Teaching methods:
Lecture(s), seminars, labs

Assessment methods:
Written exam, Participation, Presentation, pre-lab quizzes, post-lab reports

BIO 2001 Cell Biology
ECTS: 5.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University
Solomina Ye., Tomsk State University
Contact: volkovhome@yandex.ru, evgeniyasea27@gmail.com

Pre-requisites: None
Co-requisites: Biochemistry

Course objectives:
✓Understanding of the structure of prokaryote (bacteria) and eukaryote cells (animal, plant, fungal).
✓ To comprehend the structure/function relationship of the plasma membrane.
✓ To understand the functions of cell organelles and sub-cellular structures.
✓ To deepen the knowledge about transport of material in- and out of the cell.
✓ To understand communication between the cell interior and exterior of the cell (cell signalling). To understand the principles of transport between the different cell organelles and how molecules and proteins are reliably transported to the different organelles.
✓ To create understanding of cell motility and how the cell controls its shape (cytoskeleton).

Full course description:
This course aims to develop a detailed understanding of the cell as the basic unit of life. The cell can be seen as an organism that can perform a wide range of functions. In eukaryotes, these functions are linked to the different compartments/organelles in the cell: nucleus, mitochondria, chloroplasts, endoplasmatic reticulum, lysosomes, endosomes, etc. There is a continuous transport between the different organelles (intracellular vesicular transport) and between the cell interior and the extracellular environment (endocytosis & exocytosis). All these cellular transport mechanisms will be studied in detail. Additionally, the cell contains intracellular structures that regulate shape, strength, and motility, i.e. the cytoskeleton. The cytoskeleton is a highly dynamic structure and the different components of the cytoskeleton (microtubules, F-actin, intermediate filaments) and their assembly and disassembly will be explained. Finally the basic principles of signal transduction will be studied, i.e. how does the cell react to signals from the environment, how are these signals detected and how are these processed into a primary cellular response?

Literature: Essential Cell Biology" by Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter

Teaching methods:
Lecture(s), PBL, Presentation(s), Assignment(s)

Assessment methods:
Assignment, Written exam, Presentation

PHY 2002 Thermodynamics and Statistical Physics

ECTS: 5.0

Course coordinator:
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contact: ***dmitriy.bezrodnyy@gmail.com***

Pre-requisites: None
Co-requisites: PRA Physical chemistry

Course objectives:
The course is aimed to acquaint the student with the basics of Thermodynamics and Statistical Physics; to acquire general understanding of theoretical and practical methods in Thermodynamics and Statistical Physics; to be able to apply this knowledge in analysis and resolution of practical problems.

Full course description:
Thermodynamics is the study of many-particle systems in terms of their macroscopic quantities such as temperature, heat, energy, and entropy. Statistical Physics relates these macroscopic quantities to the microscopic properties such as kinetic and rotational energy and vibrations, using statistics. In this course, students will achieve comprehension of the fundamentals of Thermodynamics and Statistical Physics. We cover the major elements of this subject: temperature and heat, thermal properties of matter, the first and second law of thermodynamics, entropy and free energy, the relation between macroscopic parameters and microscopic dynamics, and the statistics of thermodynamic ensembles. Each of these subjects is taught on a theoretical level as lectures, and trained on a practical level with exercises and by using knowledge in applied situations. This course can be complimented by skills training with appropriate experimental practical training sessions.

Literature:
Required: Thermodynamics: from concepts to applications, A. Shavit & C. Gutfinger, CRC Press, 2nd Edition, December 2008
Recommended: Statistical Thermodynamics, L.C. Fai & G.M.Wysin, CRC Press, 1st Edition, October 2012

Teaching methods:
Lecture(s), PBL

Assessment methods:
Final paper, Written exam

PRA 2006 Physical Chemistry
ECTS: 2.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: ***visaqam143@gmail.com***, gulnara.voronova@gmail.com

Pre-requisites: None
Co-requisites: CHE2003 Physical Chemistry; PHY 2002 Thermodynamics and Statistical Physics

Course objectives:
✓ To provide a molecular and mathematical understanding of basic concepts in physical chemistry on a more advanced level.
✓ To explain and describe the behaviour of systems when temperature and pressure is changed.
✓ To apply the general principles of thermodynamics in understanding and description of chemical and environmental processes like bookkeeping heat by means of enthalpy when solutions mix.
✓ To demonstrate how molecules interact in terms of electrostatics, from reacting to an existing field to inducing one.
✓ To present how these interactions apply in known (bio)systems and can predict physical properties of molecules.

Full course description:
Application of the principles and methods of physics and mathematics to the quantitative study of chemistry, focusing on chemical thermodynamics, electrochemistry, and elementary concepts in chemical transport phenomena.

Literature:
The sources will be added

Teaching methods:
Research, Skills, PBL

Assessment methods:
Assignment

PRA 3006 Applied Cell Biology

ECTS: 2.0

Course coordinator:
Zhukova I.A., SibSMU
Solomina Ye., Tomsk State University
Contact: irzhukova@inbox.ru, evgeniyasea27@gmail.com

Pre-requisites: BIO 2001 Cell Biology, PRA2004 Advanced Molecular Laboratory Skills
Co-requisites: None

Course objectives:
The course is aimed at acquiring the skills for cell culturing, immunohistochemistry, PCR, metabolic assays, testing cell viability, DNA analysis by agarose gel electrophoresis; learning to interpret and effectively communicate experimental results

Full course description:
The main objective of this course is to provide a practical introduction into molecular and cell biology and to demonstrate how experimental cell biology can be used in the context of regenerative medicine. We will use osteoblasts to study the effects of a hypoxia mimic on angiogenic markers. A variety of experiments will be performed to study differences on RNA and protein level. Cell Profiler will be used for image/data analysis.

Literature:
Laboratory manual

Teaching methods:
Skills, Research, Assignment(s)

Assessment methods:
Lab Notebook, Participation, Assignment

PRA 2005 Physics Laboratory: Thermodynamics

ECTS: 2.0

Course coordinators:
Pleshkov M.O., Physics Faculty, Tomsk State University
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contact: pankerams@gmail.com, dmitriy.bezrodnyy@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives: This practical is aimed at:
✓ the obtaining a deeper understanding of physics by performing various key experiments in the area of Thermodynamics;
✓ the design and execution of the experiments and their relation to the fundamental laws and principles of physics;
✓ the further training of physical laboratory techniques and procedures;
✓ data analysis and reporting.

Full course description:
This lab relates to level 200 physics course such as Thermodynamics.
This skill will contain: Design, use and measurement in physical experimentation; Gathering data using automated processes; Data manipulation and analysis using modern tools such as MATLAB or python; Experiments in Thermodynamics (the heat capacity, Maxwell distribution, liquids viscosity and some other).

Literature:
There is no book directly associated to this course. Information on the individual experiments is provided in this syllabus and in separate detailed experiment descriptions. Additionally, this course relates to the course in Physics: Thermodynamics and Statistical physics.

Teaching methods:
In this skill participants work together in a small team and each of the six weeks perform a different physical experiment. Each experiment is thoroughly planned, executed, and analysed by the team, and each week a report is submitted. The final grade is based on these reports. Participants are expected to more independent that in the PRA1003 Basic Physics Lab, but staff are available for support.

Assessment methods:
Evaluation of student performance will be based on lab reports, peer review, fill-in sheets and the quality of their logbook.

INT 3003 Vegetation science

ECTS: 5.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University
Contact: volkovhome@yandex.ru

Pre-requisites: BIO2002.General Botany, PRA2008.Exploring the World of Plants, SFT1003.Field Research Skills
Co-requisites: None

Course objectives:
At the end of the course, the student will understand the basics of the plant communities formation and the types of relationships between plants; be able to explain different aspects of the organization of plant communities and different types of vegetation dynamics; be able to discuss the mechanisms of the influence of vegetation on the main factors of the environment, as well as the influence of the environment on the distribution of plant communities and the formation of the structure of vegetation; understand the typological diversity of plant communities when acquainted with the problem of their classification; be able to apply the basic methods of field research of plant communities

Full course description:
The discipline is aimed at obtaining fundamental and applied knowledge in the field of vegetation science and ecology of plant communities as elementary structural parts of the Earth's phytosphere. Main topics to be considered at the course are: System approach in geobotany/vegetation ecology; Mutual relations of plants in plant communities; Organization of plant communities; The influence of plant communities on the environment; Classification of plant communities; Vegetation dynamics; Influence of the environment on the distribution of plant communities and the structure of vegetation; Some methods of field research of plant communities and the problem of representativeness of field geobotanical materials

Literature:
1. Box, Elgene O., Fujiwara, Kazue (Eds.) Warm-Temperate Deciduous Forests around the Northern Hemisphere. Series: Geobotany Studies, Springer, 2015. DOI 10.1007/978-3-319-01261-2
2. Box, Elgene O. (Eds.) Vegetation Structure and Function at Multiple Spatial, Temporal and Conceptual Scales. Series: Geobotany Studies, Springer, 2016. DOI 10.1007/978-3-319-21452-8
3. Greller, Andrew M., Fujiwara, Kazue, Pedrotti, Franco (Eds.) Geographical Changes in Vegetation and Plant Functional Types. Series: Geobotany Studies, Springer, 2018. DOI 10.1007/978-3-319-68738-4
4. Pedrotti, Franco Plant and Vegetation Mapping. Series: Geobotany Studies, Springer, 2013. DOI 10.1007/978-3-642-30235-0
5. Adams, Jonathan Vegetation-Climate Interaction: How Vegetation Makes the Global Environment. Series: Geobotany Studies, Springer, 2007. DOI 10.1007/978-3-540-32492-8
6. Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. Applied Vegetation Science, 2016, Volume 9, issue 1.
7. Walter H. Vegetation of the earth and ecological systems of the geo biosphere. Transl. from the 5. rev. German ed. by Owen Muise. New York; Heidelberg; Berlin; Tokyo: Springer. 1985. 318 p.

Teaching methods: Lecture(s), Seminars, PBL, Flipped classroom

Assessment methods: Pre-class quizzes, Post-class reports, Questionnaire sheets, Oral presentations, Discussion and brainstorming, Written tests, Oral exam.

INT 3003 Vegetation science

ECTS: 2.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University
Contact: volkovhome@yandex.ru

Pre-requisites: None
Co-requisites: BIO 2002. General Botany; PRA2008. Exploring the World of Plants; BIO 1003. Field Research Skills

Course objectives:
At the end of the course, the student will understand the basics of the plant communities formation and the types of relationships between plants; be able to explain different aspects of the organization of plant communities and different types of vegetation dynamics; be able to discuss the mechanisms of the influence of vegetation on the main factors of the environment, as well as the influence of the environment on the distribution of plant communities and the formation of the structure of vegetation; understand the typological diversity of plant communities when acquainted with the problem of their classification; be able to apply the basic methods of field research of plant communities

Full course description:
The discipline is aimed at obtaining fundamental and applied knowledge in the field of vegetation science and ecology of plant communities as elementary structural parts of the Earth's phytosphere. Main topics to be considered at the course are: System approach in geobotany/vegetation ecology; Mutual relations of plants in plant communities; Organization of plant communities; The influence of plant communities on the environment; Classification of plant communities; Vegetation dynamics; Influence of the environment on the distribution of plant communities and the structure of vegetation; Some methods of field research of plant communities and the problem of representativeness of field geobotanical materials

Literature:
1. Box, Elgene O., Fujiwara, Kazue (Eds.) Warm-Temperate Deciduous Forests around the Northern Hemisphere. Series: Geobotany Studies, Springer, 2015. DOI 10.1007/978-3-319-01261-2
2. Box, Elgene O. (Eds.) Vegetation Structure and Function at Multiple Spatial, Temporal and Conceptual Scales. Series: Geobotany Studies, Springer, 2016. DOI 10.1007/978-3-319-21452-8
3. Greller, Andrew M., Fujiwara, Kazue, Pedrotti, Franco (Eds.) Geographical Changes in Vegetation and Plant Functional Types. Series: Geobotany Studies, Springer, 2018. DOI 10.1007/978-3-319-68738-4
4. Pedrotti, Franco Plant and Vegetation Mapping. Series: Geobotany Studies, Springer, 2013. DOI 10.1007/978-3-642-30235-0
5. Adams, Jonathan Vegetation-Climate Interaction: How Vegetation Makes the Global Environment. Series: Geobotany Studies, Springer, 2007. DOI 10.1007/978-3-540-32492-8
6. Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. Applied Vegetation Science, 2016, Volume 9, issue 1.
7. Walter H. Vegetation of the earth and ecological systems of the geo biosphere. Transl. from the 5. rev. German ed. by Owen Muise. New York; Heidelberg; Berlin; Tokyo: Springer. 1985. 318 p.

