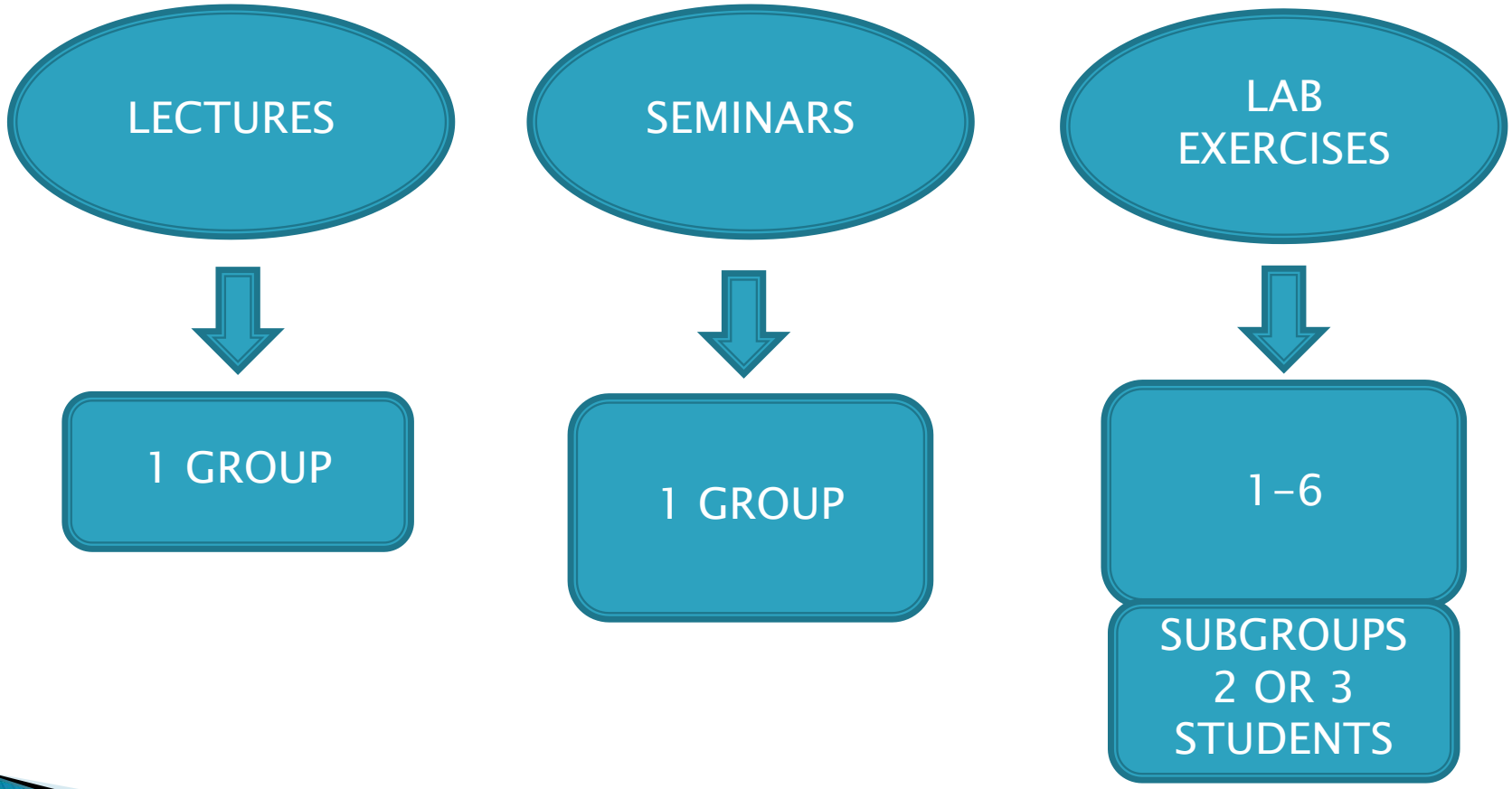
Department of Physics and Biophysics	
Ozren Gamulin, PhD, Assistant professor (Head of Department)	
Sanja Dolanski Babić, PhD, Assistant professor (Course Coordinator)	
Marko Škrabić, Assistant	
Nikola Šegedin, Assistant	

- Ana Horvatin – office secretary
- Andreja Ožvald – lab technician

Course plan


LECTURES
1 GROUP
SEMINARS
1 GROUP
LAB EXERCISES
1-6
SUBGROUPS 2 OR 3 STUDENTS

Plan of the course!

1. Week				
	Time	Type	Topic	Lecturer
Monday 16.04.2018.	10:00 -11:30	Lecture 1	The structure of matter: force and energy, vector and scalar fields, fundamental forces in nature; basic mathematical functions, periodic functions, Fourier theorem	S. Dolanski Babić, PhD
	12:00- 14:00	Lab A	Error calculation; graph drawing	M. Škrabić N. Šegedin
Tuesday 17.04.2018	9:00 -10:30	Seminar 1	Basic mechanics: Newton's laws, torque, conditions of translational and rotational equilibrium; lever, levers in the body, application in dentistry	S. Dolanski Babić, PhD
	10:45- 11:30	Lecture 2	The structure of atom energy states of atoms, electron quantum numbers, Paulli's exclusion principle	S. Dolanski Babić, PhD
Wednesday 18.04.2018	9:00 -11:00	Lab. 1	Exercises 1 - 6	M. Škrabić N. Šegedin
	12:30- 14:00	Lecture 3	Structure of molecule; molecular bonds; energy states; spectroscopy	S. Dolanski Babić, PhD
Thursday 19.04.2018.	9:00-9:45	Lecture 4	Oscillations: free, damped and forced - resonance	S. Dolanski Babić, PhD
	10:15-11:45	Seminar 2	Sound waves; physical and physiological parameters of sound, Doppler effect, ultrasound generator	S. Dolanski Babić, PhD
	12:45-14:45	Lab. 2	Exercises 1 - 6	M. Škrabić N. Šegedin
Friday 20.04.2018.	8:30-9:15	Lecture 5	Structure of solids: crystals and polycrystals; imperfections and defects in crystal lattice: point and line defects; metal alloys, polymers	O. Gamulin, PhD
	9:30-11:00	Lecture 6	Elastic force; linear elastic deformation; viscoelastic properties of matter; mechanical elements and models; mechanical properties	O. Gamulin, PhD