Teaching methods:
Lecture(s), Seminars, PBL, Flipped classroom

Assessment methods:

Pre-class quizzes, Post-class reports, Questionnaire sheets, Oral presentations, Discussion and brainstorming, Written tests, Oral exam.

INT 1003 Basic Principles of Pharmacology

ECTS: 5.0

Course coordinator:
Zhukova I.A., SibSMU
Contact: irzhukova@inbox.ru

Pre-requisites: None
Co-requisites: None

Course objectives:
To explain the basic principles of pharmacokinetics and pharmacodynamics of drugs

Full course description:
Pharmacokinetics (what the body does to a drug) and pharmacodynamics (what a drug does to the body) describe basic principles that are important for predicting and understanding drug effects in the human body.
Pharmacokinetics can be defined as the characterization of transport processes of drug in the body throughout the phases of absorption, distribution, metabolism and excretion. These transport processes are usually studied in blood or blood plasma and evaluated in terms of pharmacokinetic parameters such as clearance, volume of distribution and elimination half-life. These principles are of particular importance in the clinical use of drugs when dealing with pharmacodynamic issues such as drug interactions, concentration response relations, therapeutics versus non therapeutic effects, dosing schedules and differential drug actions at receptor sites. The course will discuss two important (psycho) pharmacological principles of receptors: first, they are organized in multiple subtypes, and second, their interaction with drugs can be defined as agonist, partial antagonist, antagonist and inverse agonist. The course will cover the major principles of signal transduction, in particular in relation to the nervous system. Furthermore, the basic principles of drug metabolism and toxicity will be discussed. Finally, the action of drugs on the Central nervous system and mechanism of action in major diseases of the brain will be discussed.

Literature:
The sources will be added

Teaching methods:
Lecture(s), tutorial groups, practical.

Assessment methods:
Report on lab practical, exam with multiple choice and essay questions.

MAT 2004 Differential Equations

ECTS: 5.0

Course coordinator:

Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: ***diomedis@mail.ru***

Pre-requisites: None
Co-requisites: None

Course objectives:

✓ To develop the insight that certain problems in the natural sciences can be described through functions and differential equations and can be solved by techniques such as integration, differentiation, and optimization.
✓ To be able to classify differential equations by type and order.
✓ To be able to solve specific types of differential equations, including linear differential equations, second order differential equations with constant coefficients, using undetermined coefficients and variation of parameters.
✓ To have some understanding of how to use series, Laplace transforms, and numerical methods to solve differential equations.

Full course description:

This is a course about the art of using differential equations to model different phenomena in Physics, Chemistry and Biology. A differential equation is a mathematical equation for an unknown function of one or several variables that relates the values of the function itself and its derivatives of various orders. Differential equations can be broadly classified as linear and nonlinear, and ordinary and partial. This course is limited to linear and nonlinear ordinary differential equations. We will focus on understanding whether these differential equations have a solution, and if so, what properties this solution has. We will see how to solve first order and higher order differential equations including linear differential equations, second order differential equations with constant coefficients, using undetermined coefficients and variation of parameters. Since nonlinear differential equations are the main tool in the Natural Sciences and the differential equations occurring in real applications almost never can be solved analytically, we will see different numerical methodologies for solving differential equations.

Literature:

The sources will be added

Teaching methods:

Lectures and exercises.

Assessment methods:

Final exam, homework assignments.

INT 2005 Soil science
ECTS: 5.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University
Contact: volkovhome@yandex.ru

Pre-requisites: None
Co-requisites: None

Course objectives:
The course is aimed at: creating a holistic view of the soil as a natural-historical body (structure, origin and development); studying of physical and geographical concepts, models and laws that describe the "mechanisms" of soil cover differentiation; giving an idea of the basic laws of the soil geography, the conditions of formation, the soil genesis, the patterns of soil distribution in different regions of the Earth and zonal-regional features of the soil cover in the composition of soil cover in various natural zones of the Earth; forming the skills of determining of the main soil groups and their connection with certain soil-bioclimatic belts and areas of the world; identifying the main problems associated with the use and protection of soils.

Full course description:
In the framework of the «Soil science» course, students master the subject, the main objectives and the basis of soil science. This course provides students with an in-depth understanding of the physical, biological and chemical processes that occur in the soil, its role in plant production, and the importance of environmental management for its conservation. The course provides an overview of the basic laws of geography, zonal patterns of distribution and organization of soil cover of the Earth. Against the background of brief information about the physico-geographical features of the regions, questions related to the soil cover characterization based on consideration of the geography of soil-forming processes will be touched upon.

Literature:
1. Blume H.-P. et al. Scheffer/Schachtschabel Soil Science. Springer-Verlag Berlin Heidelberg, 2016. 618 p.
2. Brady N.C. and Weil R.R. The Nature and Properties of Soils. 13th Edition. Prentice Hall. Upper Saddle River, New Jersey. 2002. 960 p.
3. Schaetzl R.J., Thompson M.L. Soils: Genesis and Geomorphology. Second Edition. New York: Cambridge Univ. Press, 2015. 778 p.
4. Stroganova M.N., Urusevskaya I.S. Geography and structure of the world soil cover (pedosphere) // Encyclopedia of Life Support Systems. Vol. 4. EOLSS Publishers Co. Ltd (www.eolss.net), 2010. 27 p.
5. White R.E. Principles and practice of soil science: the soil as a natural resource. 4th Edition. Oxford. Blackwell Publishing, 2006. 364 p.
6. Zech W., Hintermaier-Erhard G. Soil of the World. Atlas. St. Petersburg: Academia, 2007. 120 p. (in Russian, German)
7. IUSS Working Group WRB. World Reference Base for Soil Resources. International soil classification system for naming soils and creating legends for soil maps. World Soil Resources Reports No. 106. FAO: Rome, 2015. 192 p

Teaching methods:
Lecture(s), PBL, Skills
Assessment methods: Final paper, Written exam

INT 2008 Cognitive Neurosciences: From Sensation to Perception

ECTS: 5.0

Course coordinator:
Zhukova I.A., SibSMU
Contact: ***irzhukova@inbox.ru***

Pre-requisites: Cognitive Neurosciences: Biological Foundations of Behaviour
Co-requisites: None

Course objectives:
To understand the physiological basis of visual and auditory perception.

Full course description:
The goal of this course is to understand the basic physiologic principles that underlie visual and auditory perception. The course will introduce the sensory systems that are responsible for vision and hearing in humans. Central topics include the nature of the stimulus (physical attributes such as amplitude and frequency, and perceptual attributes such as intensity and colour), the transduction process (the transformation of a physical stimulus into a neural signal leading to a subjective experience), the functional neuroanatomy of the human sensory system (the organization of sensory neurons into functional maps, columns, and pathways), and mechanisms for object perception (the organization of sensory features into meaningful percepts, for example, a face in a crowd or speaker at a loud party). Finally, the course will introduce psychophysical and neuroscientific methods designed for measuring perception.

Literature:
Goldstein, E. & Brockmole, J. (2016). Sensation and perception (10th edition). Australia: Cengage Learning. [ISBN: 978-1-305-58029-9]

Teaching methods:
E-reader Instructional format Lectures and tutorials

Assessment methods:
Written assignment (20%), presentation (20%), final exam (60%)

PHY 2005 Spectroscopy
ECTS: 5.0

Course coordinator:
Pleshkov M.O., Physics Faculty, Tomsk State University
Contact: pankerams@gmail.com

Pre-requisites: PHY2003. Vibrations and waves.
Co-requisites: PRA2010. Spectroscopic methods

Course objectives:
✓ To have a basic understanding of the theoretical background of the measurement principles typically used in spectroscopy and spectrometry.
✓ To learn to read and interpret the diverse types of spectral data obtained from the most common spectroscopic techniques.
✓ To learn to identify and characterize chemical compounds using a variety of available analytical techniques.
✓ To be able to develop an analytical strategy to identify an unknown compound.

Full course description:
The emphasis of this course will be on a number of essential topics in the field of spectroscopy. The course will focus on several spectroscopic and chromatographic techniques such UV-Vis spectroscopy, X-ray fluoroscopy, gas and liquid chromatography and mass spectrometry. First, the theoretical background and physical basics of the techniques will be discussed. Then, the reading and interpretation of spectral analysis will be covered. The main focus of the course will be on the acquiring of knowledge and practical expertise to characterize chemical compounds. An analytical strategy to get structural information for unknown molecules from experimental data will be developed.

Literature:
Spectroscopy; Lampman, Pavia, Kriz, Vyvyan; 4th edition (International Edition): Brooks/Cole

Teaching methods:
Lectures and tutorial group meetings

Assessment methods:
A midterm examination, which consists of open questions and problems, A final examination, which consists of open questions and problems, The contributions to the tutorial group meetings.

PHY 2004 Electromagnetism

ECTS: 5.0

Course coordinator:
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contact: dmitriy.bezrodnyy@gmail.com

***Pre-requisites*:** None
Co-requisites: None

Course objectives:
The course is aimed to acquaint the student with the basics of electromagnetism; to acquire general understanding of theoretical and practical methods in electromagnetism; to serve as sufficient basis for future education in physical sciences; to be able to apply this knowledge to concrete practical problems; to be able to read texts that build on the subjects of this course.

Full course description:
Electromagnetism, also known as Maxwell theory, is the science of one of the four fundamental forces in Nature and deals with the effects of electrical charge and the associated force fields and energies. Electromagnetism unites the concepts of electricity and magnetism. These two concepts and their relations form the core of this course, which ultimately can be expressed in the four fundamental laws of electromagnetism: Maxwell's equations. Important components of the course are:
1. ELECTROSTATICS: Charge, electric forces, Coulomb's law, the electric field, electric potential and energy;
2. (CLASSICAL) ELECTRODYNAMICS: Electrical flux, Gauss law;
3. MAGNETISM: Magnetic fields, magnetic flux, Gauss's law for magnetism;
4. MAXWELL's LAWS: The four Maxwell equations and the Lorentz Force;
5. ELECTROMAGNETIC RADIATION AND WAVES;
6. ADVANCED TOPICS. These topics are divided over the six lecturing weeks of the course.

Literature:
A course manual and title for the associated text book will be provided during the course

Teaching methods:
Lecture(s), PBL

Assessment methods:
Assignment, Written exam

PRA3008 Plant Breeding and Physiology
ECTS: 5.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University
Contact: volkovhome@yandex.ru

Pre-requisites: BIO 2002. General Botany
Co-requisites: CHE 2004. Biochemistry

***Course objectives*:**
To be able to characterize water balance in plant cells, mineral nutrition of plants, plants response to stress, assimilation, plant growth, physiology of flowering and fruiting, plant breeding, germination and development.

Full course description:
Topics of the course include: Water balance in plant cells; Pathway of water movement; concepts of symplast and apoplast; ascent of sap; transpiration; energy exchange during transpiration; role of stomata; relationship with photosynthesis; antitranspirants; guttation; exchange of gases; Water Stress Physiology; Characterization of stress response to water and high and low temperature response to saline soils; mechanism of response; Mineral nutrition; Essential and non-essential elements; criteria for essentiality; macro and micronutrients; roles of essential elements; mineral deficiency symptoms; ion antagonism and toxicity. Assimilation of Mineral Nutrients; Transport of ions across cell membranes, passive absorption, electrochemical gradient, Donnan's equilibrium, facilitated diffusion, accumulation against concentration gradient, active absorption, role of ATP, carrier systems, role of cell membrane, proton pump and ion flux; Translocation in the phloem; Structure-function relationship for the Translocation of photoassimilates from source to sink cells. Plant growth substances: Structure, biosynthesis, analysis, transport, physiological effects and mechanism of action; Control of flowering; Flowering; physiological definition; role of light; photoperiodism – discovery; variation in response; long day; short day and day neutral plants; inductive and non- inductive cycles; role of dark period; role of quality and intensity of light; vernalization; mechanism; bolting in long day plants; role of growth regulators; nutrient status; nature of the flowering stimulus; diffusibility of photoperiodic and vernalization stimuli; florigen concept. Physiology of fruit ripening; Physiological and biochemical changes; Phytochrome and plant development; Discovery; chemical nature; mode of action; role of low energy response (LER) and high irradiance response (HIR); red (R) and far red (FR) light on photomorphogenesis.

Literature:
1. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
2. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York, USA.
3. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
4. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4th edition, Sinauer Associates Inc .MA, USA
5. "Advances in Photosynthesis" by Mohammad Najafpour
6. https://www.intechopen.com/books/advances-in-photosynthesis-fundamental-aspects
7. Whitmarsh J, Govindjee (1999). "Chapter 2: The Basic Photosynthetic Process". In Singhal GS, Renger G, Sopory SK, Irrgang KD, Govindjee.
8. Concepts in Photobiology: Photosynthesis and Photomorphogenesis. Boston: Kluwer Academic Publishers. p. 13. ISBN 978-0-7923-5519-9.

9. Hesketh JD, Moss DN (1963). "Variation in the response of photosynthesis to light". Crop Sci. 3: 107–110.

Teaching methods:
Research, Skills, PBL

Assessment methods:
Assignment

PRA 2012 Cognitive Neurosciences: From Sensation to Perception

ECTS: 2.0

Course coordinator:
Zhukova I.A., SibSMU,
Contact: irzhukova@inbox.ru

Pre-requisites: INT 2007. Cognitive Neurosciences: Biological Foundations of Behaviour
Co-requisites: None

Course objectives:
The course is aimed at understanding the physiological basis of visual and auditory perception.

Full course description:
The goal of this course is to understand the basic physiologic principles that underlie visual and auditory perception. The course will introduce the sensory systems that are responsible for vision and hearing in humans. Central topics include the nature of the stimulus (physical attributes such as amplitude and frequency, and perceptual attributes such as intensity and colour), the transduction process (the transformation of a physical stimulus into a neural signal leading to a subjective experience), the functional neuroanatomy of the human sensory system (the organization of sensory neurons into functional maps, columns, and pathways), and mechanisms for object perception (the organization of sensory features into meaningful percepts, for example, a face in a crowd or speaker at a loud party). Finally, the course will introduce psychophysical and neuroscientific methods designed for measuring perception.

Literature:
Goldstein, E. & Brockmole, J. (2016). Sensation and perception (10th edition). Australia: Cengage Learning. [ISBN: 978-1-305-58029-9]

Teaching methods:
E-reader Instructional format Lectures and tutorials

Assessment methods:
Written assignment (20%), presentation (20%), final exam (60%)

PRA 2010 Spectroscopic Methods

ECTS: 2.0

Course coordinator:
Pleshkov M.O., Physics Faculty, Tomsk State University
Contact: pankerams@gmail.com

Pre-requisites: PHY2003. Vibrations and waves.
Co-requisites: PRA2010. Spectroscopic methods

Course objectives:
✓ To have a basic understanding of the theoretical background of the measurement principles typically used in spectroscopy and spectrometry.
✓ To learn to read and interpret the diverse types of spectral data obtained from the most common spectroscopic techniques.
✓ To learn to identify and characterize chemical compounds using a variety of available analytical techniques.
✓ To be able to develop an analytical strategy to identify an unknown compound.

Full course description:
Practical expertise to characterize chemical compounds. An analytical strategy to get structural information for unknown molecules from experimental data will be developed.

Literature:
Spectroscopy; Lampman, Pavia, Kriz, Vyvyan; 4th edition (International Edition): Brooks/Cole

Teaching methods:
Lectures and tutorial group meetings

Assessment methods:
A midterm examination, which consists of open questions and problems, A final examination, which consists of open questions and problems, The contributions to the tutorial group meetings.

PRA 2013 Physics Laboratory: Electromagnetism

ECTS: 2.0

Course coordinators:
Pleshkov M.O., Physics Faculty, Tomsk State University
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contact: pankerams@gmail.com, dmitriy.bezrodnyy@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:
This practical is aimed at:
✓ obtaining a deeper understanding of physics by performing various key experiments in the area of Electromagnetism;
✓ the design and execution of the experiments and their relation to the fundamental laws and principles of physics;
✓ the further training of physical laboratory techniques and procedures;
✓ data analysis and reporting.

Full course description:
This lab relates to level 200 physics course Electromagnetism.
This skill will contain: Design, use and measurement in physical experimentation; Gathering data using automated processes; Data manipulation and analysis using modern tools such as MATLAB or python; Experiments in Electrodynamics (Charge of the Electron (Millikan's experiment), Faraday's Law of Induction Experiment, the Coulomb's law, Ohm's law, Kirchoff rules and some others).

Literature:
There is no book directly associated to this course. Information on the individual experiments is provided in this syllabus and in separate detailed experiment descriptions. Additionally, this course relates to the course in Physics: Electromagnetism.

Teaching methods: In this skill participants work together in a small team and each of the six weeks perform a different physical experiment. Each experiment is thoroughly planned, executed, and analysed by the team, and each week a report is submitted. The final grade is based on these reports.
Participants are expected to more independent that in the PRA1003 Basic Physics Lab, but staff are available for support.

Assessment methods:
Evaluation of student performance will be based on lab reports, peer review, fill-in sheets and the quality of their logbook.

BIO 2004 Genetics
ECTS: 5.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University
Contact: volkovhome@yandex.ru

Pre-requisites: BIO2001 Cell Biology
Co-requisites: PRA2007 Genetics

Course objectives:
The course is aimed to understand the chemical structure of DNA and the molecular mechanisms of DNA replication; to get familiar with the basic principles how information stored in genes is converted to a (cellular) phenotype in the form of RNA and proteins; to comprehend and be able to apply the concepts of genome structure, comparative genomics, and functional genomics; to understand the molecular basis of single gene inheritance (Mendel's first law), sex-linked single gene inheritance and to interpret human pedigrees; to use the above information to deduce the concepts of Darwin's theory of Natural Selection, molecular evolution and the origin of new genes and species. To have sufficient background for more advanced courses in biochemistry and the life sciences.

Full course description:
The course discusses the principles of genetics with application to the study of biological function at the level of molecules, cells, and multicellular organisms, including humans. The topics include: structure and function of genes; chromosomes and genomes; biological variation resulting from recombination, mutation and selection; DNA repair and the genetic basis of disease inheritance; and evolutionary genetics.

Literature:
1. "Concepts of Genetics" 12th Edition by William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino, Darrell Killian
2. "Genetics: From Genes to Genomes" 6th Edition by Leland Hartwell Dr., Michael L. Goldberg Professor Dr., Janice Fischer , Leroy Hood Dr.
3. "Genetics: A Conceptual Approach" 6th Edition by Benjamin A. Pierce

Teaching methods:
Lecture(s), Assignment(s), PBL

Assessment methods:
Written exam, Participation, Assignment

CHE 3003 Modern Catalytic Chemistry

ECTS: 5.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contact: visagam143@gmail.com
Contact: gulnara.voronova@gmail.com

Pre-requisites: CHE2001.Organic Chemistry , CHE2002.Inorganic Chemistry
Co-requisites: None

Course objectives:
The course is aimed at: the outlining, describing and discussing the essential principles of catalysis; providing a survey of the different types of chemical catalysis, to include transition metals, organocatalysis; introducing the state-of-art in the field, illustrated by appropriate example; examining case studies of key reactions for the synthesis of fine chemicals; providing the basis for the further studies in this rapidly- moving field, and to link catalysis to other areas of chemistry.

Full course description:
This course will provide a comprehensive introduction to the topic of catalysis, with a focus on homogeneous catalysis mediated by organometallic compounds; and emphasis on modern chemistry and key processes. Each week a different important and relevant catalytic process will be reviewed in detail: Polymerisation and selective oligomerisation; catalytic C-C coupling reactions; Hydroformylation (including the Monsanto process); Hydrosilylation (with modern developments) and other hydrometalation reactions; catalytic metathesis (alkene and alkyne), and their applications in some modern cases studies; Definition and illustration of catalysis and kinetics; Catalysis by enzyme; Catalysis in and on synthetic polymerization; Catalysis on the surfaces of inorganic solids.

Literature:
The sources will be added

Teaching methods:
Lecture(s), PBL

Assessment methods:
Questionnaire sheets, Oral presentations, Written tests, Oral exam

PHY 2003 Vibrations and Waves

ECTS: 5.0

Course coordinator:
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contact: ***dmitriy.bezrodnyy@gmail.com***

Pre-requisites: PHY2001.Classical Mechanics
Co-requisites: None

Course objectives:
The course is aimed to acquaint the student with the fundamental principles of vibrations and waves as they apply to all systems; to develop an understanding of damping and forcing on vibrations; to identify appropriate mathematical methods to solving problems relating to these phenomena (such as differential equations); to understand wave characteristics such as standing waves, beats, wave packets and the Doppler effect

Full course description:
Vibrations and waves covers the behavior of many physical systems ranging from optical or acoustic to mechanical, oscillating systems. Participants will investigate simple harmonic oscillators, particle and packet velocities as well as damped, driven and coupled oscillators. The use of Fourier series to describe waves will allow a more mathematical analysis to take place. We will explore of sound propagation in a variety of media including sounds in gasses, liquids and solids (strings, rods etc.). In addition, the behavior of interfering waves (such as formation of standing waves) will be demonstrated. Material properties such as reflection, transmission and impedance will also be covered.

Literature:
Vibrations and Waves, George C. King, John Wiley and Sons (UK), 1st edition, 2009

Teaching methods:
Lecture(s), PBL

Assessment methods:
Assignment, Written exam

PRA 2007 Genetics
ECTS: 2.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University
Contact: volkovhome@yandex.ru

Pre-requisites: BIO2001. Cell Biology
Co-requisites: BIO 2004. Genetics

Course objectives:
To be able to purify genomic DNA from eukaryotic cells and plasmid (circular) DNA from prokaryotic cells and perform quantitative analyses on each product. To perform and comprehend polymerase chain reaction (PCR) analysis. Analyze DNA products using restriction digestion, ligation and agarose gel electrophoresis. To isolate RNA from eukaryotic cells and apply reverse transcription to generate copy DNA To study specific proteins by Western immunoblotting. To independently use genetic and genomic websites, general and specialized databases and determine relationships of genes within and between databases. To have sufficient technical training for more advanced skills in molecular biology and the life sciences. To apply genetic principles to a pre-assigned task and present the findings to a larger audience.

Full course description:
The skills trainings are aimed to obtain a basic introduction to techniques and methods in modern Genetics. The first skills take place at a designated skills laboratory at Chemelot campus; subsequent skills training topics "Genomes and Genomics" and are taught in a computer landscape. These days integrate theoretical and practical information. Each student will receive theoretical and practical in silico training in the morning, followed by a limited number of tasks to execute on the computer and answered in a skills report. The final skills consist of a student group presentation where the combined theoretical and practical skills on Genetics are applied to a pre-assigned task.

Literature:
The sources will be added

Teaching methods:
PBL, Research, Skills, Work in subgroups, Assignment(s)

Assessment methods:
Participation, Assignment.

PRA3001 Advanced Organic Synthesis

ECTS: 5.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contact: visaqam143@gmail.com
Contact: gulnara.voronova@gmail.com

Pre-requisites: CHE2001. Organic Chemistry
Co-requisites: CHE3001. Organic Reactions

Course objectives: The main objective of this skill is to provide a solid foundation in multi-step organic synthesis. Most organic compounds cannot be prepared in a single step. Instead, a sequence of reactions has to be designed to obtain these materials. Some of these steps may require complex chemistry, very reactive intermediates or inert atmospheres. This course focuses on these special situations.

Full course description:
This skill will contain: Advanced synthetic chemistry of various organic reaction types. Multi-step organic synthesis. Synthesis and handling of reactive compounds under inert atmosphere. Extensive use of spectroscopic characterization.

Literature:

Teaching methods:
Research, Skills, Paper(s)

Assessment methods:
Assignment, Final paper, Observation

PRA 2014 Physics Laboratory: Vibrations and Waves

ECTS: 2.0

Course coordinators:
Pleshkov M.O., Physics Faculty, Tomsk State University
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contact: pankerams@gmail.com, dmitriy.bezrodnyy@gmail.com
ECTS: 2.0

Pre-requisites: None
Co-requisites: None

Course objectives: This practical is aimed at obtaining a deeper understanding of physics by performing various key experiments in the areas of Classical Mechanics and Optics; designing and execution of the experiments and their relation to the fundamental laws and principles of physics; further training of physical laboratory techniques and procedures; data analysis and reporting.

Full course description:
This lab relates to level 200 physics courses such as Classical Mechanics and Vibrations and Waves.
This skill will contain: Design, use and measurement in physical experimentation; Gathering data using automated processes; Data manipulation and analysis using modern tools such as MATLAB or python; Experiments in mechanics (Driven Damped Harmonic Oscillator, etc), and Optics (Interference, Diffraction, Properties of Light etc).

Literature:
There is no book directly associated to this course. Information on the individual experiments is provided in this syllabus and in separate detailed experiment descriptions. Additionally, this course relates to the courses in Physics: Classical Mechanics, and Vibrations and Waves.

Teaching methods:
In this skill participants work together in a small team and each of the six weeks perform a different physical experiment. Each experiment is thoroughly planned, executed, and analysed by the team, and each week a report is submitted. The final grade is based on these reports.
Participants are expected to more independent that in the PRA1003 Basic Physics Lab, but staff are available for support.

Assessment methods:
Evaluation of student performance will be based on lab reports, peer review, fill-in sheets and the quality of their logbook.

MAT 1004 Programming. Part 1

ECTS: 5.0

Course coordinator:
Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: diomedis@mail.ru

Pre-requisites: None
Co-requisites: None

***Course objectives*:**
✓ Identify, interpret and apply fundamentals of imperative programming such as variables, conditionals, iteration, etc.
✓ Identify, interpret and apply fundamentals of object-oriented programming, including defining classes, invoking methods, using class libraries, etc.
✓ Give examples of important topics and principles of software development.
✓ Point out obvious mistakes in programs and analyze how they run.
✓ Design, compose and evaluate programs that solve specific problems.
✓ Use a software development environment to create, debug, and run programs.

Full course description:
The course provides the basics of computer science and computer programming. After a short introduction to computer organization, the principles of structured programming in Java are presented. The main topics of the course are: data types, statements and sequential execution, conditional statements, loops, methods, and recursion. Final part of the course introduces students to the concepts of object- oriented programming design and learns them how to design their own classes to model and solve several problems. No prior programming experience is assumed.

Literature:
The sources will be added

Teaching methods:
Lecture(s), PBL, computer practicals.

Assessment methods:
Final exam, homework assignments

INT 3004 Neuropsychopharmacology

ECTS: 5.0

Course coordinator:
Zhukova I.A., SibSMU
Contact: ***irzhukova@inbox.ru***

Pre-requisites: INT1003. Basic Principles of Pharmacology
Co-requisites: None

***Course objectives*:**
✓ To know the basic principles of neurotransmission & the basic mechanism of drugreceptor interaction
✓ To understand the mechanism of action of the major groups of drugs acting in the central nervous system
✓ To understand the major neurotransmitter systems in the brain and their role in cognitive and affective disorders and functions
✓ To understand the pharmacotherapy of anxiety disorders, CNS degenerative disorders, ADHD
✓ To understand the acute and long term effects of drugs of abuse

Full course description:
In the first part of the course the focus will be on the molecular and cellular biology of the nervous system. Focus will be the neurotransmission process, in particular the role of neurotransmitter receptors as a basis for understanding the mode of action of CNS drugs. The second part of the course will give an overview of the major classes of a number of CNS drugs: the hypnotics and sedatives, the anxiolytics, and the drugs used to treat CNS degenerative disorders. The pharmacology of these drugs will be put in the perspective of their clinical use. The final part of the course will be devoted to illicit drugs, their acute and long term effects, and their potential as medicines.

Literature:
Journal articles, book(s) chapter(s).

Teaching methods:
Lectures and tutorial group meetings Form of

Assessment methods:
Written assignments and presentations

PRA 2002 Programming
ECTS: 5.0

Course coordinator:
Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: diomedis@mail.ru

Pre-requisites: None
Co-requisites: MAT1004. Programming. Part 1

Course objectives:
The course is aimed at familiarizing students with the practical skills required in computer programming

Full course description:
The course is intended to introduce students to more practical concepts involved with computer programming. The students will gain experience implementing these concepts in programming tasks described by each assignments. Topics include: Implementing recursive methods Basics of object-oriented programming Basics of graphical user interface (GUI) programming String manipulation and parsing File input and output • Introduction to data structures

Literature:
The sources will be added

Teaching methods:
Work in subgroups, PBL, Skills

Assessment methods:
Assignment, Written exam, Computer test

PRA 3011 Neuropsychopharmacology

ECTS: 2.0

Course coordinator:
Zhukova I.A., SibSMU
Contact: ***irzhukova@inbox.ru***

Pre-requisites: INT1003. Basic Principles of Pharmacology
Co-requisites: None

***Course objectives*:**
✓ To know the basic principles of neurotransmission & the basic mechanism of drugreceptor interaction
✓ To understand the mechanism of action of the major groups of drugs acting in the central nervous system
✓ To understand the major neurotransmitter systems in the brain and their role in cognitive and affective disorders and functions
✓ To understand the pharmacotherapy of anxiety disorders, CNS degenerative disorders, ADHD
✓ To understand the acute and long term effects of drugs of abuse

Full course description:
In the first part of the course the focus will be on the molecular and cellular biology of the nervous system. Focus will be the neurotransmission process, in particular the role of neurotransmitter receptors as a basis for understanding the mode of action of CNS drugs. The second part of the course will give an overview of the major classes of a number of CNS drugs: the hypnotics and sedatives, the anxiolytics, and the drugs used to treat CNS degenerative disorders. The pharmacology of these drugs will be put in the perspective of their clinical use. The final part of the course will be devoted to illicit drugs, their acute and long term effects, and their potential as medicines.

Literature:
Journal articles, book(s) chapter(s).

Teaching methods:
Lectures and tutorial group meetings Form of

Assessment methods:
Written assignments and presentations

BIO 3002 Siberian Ecology

ECTS: 5.0

Course coordinator: ***Volkova I.I., Biological Institute, Tomsk State University***
Contact: ***volkovhome@yandex.ru***

Pre-requisites: None
Co-requisites: None

Course objectives:
Siberia are perhaps the most interesting regions in the popular imagination. In this course you will get an overview of the characteristics and importance of siberian nature, especially forests and mires, study their history and think about their future.

Full course description:
For many years Tomsk state university has been engaged in the study of the landscapes of Siberia, including the Arctic and sub-Arctic areas, which are a convenient platform for the study of climate change and human impact. Today, Western Siberia is faced with powerful changes in the natural environment, which the other northern regions of the world will face in the near future, and the need for specialists with a wide range of knowledge about the region will definitely increase.
Siberian forests and mires are amongst the largest pristine biomes of the world. Our understanding of their evolution, functioning and development are far from complete. You will look at what defines the siberian region, the differences and similarities between the forest of the range of natural zones of Siberia, and investigate the structure and biodiversity of siberian mires. Also, you will look at the development of mires, how biodiversity changes over time (ecologically and evolutionarily) and how trophic levels work within these forests and mires. Furthermore, the role of forests and mires in relation to climate change and global carbon cycling will be investigated. Some aspects of landscape ecology as well as environmental management are included.

Literature:
1. “Vegetation Cover and Environment of the Mammoth Epoch in Siberia” by Valentaina V. Ukraintseva, Jim L. Mead, Richard H. Hevly
2. “Permafrost Ecosystems: Siberian Larch Forests (Ecological Studies)” by Akira Osawa and Olga A. Zyryanova
3. “Novel Methods for Monitoring and Managing Land and Water Resources in Siberia (Springer Water)” by Lothar Mueller and Askhad K. Sheudshen
4. “Basic Landscape Ecology” by Robert Coulson and Maria Tchakerian

Teaching methods:
Lecture(s), Assignment(s), PBL

Assessment methods:
Assignment, Written exam, Presentation

PHY 3003 Electrodynamics

ECTS: 5.0

Course coordinator:
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contact: ***dmitriy.bezrodnyy@gmail.com***

Pre-requisites: PHY2004. Electromagnetism
Co-requisites: None

Course objectives:
The course is aimed at the acquiring general understanding of electrodynamics; ability to use Maxwell equations to solve practical problems such as transmission along coaxial lines.

Full course description:
Electrodynamics is the first example of a field theory: charged particles create a field and this field acts on other charged particles. In other words electromagnetic forces are mediated by a field. This should put in contrast to Coulomb's law in electrostatics or even Newton's gravitational law. Both laws imply the objectionable notion of an action on a distance: moving a charge or mass at location A instantaneously gives rise to a different force at point B. How the electromagnetic field evolves in time is given by the 4 famous Maxwell equations. These equations for example state that light propagates at a constant speed, which eventually led to Einstein's theory of relativity. This course will start at the Maxwell equations and their consequences: conservation laws, electromagnetic waves, radiation, etc…

Literature:
"Introduction to Electrodynamics", David Griffiths, 4th Edition

Teaching methods:
Lecture(s), PBL

Assessment methods:
Final paper, Written exam

INT 3001 Biomaterials
ECTS: 5.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: visaqam143@gmail.com, gulnara.voronova@gmail.com

Pre-requisites: CHE2001. Organic Chemistry
Co-requisites: None

Course objectives:
The course is aimed at providing an overview of all materials that are used in biomedical applications; understanding the synthesis and structure of different biomaterials; metals, ceramics, polymers, and composites thereof; introduction the student to the evaluation, characterization, and testing of biomaterials; providing a detailed understanding of the interaction of biomaterials with surrounding tissues and the complete organism

Full course description:
What makes a material a biomaterial? The overall objective of the course Biomaterials is for the student to gain insight in the role that properties of materials can play in solving biomedical problems. Relevant questions in this context are: which requirements need to be met to render a material suitable for biomedical applications? Which biomedical problem is to be solved, and which material offers the best solution? What is the current state-of-the-art? What are the most promising developments? A biomaterial is defined as "any substance or combination of substances, other than drugs, synthetic or natural in origin, which can be used for any period of time, which augments or replaces partially or totally any tissue, organ or function of the body, in order to maintain or improve the quality of life of the individual". In this course, the exact structure and physico-chemical characteristics of various biomaterials (metals, ceramics, polymers, composites) will be explained. For instance, the composition, degradation behavior and mechanical properties are important parameters. The techniques that are used to evaluate the physico-chemical characteristics of biomaterials are, consequently, an important subject. Furthermore, the interactions between different biomaterials and the biological environment (cells, extracellular matrix, tissues, organs) will be studied. The concepts of biocompatibility, bioinertness and bioactivity will be introduced, as well as various methods used to determine the biological response to a biomaterial.

Literature:
The sources will be added

Teaching methods:
Lecture(s), PBL

Assessment methods:
1) A final examination with open questions;
2) A poster presentation on the short project concerning biomaterials research

BIO 2006 Genomics and Proteomics

ECTS: 5.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University,
Zhukova I.A., SibSMU
Contact: : volkovhome@yandex.ru, irzhukova@inbox.ru

Pre-requisites: BIO2004 Genetics
Recommended:
Co-requisites: none

Objectives:

The course is aimed at understanding how genomics applications are used to unravel the biology of life; understanding the basic principles of omics-techniques; gaining insight in the advantages and limitations of genomics-based experiments; appreciating the surplus value of combining data from different omics-applications as a systems approach; providing the basis for gaining insight in bioinformatics and computational genomics.

Description of the course:

The introduction of genomics applications has added an extra dimension to the understanding of the molecular nature of life. Prerequisites were the unraveling of the genome of humans and other organisms, and the development of high-throughput methods for the simultaneous analysis of the expression levels of as much as possible genes. This course will give students insight in the analytical principles behind omics technologies such as array-based analysis, in the information that can or cannot be obtained by the different 'omics'-approaches, and in the novel developments of omics applications such as miRNA arrays, analysis of the epigenome, and next generation sequencing. Specific themes of the course are trancriptomics, proteomics, metabolomics with special attention for the surplus value of combining of data from various omics approaches as the best way to understand life (Systems Biology). Special areas of attention are Nutrigenomics and Toxicogenomics.

Literature:

1. Sethi et al. Approaches for targeted proteomics and its potential applications in neuroscience. J. Biosci. 2015.
2. Drake et al. Challenges to developing proteomic-based breast cancer diagnostics. OMICS 2011.
3. Berna et al. Nutrigenetics and nutrigenomics insights into diabetes etiopathogenesis. Nutrients 2014.
4. Malone et al. Microarrays, deep sequencing and the true measure of the transcriptome. BMC Biology 2011.
5. Trifonova et al. Postgenomics diagnostics: metabolomics approaches to human blood profiling. OMICS 2013.

Teaching methods:

Thematic lectures on methodological principles and techniques, with examples of omics applications. PBL sessions to address in more detail some of the thematic subject of the lectures. Journal club sessions to study and discuss relevant literature on the application of omics-methods in life sciences. An assignment involving the writing of an essay on a specific subject as for instance 'personalized genomics'. There is a visit to laboratories using omics technology. There will be a group discussion on Big Data.

Assessment methods:

The final grade will depend on the final examination with a mixture of open and multiple choice questions, and on the score for the essay.

MAT 2003 Programming. Part 2

ECTS: 5.0

Course coordinator: Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: diomedis@mail.ru

Pre-requisites: MAT 1004. Programming. Part 1
Co-requisites: None

Course objectives:
1) Identify, interpret and apply fundamentals of imperative programming such as variables, conditionals, iteration, etc. 2) Identify, interpret and apply fundamentals of object-oriented programming, including defining classes, invoking methods, using class libraries, etc. 3) Give examples of important topics and principles of software development. 4) Point out obvious mistakes in programs and analyze how they run. 5) Design, compose and evaluate programs that solve specific problems. 6) Use a software development environment to create, debug, and run programs. (Part 2)

Full course description:
The course provides the basics of computer science and computer programming. After a short introduction to computer organization, the principles of structured programming in Java are presented. The main topics of the course are: data types, statements and sequential execution, conditional statements, loops, methods, and recursion. Final part of the course introduces students to the concepts of object- oriented programming design and learns them how to design their own classes to model and solve several problems. No prior programming experience is assumed. (Part 2)

Literature:
The sources will be added

Teaching methods:
Lecture(s), PBL, computer practicals.

Assessment methods:
Attendance, Final exam, homework assignments

MAT 1006 Analytic Geometry

ECTS: 5.0

Course coordinator: Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: diomedis@mail.ru

Pre-requisites: None
Co-requisites: None

Course objectives:
Systems of linear algebraic equations. Vector algebra in three-dimensional space. Problems of analytic geometry on a plane and in space. Linear spaces and linear mappings. Bilinear and quadratic forms. Affine, Euclidean and unitary spaces.

Full course description:
This course is a part of an introduction into geometry and geometric analysis. The basic concepts of geometry (points, lines and planes) are among the initial concepts. They can be described, but an attempt to define leads to the replacement of the defined concept by its equivalent.
The course of analytical geometry is one of the basic courses of mathematics. Therefore, the main goal of the course is to familiarize students with the mathematical apparatus necessary for application in physical courses.

Literature:
The sources will be added

Teaching methods:
Lecture(s), PBL

Assessment methods:
Attendance, Assignment, Written exam

PRA 3005 Programming in the Life

ECTS: 2.0

Course coordinator:
Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: diomedis@mail.ru

Pre-requisites: MAT1004 Programming. Part 1; PRA2002 Programming
Co-requisites: None

Course objectives:
The ability to write software (to script, to program, to code) for students and their future data-centric, multidisciplinary careers.

Full course description:
This is an interesting course for life scientists to learn how to write computer code for use in their research. The course covers fundamental concepts of programming and software design focusing on programming in R and Python. The course will go through various aspects of R scripting emphasizing the parts useful for life scientists. After introductory lectures on good programming practices, basic software design theory and a brief overview of R, we will delve into programming. The course start by learning how to use R as a simple calculator, what are variable types, how to use data structures, how to implement repeating actions with and without loops, how to take actions based on certain condition. The course gradually proceed to loading data, importing data from common file formats, some basic matrix algebra and learning how to perform basic statistical tests and visualize results.

Literature:
The sources will be added

Teaching methods:
Skills, PBL

Assessment methods:
Participation, Presentation, Assignment

PRA 3012 Genomics and Proteomics

ECTS: 2.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University,
Zhukova I.A., SibSMU
Contact: : volkovhome@yandex.ru, irzhukova@inbox.ru

Pre-requisites: BIO2004. Genetics
Recommended:
Co-requisites: none

Objectives:
✓ To view and use the various biological databases available on the World Wide Web.
✓ To retrieve the gene sequence in FASTA format
✓ To determine the conserved domain
✓ To find whether the given pattern is present in the following protein. Also to find its homologous proteins present in SWISPROT database possessing the similar pattern.
✓ To find Struturally solved homologus proteins
✓ To perform the local alignment between the given sequences
✓ Comment on the evolutionary relationship between the sequences.

Description of the course:
Biological databases are libraries of life sciences information, collected from scientific experiments, published literature, high-throughput experiment technology, and computational analyses. They contain information from research areas including genomics, proteomics, metabolomics, microarray gene expression, and phylogenetics.

Literature:
6. Sethi et al. Approaches for targeted proteomics and its potential applications in neuroscience. J. Biosci. 2015.
7. Drake et al. Challenges to developing proteomic-based breast cancer diagnostics. OMICS 2011.
8. Berna et al. Nutrigenetics and nutrigenomics insights into diabetes etiopathogenesis. Nutrients 2014.
9. Malone et al. Microarrays, deep sequencing and the true measure of the transcriptome. BMC Biology 2011.
10. Trifonova et al. Postgenomics diagnostics: metabolomics approaches to human blood profiling. OMICS 2013.

Teaching methods:
Exercises in a computer laboratory

Assessment methods:
Assignments.

INT 2003 Science in Action

ECTS: 5.0

Course coordinator:
Pleshkov M.O., Physics Faculty, Tomsk State University
Contact: pankerams@gmail.com

Pre-requisites: None
Co-requisites: None

Course objectives:
By the end of this course students should be able to:describe the contemporary social, economic, political, and cultural dynamics of knowledge production in the sciences.
Identify the complexities of how scientific knowledge is distributed and communicated in society critically analyze 'common sense' views of the making and use of scientific claims.

Full course description:
This course is situated in the field of Science and Technology Studies (STS) and analyses the social and cultural complexities involved in the production and dissimination of scientific knowledge. Scientific knowledge production and technological developments to not take place in a social, cultural, political, or economic vaccum. On the contrary, this course shows how these forces play inextricable roles in the practice and production of science. As our point of departure we critically engage with notions of progress inherent in much of modern science. We then look begin to look at the organization of knowledge production and its collaborative character from an STS perspective. We also study processes in which credible facts are established and published. Furthermore, this course also pays attention to the integrity of science and in particular its grey areas. Beside the immediate context in which scientific facts are established (i.e. the lab), the course also takes into account the wider socio-economic context in which science operates. This involves not only the commercialization of science, but also the way its promises and expectations are related to our hopes and fears. Finally, you will gain insights into the way the cultural-historical contexts affects the interpretation of facts. Based on discussions and analyses of these topics the course aims to make you reflect critically on 'common sense' views of the making and use of scientific claims.
Besides tutorial meetings, the course also involves lectures, discussion meetings, video analysis, and a visit to a scientific lab for an interview

Literature:
The sources will be added

Teaching methods:
Lecture(s), PBL

Assessment methods:
Participation in -and preparation of- discussions and assignments (team/individual), interview report, final presentation and final paper are part of the examination.

BIO 3001 Microbiology

ECTS: 5.0

Course coordinators:
Zhukova I.A., SibSMU
Volkova I.I., Biological Institute, Tomsk State University
Contacts: irzhukova@inbox.ru, volkovhome@yandex.ru

Pre-requisites: None
Co-requisites: PRA3009. Microbiology

Course objectives:
To obtain basic knowledge of selected evolutionary, ecological, morphological, physiological, and biochemical aspects of representative micro-organisms with special attention to medical microbiology, i.e. of bacteriology, virology and genetically modification of microorganisms. To study the characteristics of a selection of micro-organisms in relation to their related infectious diseases, more specific pathogenesis, epidemiology, diagnosis and therapy.

Full course description:
This course is intended for students in allied health majors. The course will start with two introduction lectures on Bacteriology and Virology. The general principles of replication, classification, metabolism and antibiotic resistance of bacteria as well as the presence of bacteria in several organ systems and the composition of the indigenous flora will be discussed in week 1. The general priciples of replication, classification and pathogenesis of viruses will be discussed in the introduction lecture of week 2. Several aspects of bacteriology and virology will be further discussed in the expert and tutorial group meetings, which will include topics as HIV, Tuberculosis and ESBL.
The knowledge you have obtained in the first two weeks will serve the basis for the following three weeks, where Infectious diseases, Outbreaks & resistance and Microbiological diagnostics will be discussed in the lectures as well as in the tutorial groups. In these topics, both the bacterial and viral aspects will be discussed.
The last part of this course will deal with genetically modified microorganisms, in which you gain inside in the purposes of modification and the tools that are available. In the PBL tutorial group linked to this part of the course (Case: The Experiment), you will design your own experiment on paper; genetically modification of viral genes.

Literature:
1. “Microbiology: An Introduction” 13th Edition by Gerard J. Tortora and Berdell R. Funke
2. “Sherris Medical Microbiology” 7th Edition by Kenneth J. Ryan and Nafees Ahmad
3. “Basic Medical Microbiology” by Patrick R. Murray

Teaching methods:
Lecture(s), Research, PBL

Assessment methods:
Presentation, Assignment, Written exam

CHE 3001 Organic Reactions

ECTS: 5.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: visagam143@gmail.com, gulnara.voronova@gmail.com

***Pre-requisites*:** CHE2001.Organic Chemistry
Co-requisites: PRA3001.Advanced Organic Synthesis

Course objectives:
✓ To provide a comprehensive overview of chemical reactivity.
✓ To understand the reactivity of most common functional groups.
✓ To be able to present detailed reaction mechanisms for typical organic reactions.
✓ To give the ability to design multi-step reaction sequences to obtain a specific organic compound.
✓ To provide insight into industrial processes to obtain organic chemicals.

Full course description:
This course focuses on chemical reactivity. In this course, a broad review will be presented of the most important functional groups and their reactivity. This review will not only consist of comparatively simple molecules, such as alcohols, aldehydes, ketones, carboxylic acids and amines, but will also be illustrated with examples from more complex biomolecules. Knowledge of the various types of organic reactions will provide the basic skills to design multistep synthesis sequences to obtain specific organic compounds. In this context special attention will also be paid to organometallic reactions and their importance for multistep organic synthesis. Furthermore, the reaction types will be placed in an appropriate context with regard to practical applicability and industrial processing. Finally, also theoretical aspects regarding reaction mechanisms will be presented.

Literature:
1. Chemical Reactions, Denise Walker - 2007
2. Chemical Reactions. Eve Hartman, Wendy Meshbesher - 2016

Teaching methods:
Lecture(s), seminars, labs

Assessment methods:
Written exam, Participation, Presentation, pre-lab quizzes, post-lab reports

PHY 3002 Particle physics / High-Energy Physics

ECTS: 5.0

Course coordinator:
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contact: ***dmitriy.bezrodnyy@gmail.com***

Pre-requisites: None
Co-requisites: None

Course objectives:
To acquire a general understanding of key concepts in Nuclear and elementary Particle physics To be able to apply this knowledge to numerical calculations. To be able to read scientific texts that build on the subjects of this course.

Full course description:
This course provides an overview of the key concepts in nuclear and elementary particle physics. Nuclear physics is the study of complex nuclei. The following topics will be explored: basic nuclear properties, the nuclear force, models of nuclear structure, different types of nuclear decay, and nuclear fission and fusion and their applications. Particle Physics provides us with an understanding of the fundamental particles in the universe and the interactions between them. This course will provide an overview of the particles and interactions in the Standard Model of particle physics. Students will be taught how to use Feynman diagrams to calculate interaction cross-sectons for simple examples within Quantum Electrodynamics (QED), which describes the electromagnetic interaction. An overview of the development of the Standard Model through experimental observations will also be provided. This course requires a good understanding of Quantum Mechanics. Special relativity is also inherent in Modern Particle Physics, however for this course any necessary concepts will be taught in the lectures.

Literature:
Nuclear and Particle Physics: An Introduction by Brian R. Martin

Teaching methods:
Lecture(s), PBL

Assessment methods:
Written exam

PRA 3009 Microbiology
ECTS: 2.0

Course coordinator:
Zhukova I.A., SibSMU
Contact: *irzhukova@inbox.ru*

Pre-requisites: None
Co-requisites: BIO 3001. Microbiology

Course objectives:
In this skill training you will perform microbiological tests such as a variety of biochemical and molecular methods that enable you to identify an infectious agent and genetic relatedness in case of an outbreak.

Full course description:
The laboratory includes staining, microscopic examination and identification of microbes, prokaryotic ecology, aseptic technique and isolation of microbes, microbial growth media, control of microbial growth including antibiotic sensitivity testing, metabolism, genetics, taxonomy, protists, fungi, helminths, and arthropod vectors. Medical microbiology is concerned with the diagnosis, treatment and prevention of infectious diseases. For identification and treatment of an infectious agent patient samples are analyzed in a medical microbiology laboratory. In the first three weeks of this skill training you will get acquainted with the basic microbiological techniques such as, microbial culture, biochemical tests, antimicrobial resistance, and molecular characterization. In the subsequent weeks, you will each analyze a potential outbreak for which you will need to determine the infectious agent, analyze the antimicrobial resistance pattern to propose therapy as well as the genetic composition of the micro-organism in order to determine genetic relatedness. For this you will use the techniques that you have learned in the previous weeks. Finally you will need to present your results in a practical report.

Literature:
1. “Microbiology: Laboratory Theory & Application” by Michael J. Leboffe and Burton E. Pierce
2. “A Photographic Atlas for the Microbiology Laboratory” 4th Edition by Michael J. Leboffe, Burton E. Pierce

Teaching methods:
Research, Skills, PBL

Assessment methods:
Assignment, Final paper

PRA 3004 Polymer Processing

ECTS: 2.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: ***visaqam143@gmail.com***, gulnara.voronova@gmail.com

Pre-requisites: CHE2001. Organic Chemistry
Co-requisites: None

Course objectives:
The course is aimed at obtaining of skills to determine the physical and mechanical properties of polymers and to increase the understanding of the underlying analytical methods; obtaining of skills in the processing of polymers e.g. extrusion and injection moulding, compounding, pressing, etc.; the understanding of the processing of different polymers like thermoplastic, thermosetting and elastomeric polymers and coatings/paints

Full course description:
In this practical course the processing and mechanical testing of polymers will be explored. The course will exist of four different experiments. In these experiments the processing and testing of a specific polymer will be conducted. Thermoplastic polymers will be compounded (pure and as a blend) and processed in a blow or flat film trough extrusion. By the use of injection moulding standard dog bones will be made for mechanical testing. Mechanical and physical properties of the product will be determined by tensile and bending strength analysis, Melt Flow Index (MFI) and a notched test bar impact test. Thermosetting polymers will be processed into composites. Different techniques for constructing composite materials will be addressed. Attaching different composite parts to each other is complicated and different methods will be explored. Mechanical and physical testing will be performed using the above described techniques. Rolling and pressing techniques will be used to process elastomers and the process of vulcanisation will be studied. After processing mechanical and physical testing will be performed. Coatings/paints play are an important application area of polymers. A basic coating will be made and will be processed. Characteristics like scratch and impact resistance of this coatings will be tested.

Literature:
The sources will be added

Teaching methods:
Research, Skills, PBL

Assessment methods:
Participation, Assignment, Observation

PRA 3002 Advanced Physics Laboratory: Particle Physics

ECTS: 2.0

Course coordinators:
Pleshkov M.O., Physics Faculty, Tomsk State University
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contacts: pankerams@gmail.com, dmitriy.bezrodnyy@gmail.com

***Pre-requisites*:** PRA2005. Physics Laboratory
Co-requisites: None

Course objectives:
To acquaint the participants with an overview of the main areas in high level experimental physics To illustrate the relationship between observation, experiment and hypothesis To give the participants a better understanding of the laws of physics To hone the skills required for planning and conducting experimental physics To develop the skills of experimental design and the impact this has on the outcome.

Full course description:
This skill is the culmination of the physics laboratory modules, and requires participants to use the skills that they have acquired in their previous lab experiences to good effect in order to design and conduct suitable experiments. The participants will have the opportunity to conduct experiments in Nuclear physics, and particle physics (ESR, Seeman effect, etc). During this skill, the participants will design experiments to test hypotheses in a variety of fields, ensuring that the data that they gather is sufficient to address pertinent questions in this field. Unlike the prerequisites, the participants will not be given step-by-step instructions for each experiment - a certain level of independence is both expected and required.

Literature:
1. University Physics with Modern Physics, H.D. Young & R. A. Freedman, Pearson Education (US), 13th International edition, May 2011.
2. Practical Physics, G.L. Squires, Cambridge University Press, 4th edition, September 2001.
3. Measurements and their Uncertainties: A practical guide to modern error analysis, I. Hughes & T. Hase, Oxford University Press, August 2010.

Teaching methods:
This skill is taught in a ‘carousel’ style – participants work in small teams (2 or 3 per team) with each team working on a different experiment during the session. During each subsequent week the team conducts a different experiment, this provides the opportunity for each team to perform experiments in diverse areas of physics during the entire module.

Assessment methods:
Assessment consists of personal contribution within the lab, quality of lab notes kept plus individual lab reports written following the laboratory session.

BIO 2005 Biotechnology
ECTS: 5.0

Course coordinators:
Volkova I.I., Biological Institute, Tomsk State University
Solomina Ye., Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University,
Contacts: volkovhome@yandex.ru, evgeniyasea27@gmail.com, gulnara.voronova@gmail.com

Pre-requisites: None
Co-requisites: PRA Biotechnology

Course objectives:
You will gain a better understanding of the progress of the biotechnology field and how it has impacted our daily lives in various ways. The course challenges you to generate your own biotechnological ideas and how to commercialize it, resembling the real commercial setting.

Description of the course:
Biotechnology is one of the most cutting-edge fields in the scientific world. The technological application of biological systems has led to the advancement of various products for the benefits of mankind. This course invites you to further explore the world of biotechnology. In this course, you will discover different types of biotechnology and their applications. You will be informed the latest discovery in the field from guest lecturers and readings. You will learn how biotechnological applications have impacted our daily lives with or without our realization. You will also obtain hands-on experiences in generating your own biotechnological ideas in various fields including agriculture, health and medicine, food science, and environment. You will then expand upon your ideas for a commercial purpose. The journey from brainstorming an idea to delivering an elevator pitch on your product will be one of the main focuses in the course. You will get to experience the process of commercializing an idea as practiced in the real commercial setting. This course offers an interdisciplinary perspective of scientific research (in biology, chemistry, or physics) and industrial approach which may potentially lead to an entrepreneurship.

Literature:
The sources will be added

Teaching methods:
Lectures and tutorial group meetings, individual home tasks

Assessment methods:
Final paper, Written exam

BIO 3003 Biological Diversity

ECTS: 5.0

Course coordinator:

Volkova I.I., Biological Institute, Tomsk State University
Contact: ***volkovhome@yandex.ru***

Pre-requisites: BIO2002 General Botany, BIO2003 General Zoology
Co-requisites: None

Course objectives:

At the end of this course the students will:
✓ understand what is biodiversity; how biodiversity has evolved and is evolving; how biodiversity structure itself; how biodiversity is spread on Earth; why is biodiversity important and what are the causes of its decline;
✓ be able to analyze and measure biodiversity
✓ be able to apply techniques for monitoring and sampling of biodiversity

Full course description:

The course presents an overview of the theory behind biological diversity evolution and dynamics and of methods for diversity calculation and estimation. Students will become familiar with the major alpha, beta, and gamma diversity estimation techniques and get understanding how biodiversity evolved and is evolving on Earth and how to correctly use and interpret biodiversity data. This is important for all students interested in conservation biology and ecology, whether they pursue careers in academia or as policy makers and other professionals.

Literature:

1. “Encyclopedia of biodiversity” by Simon A Levin
2. Van Dyke F. Conservation biology: foundations, concepts, applications. 2nd ed. Dordrecht: Springer, 2008. 477 p.

Teaching methods:

Lecture(s), Assignment(s), PBL

Assessment methods:

Participation, Final paper, Two-part exam: written (test) and oral

CHE 3002 Transition Metal Chemistry

ECTS: 5.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: ***visaqam143@gmail.com***, gulnara.voronova@gmail.com

Pre-requisites: CHE2001 Organic Chemistry, CHE2002 Inorganic Chemistry
Co-requisites: PRA3007 Transition Metal Chemistry

Course objectives:
✓ To build up on the student's knowledge of d-block elements acquired during Inorganic Chemistry
✓ To allow the student to gain deeper understanding of the electronic structure and properties of d-block elements
✓ To deepen the student's understanding of crystal field theory and its applications in spectroscopy and magnetochemistry
✓ To provide the student with a complex understanding of the reaction types and mechanistic pathways in the coordination chemistry of d-block elements
✓ To introduce the student to organometallic chemistry
✓ To provide a descriptive survey of basic organometallic reactions and their mechanistic pathways
✓ To give the student a brief introduction to molecular catalysis

Full course description:
This course will build up on the student's knowledge about the d-block elements acquired in the inorganic chemistry course. The course will start with a review of the basic properties and electronic structure of transition metals, progressing into a deeper understanding of both, variable oxidation state (number). The review of crystal field theory will lead into a discussion on spectroscopic transitions and Jan-Teller distortions. A review on the basics of coordination chemistry will also be undertaken, rapidly progressing into a discussion on the different reactions undergone by transition metal coordination compounds (formation of complex ions; formation of coloured compounds; the origin of colour in the transition metal ions) and the kinetic and thermodynamic principles behind them. The student will be introduced to organometallic chemistry and its main principles. A selected number of organometallic catalytic cycles will be discussed and analysed.

Literature:
The sources will be added

Teaching methods:
Lecture(s), Seminars, PBL, Research

Assessment methods:
Presentation, Written exam,

INT 2001 Molecular Biology

ECTS: 5.0

Course coordinators:
Volkova I.I., Biological Institute, Tomsk State University
Solomina Ye. Tomsk State University
Contacts: volkovhome@yandex.ru, evgeniyasea27@gmail.com

Pre-requisites: BIO2002. General Botany; BIO2003. General Zoology
Co-requisites: None

Course objectives:
The course focuses on the structure and function of biologically important molecules, giving you a range of theoretical knowledge and practical lab skills. You will learn about DNA, RNA and proteins and the molecular events that govern cell function while exploring the relevant aspects of biochemistry, genetics and cell biology. Advances in molecular biology have led to the completion of several large genome projects that are changing the face of modern biology, especially in areas of medicine, agriculture and biotechnology.

Full course description:
An introduction to the basic structure and function of cells, with an emphasis on eukaryotic cell biology. Topics include investigation of the eukaryotic cell-cycle. Gene expression and its regulation are introduced. Protein structure and metabolism; gene replication, repair, recombination, and expression; RNA processing and metabolism, and molecular transport, trafficking, and signalling are covered. RNAi technology in cancer drug development is covered. Importance of Molecular Cell Biology for biotechnology and the society are highlighted. Hands on laboratory sessions include molecular cell biology techniques such as DNA isolation from plant and animal cells; Analysis of cell division in plant cells (i.e., onion root tips); and DNA analysis by agarose gel electrophoresis.

Literature:
The sources will be added

Teaching methods:
These range from lectures and tutorials

Assessment methods:
A final examination with open quastions

INT 3001 Biomaterials

ECTS: 5.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: ***visaqam143@gmail.com***, gulnara.voronova@gmail.com

Pre-requisites: CHE2001. Organic Chemistry
Co-requisites: None

Course objectives:
The course is aimed at providing an overview of all materials that are used in biomedical applications; understanding the synthesis and structure of different biomaterials; metals, ceramics, polymers, and composites thereof; introducing the student to the evaluation, characterization, and testing of biomaterials; providing a detailed understanding of the interaction of biomaterials with surrounding tissues and the complete organism

Full course description:
What makes a material a biomaterial? The overall objective of the course Biomaterials is for the student to gain insight in the role that properties of materials can play in solving biomedical problems. Relevant questions in this context are: which requirements need to be met to render a material suitable for biomedical applications? Which biomedical problem is to be solved, and which material offers the best solution? What is the current state-of-the-art? What are the most promising developments? A biomaterial is defined as "any substance or combination of substances, other than drugs, synthetic or natural in origin, which can be used for any period of time, which augments or replaces partially or totally any tissue, organ or function of the body, in order to maintain or improve the quality of life of the individual". In this course, the exact structure and physico-chemical characteristics of various biomaterials (metals, ceramics, polymers, composites) will be explained. For instance, the composition, degradation behavior and mechanical properties are important parameters. The techniques that are used to evaluate the physico-chemical characteristics of biomaterials are, consequently, an important subject. Furthermore, the interactions between different biomaterials and the biological environment (cells, extracellular matrix, tissues, organs) will be studied. The concepts of biocompatibility, bioinertness and bioactivity will be introduced, as well as various methods used to determine the biological response to a biomaterial.

Literature:
The sources will be added

Teaching methods:
Lecture(s), PBL

Assessment methods:
1) A final examination with open questions;
2) A poster presentation on the short project concerning biomaterials research

PHY 3001 Quantum Physics

ECTS: 5.0

Course coordinator:
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contact: ***dmitriy.bezrodnyy@gmail.com***

Pre-requisites: PHY2001. Classical Mechanics
Co-requisites: None

Course objectives:
✓ Understand the foundations underlying Quantum Mechanics
✓ Solve Schrödingers wave equation for analytically solvable potentials
✓ Calculate QM expectation values of physical observables and their time evolution
✓ Use the operator and vector space notation in calculations
✓ Calculate the non-classical behavior resulting from the postulates of QM
✓ Understand the modern orbital atomic model of Hydrogen and calculate the corresponding wave functions.

Full course description:
This course is an introduction to Quantum Mechanics, aimed at interested physics or chemistry students. Some prior knowledge of classical physics, linear algebra and infinitesimal calculus will help in looking through the equations and understand what is going on. When looking at the world at very small scales, classical physics (classical mechanics, electromagnetism, thermodynamics) is no longer sufficient to explain our observations. In order to describe the phenomena at these scales, we will enter the strange world of wave functions, probabilities of reality and Schrödingers equation. Starting from the failings of classical physics, we will see the necessity of describing the world in a different way, and try to make sense of it in terms of classical variables like position and momentum. We will calculate the quantized energy states of various analytically solvable systems like the square-well potential and the harmonic oscillator, before turning to the proper linear-algebraic description of quantum mechanics. We will explore things like tunneling, commutation relations of operators, Heisenberg's uncertainty principle, Pauli's exclusion principle and spin. Finally, we will do a proper treatment of the hydrogen atom in 3D and its orbitals.

Literature:
1. "Introduction to Quantum Mechanics", David J Griffiths
2. "Atomic physics", Max Born

Teaching methods:
Lecture(s), PBL

Assessment methods:
Written exam, tutor grade for participation in tutor-group discussions and tasks.

PRA 3003 Molecular Biology

ECTS: 5.0

Course coordinator:
Zhukova I.A., SibSMU
Solomina Ye., Tomsk State University
Contact: irzhukova@inbox.ru, evgeniyasea27@gmail.com

Pre-requisites: BIO2001. Cell Biology, BIO2004.Genetics
Co-requisites: BIO 3001. Microbiology

Course objectives:
To grasp the contextual setting which animal models are commonly used in Molecular Life Sciences. To apply DNA cloning, transfection and imaging procedures using prokaryotic and eukaryotic cells. To perform quantitative analyses on (non)coding RNA species and proteins from cell culture and organ biopsies. To apply molecular biological principles to a pre-assigned task and present the findings to a larger audience. To interpret scientific results and to write a scientific proposal on a Molecular Biological approach to relevant human disorders and defend it in a larger audience.

Full course description:
The general aim of this skills course is to obtain detailed knowledge about the techniques that can be applied to address molecular processes in cell signaling and control of gene expression. Topics include the activation of intracellular signaling pathways; analysis of cellular responses; analysis of gene expression; analysis of protein activation; in silico analysis of signaling pathways; and the culmination of the above elements in an essay and assignment to indicate active understanding of the above processes. The skills days are designed to provide a perspective of how cutting edge molecular biological techniques are applied to tackle major research questions in modern biomedical research.

Literature:
The sources will be added

Teaching methods:
Work in subgroups, Skills, Research

Assessment methods:
Participation, Presentation, Written exam, Final paper

PRA 3007 Transition Metal Chemistry

ECTS: 5.0

Course coordinators:
Visakh P. M, Institute of Smart Materials and Technologies, Tomsk State University
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: ***visaqam143@gmail.com***, gulnara.voronova@gmail.com

Pre-requisites: PRA2001 Chemical Synthesis; PRA2003 Inorganic Synthesis
Co-requisites: CHE3002 Transition Metal Chemistry

Course objectives:
To learn common techniques in inorganic synthesis To perform synthesis of coordination compounds To experimentally observe the principles of catalysis To apply the knowledge gained in CHE3002 in a laboratory setting To use the available instrumentation to spectroscopically analyse transition metal compounds

Full course description:
This course will focus on the synthesis of transition metal complexes and the experimental exploration of their chemical and physical properties. Some air sensitive techniques will be explored.

Literature:
The sources will be added

Teaching methods:
Work in subgroups, Assignment(s), Research, Skills

Assessment methods:
Assignment, Final paper, Participation

PRA3002 Advanced Physics Laboratory: Quantum Physics

ECTS: 2.0

Course coordinators:
Pleshkov M.O., Physics Faculty, Tomsk State University
Bezrodnyy D.A., Physics Faculty, Tomsk State University
Contacts: pankerams@gmail.com, dmitriy.bezrodnyy@gmail.com

***Pre-requisites*:** PRA2005. Physics Laboratory
Co-requisites: None

Course objectives:
To acquaint the participants with an overview of the main areas in high level experimental physics To illustrate the relationship between observation, experiment and hypothesis To give the participants a better understanding of the laws of physics To hone the skills required for planning and conducting experimental physics To develop the skills of experimental design and the impact this has on the outcome.

Full course description:
This skill is the culmination of the physics laboratory modules, and requires participants to use the skills that they have acquired in their previous lab experiences to good effect in order to design and conduct suitable experiments. The participants will have the opportunity to conduct experiments in Atomic physics, laser physics and particle physics (eg Photoelectric Effect, Blackbody Radiation, Atomic Spectra etc). During this skill, the participants will design experiments to test hypotheses in a variety of fields, ensuring that the data that they gather is sufficient to address pertinent questions in this field. Unlike the prerequisites, the participants will not be given step-by-step instructions for each experiment - a certain level of independence is both expected and required.

Literature:
4. University Physics with Modern Physics, H.D. Young & R. A. Freedman, Pearson Education (US), 13th International edition, May 2011.
5. Practical Physics, G.L. Squires, Cambridge University Press, 4th edition, September 2001.
6. Measurements and their Uncertainties: A practical guide to modern error analysis, I. Hughes & T. Hase, Oxford University Press, August 2010.

Teaching methods:
This skill is taught in a ‘carousel’ style – participants work in small teams (2 or 3 per team) with each team working on a different experiment during the session. During each subsequent week the team conducts a different experiment, this provides the opportunity for each team to perform experiments in diverse areas of physics during the entire module.

Assessment methods:
Assessment consists of personal contribution within the lab, quality of lab notes kept plus individual lab reports written following the laboratory session.

INT 3005 Molecular Toxicology

ECTS: 5.0

Course coordinator:
Zhukova I.A., SibSMU
Contact: *irzhukova@inbox.ru*

Pre-requisites: None
Co-requisites: None

Course objectives:
✓ To gain knowledge on experimental approaches to identify and quantify metabolites, reactive intermediates and their selective interaction with specific cellular target molecules (selective toxicity)
✓ To get acquainted with the procedures applied to assess the toxicity of drugs and chemicals.
✓ To understand the role of bioactivation and bio-inactivation in the toxicity of drugs and other xenobiotics.
✓ To be able to apply strategies used to predict toxicity
✓ To understand strategies to reduce or prevent toxicity
✓ To understand risk factors involved in inter-individual susceptibility to xenobiotics, including genetic polymorphisms, drug-drug and food-drug interactions.

Full course description: Human molecular toxicology studies the molecular mechanisms underlying toxicity of compounds in man. The conversion to reactive intermediates and metabolites is key in the actual toxicity of compounds. Therefore, the role of metabolism in the formation of metabolites and reactive intermediates and the protection against these species is extensively addressed. Moreover, compounds generally display a toxicity that is restricted to a specific organ and type of toxicity. This concept of selective toxicity is elaborated. Focus is on redox-controlled processes in biotransformation and in modulation of cell function. Topics include a survey of the molecular mechanisms determining (selective) toxicity; the versatility of enzymes, such as cytochrome P450 and glutathione S-transferases in the biotranformation of compounds; consequences of genetic polymorphisms of biotransformation enzymes; chemical and biological properties of various classes of reactive intermediates; structure-activity relationships and other approaches applied to predict metabolism; and strategies to reduce toxicity.

Literature:
A selection of scientific papers will be provided during the course.

Teaching methods:
Lectures, short practical and tutorial group meetings.

Assessment methods:
1. A final examination, which consists of open questions and multiple choise questions,
2. A presentation on a selected topic,
3. The contributions to the tutorial group meetings.

INT 2001 Introduction to Chemical Engineering

ECTS: 5.0

Course coordinator:
Voronova G. Institute of Smart Materials and Technologies, Tomsk State University
Contacts: gulnara.voronova@gmail.com

Pre-requisites:None
Co-requisites: None

Course objectives:
To provide an overview of the different fields of chemical engineering.

Full course description:
Course is designed to enable the student to explore the activities in which a modern chemical engineer is involved. You will get an overview of chemical engineering through discussion and engineering analysis of physical and chemical processes. This course will introduce (some of) the subdisciplines within chemical engineering, including overall staged separations, material and energy balances, concepts of rate processes, energy and mass transport, and kinetics of chemical reactions. Applications of these concepts to areas of current technological importance: biotechnology, energy, production of chemicals, materials processing, and purification. General issues of each of the subdisciplines will be illustrated together with selected examples and applications. Mathematics is employed as a language at the most elementary level.

Literature
Two references that you might find useful are:
1. Douglas, J. Conceptual Design of Chemical Processes. New York, NY: McGraw-Hill Science/Engineering/Math, 1988. ISBN: 9780070177628.
2. Seider, W. D., J. D. Seader, and D. R. Lewin. Product and Process Design Principles: Synthesis, Analysis, and Evaluation. 2nd ed. New York, NY: Wiley, 2003. ISBN: 9780471216636.

Teaching methods:
Lectures and tutorial group meetings, individual home tasks, problem sets.

Assessment methods:
To be determined.

MAT 2005 Numerical Mathematics

ECTS: 5.0

Course coordinator:

Tarasov E.A., Faculty of Mechanics and Mathematics, Tomsk State University
Contact: diomedis@mail.ru

Pre-requisites: Mat1001.Introduction to Natural Sciences Calculus; Mat1003. Linear Algebra; Pra2002.Programming. Part 1
Co-requisites: None

Course objectives:

To provide an understanding of core techniques in scientific computing. To have an understanding of theoretical properties of numerical algorithms. To be able to analyze which numerical methods are appropriate to solve a given problem. To be able to modify existing numerical methods to solve new problems. To provide the background knowledge and skills needed to solve problems in scientific computing arising in later courses and in scientific practise.

Full course description:

Predicting the yield of a chemical process, the path of a space rocket, the effect of a particular medicine, or filling the gaps in gene expression data: all these are scientific problems which can be formulated mathematically. Unfortunately they are in general too difficult to solve using methods like those you have learned in calculus. Numerical methods form an alternative approach in which approximate solutions are calculated for specific values of the data describing the problem. Since the development of high-performance digital computing, numerical mathematics has become a cornerstone of modern science, and the ability to use computational tools, assess the suitability of numerical methods, and develop new numerical algorithms is an essential part of the modern scientist's knowledge. In this course we address essential concepts in numerical mathematics, and algorithms for the solution of some core problems in the mathematical sciences, including arithmetic with floating-point numbers, algebraic equations, polynomial interpolation, integration and differentiation, ordinary differential equations, least-squares approximation, Fourier series, matrix equations and eigenvalues.

Literature:

The sources will be added

Teaching methods:

Lecture(s), PBL, computer practicals.

Assessment methods:

Final exam, homework assignments.

BIO 3004 Landscape ecology
ECTS: 5.0

Course coordinator:
Volkova I.I., Biological Institute, Tomsk State University
Contact: volkovhome@yandex.ru

Pre-requisites: None
Co-requisites: BIO2002. General Botany; BIO2003. General Zoology; BIO3003. Biological Diversity; INT3003. Vegetation Science, BIO3002. Siberian Ecology

Course objectives:
The course will provide the students with strong interest in ecology and sustainable management of natural resources the basis to be able to develop the high-level environment-friendly scientific projects and to make wise decisions on the nature management and land use.

Full course description:
Landscape ecology and nature conservation discipline is designed to enable students from all over the world to understand and assess landscapes and their functioning, to identify and evaluate changes and potentials of ecosystems, and, finally, to develop sustainable land use concepts. The multidisciplinary and innovative approach of the leading scientific school of Russian Federation in the field of landscape ecology, based at the TSU, provides unique possibilities for addressing the global environmental challenges of today and tomorrow. The main topics, presented at the course, provide theoretical knowledge and practical experience in landscape ecology, ecosystem dynamics, conservation biology, environmental ethics and landscape economics as well as scientific skills and advanced field skills.

Literature:
1. “Learning Landscape Ecology. A Practical Guide to Concepts and Techniques” by Sarah E. Gergel and Monica G. Turner
2. “Applied Landscape Ecology” by Francisco Castro Rego and Stephen C. Bunting, 2018
3. “Principles and methods in landscape ecology: towards a science of the landscapes” by Farina A. Dordrecht; London: Springer, 2007. 412 p. (Landscape series; Vol. 3). ISBN 9781402033278 http://www.ebooks-downloads.net/ebook-pdf/principles-and-methods-in-landscape-ecology
“Landscape Ecology” in Action by Farina A., 2012 “Landscape Ecology Concepts, Methods, and Applications” by Francoise Burel and Jacques Baudry “Key Topics in Landscape Ecology” by Jianguo Wu and Richard J. Hobbs; Published by Cambridge University Press “Landscape Ecology. Theory and Application” by Zev Naveh and Arthur S. Lieberman

Teaching methods:
Research, Skills, PBL

Assessment methods:
Assignment, Attendance

INT 3006 Regenerative Medicine
ECTS: 5.0

Course coordinator:
Zhukova I.A., SibSMU
Contact: *irzhukova@inbox.ru*

Pre-requisites: BIO2001. Cell Biology, CHE2001. Organic Chemistry
Co-requisites: None

Course objectives:
The objectives of the course "Regenerative Medicine" are to introduce students to classic and novel concepts at the base of strategies to regenerate tissues and organs. The courses will briefly overview the biomaterial classes used to fabricate scaffolds and the processing technologies used for fabrication. Further insights on cell sources and cell nutrition will be explained. Different applications will be discussed spanning from skin to skeletal tissues and organ regeneration. After attending the course, students will be able to understand:
✓ biomaterials and processing technologies used to fabricate scaffolds for tissue engineering;
✓ cell sources and activity;
✓ cell nutrient limitations in engineered tissues and technologies used to enhance cell viability;
✓ successful and unsuccessful strategies to regenerate tissue and organs;
✓ ethical principles revolving around regenerative medicine and clinical applications.

Full course description:
Regenerative medicine has been defined as an interdisciplinary field that integrates principles of engineering and life sciences to develop biological substitutes that restore, maintain, or improve tissue and organ functions. Three main gears are generally needed to achieve tissue regeneration: cell-based therapies, tissue-inducing factors, and biocompatible matrices or scaffolds. These components have been investigated singularly or in combination to create engineered tissues. Regenerative medicine research includes the following areas:
✓ Biomaterials: including novel biomaterials that are designed to direct the organization, growth, and differentiation of cells in the process of forming functional tissue by providing both physical and chemical cues.
✓ Cells: including enabling methodologies for the proliferation and differentiation of cells, acquiring the appropriate source of cells such as autologous cells, allogeneic cells, xenogeneic cells, stem cells, genetically engineered cells, and immunological manipulation.
✓ Biomolecules: including growth and other differentiating factors.
✓ Engineering design aspects: including 2D cell expansion, 3D tissue growth, bioreactors, vascularization, cell and tissue storage and shipping (biological packaging).
✓ Biomechanical aspects of design: including properties of native tissues, identification of minimum properties required for engineered tissues, mechanical signals regulating engineered tissues, and efficacy and safety of engineered tissues
In this course, we will introduce most of these elements through some examples that have already successfully reached the clinics and others that have still to be further improved to enter daily clinical practices.

Literature:
1. “Tissue Engineering", editors J. de Boer and C.A. van Blitterwijk, Academic Press Series in Biomedical Engineering, Elsevier Inc (2015).

2. “Principles of Regenerative Medicine”, editors A. Atala, R. Lanza, J.A. Thomson, and R.M. Nerem, Elsevier Inc (2008).

Teaching methods:

Lectures, tutorial groups meetings, a small research based project using literature resources.

Assessment methods:

1) A final examination, which consists of a mixture of open and multiple choice questions;
2a) a written report and 2b) oral presentation on the short project concerning regenerative medicine research.