Lectures

- Absence from lecture can NOT be made up.
- Duration: 1 or 2 sch. hours-> total 20 sch. hours

Seminars

- Duration: 2 sch. hours -> total 20 sch. hours
- Interactive type of teaching so before each seminar review materials put on https://www.sfzg.unizg.hr/predmet/173111
- Obligatory!

- Make up for one absence = essay, and for more than one absence = oral presentation

Lab exercises

- Obligatory!
- 6 lab exercises + A
- Duration: 2 sch. hours-> total 20 sch. Hours

- Student has to complete all exercises in order to get signature in Index ant to be able to take exam.
- Each exercise has to be finished, checked and signed during the Lab

- Literature: Physics Laboratory Manual, Ed. M. Balarin, J. Brnjas-Kraljević, O. Gamulin, Medicinska naklada, Zagreb

Exam

- Practical part
  - Has no grade, just pass or fail.
  - Student can be exempted from practical part of exam by passing preliminary exam right after finishing all exercises
  - If not students can take practical exam during regular exam terms.
- Written part
  - Students can get exemption by passing 2partial tests during the course
  - Each partial test has 18 questions, and to pass it the student has to collect 10 correct answers.
  - If not, then he has to take a written exam prior to oral exam. Written exam has 36 questions and to pass it the student must have 22 correct answers (61%).
- Oral part
  - Three questions one from each group.

- In order to pass the exam and gat a grade in index the student has to pass all three parts of exam.

Taking exam

- If you want to take an exam you have to register for it through STUDOMAT at least 8 days prior the exam.
- Once he applied the student has to take all parts of exam that he needs.
- Once passed practical or written part it stays valid for that academic year.

Vectors

- Physical quantities are either vectors or scalars.
- Scalars are quantities that are fully described by a magnitude (or numerical value) alone.
- Vectors are quantities that are fully described by both a magnitude and a direction.
- Example of scalars: mass, energy, density, concentration
- Example of vectors: force, acceleration, magnetic field

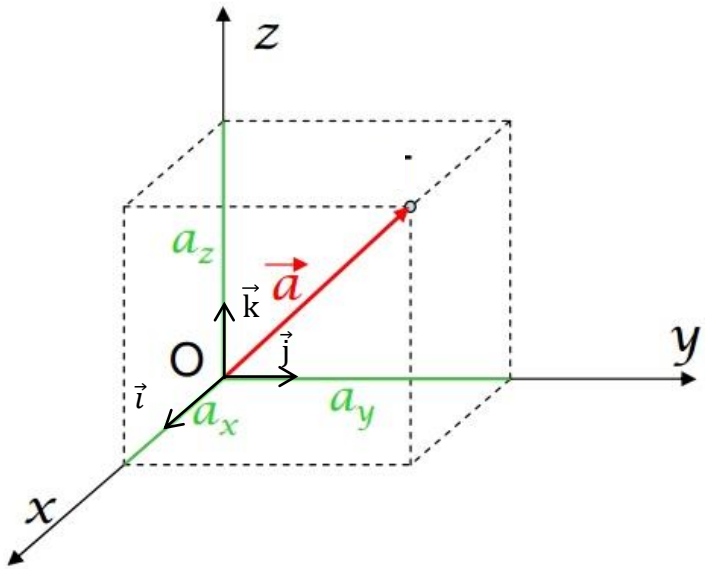
- Calculation with scalars is the same as for real numbers.
- Calculation with vectors is not that simple since the direction has to be take into consideration.
- In 3D coordinate system a vector can be represented as a sum of its projections on coordinate axes.

$$\vec{a} = a_x\vec{i} + a_y\vec{j} + a_z\vec{k}$$

Unit vector in x direction: $\vec{i}$

Unit vector in y direction: $\vec{j}$

Unit vector in z direction: $\vec{k}$

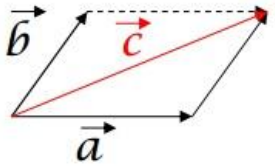


Vector addition and subtraction

Vector addition

Parallelogram rule

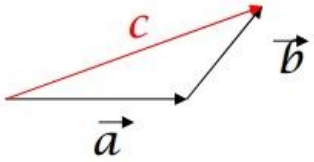
(for vectors with common origin)



$$\vec{c} = \vec{a} + \vec{b}$$

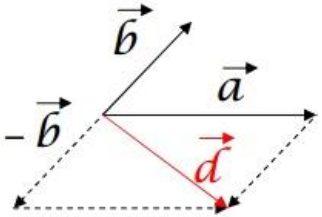
Triangle rule

(for continuing vectors)



Vector subtraction

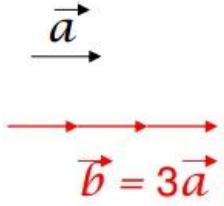
$$\vec{d} = \vec{a} - \vec{b} = \vec{a} + (-\vec{b})$$



Multiplication of vector with scalar

$n \in \mathbf{N}$

$$n \cdot \vec{a} = \vec{a} + \vec{a} + \ldots + \vec{a}$$



Scalar and vector product

Scalar product of vectors

Scalar product of vectors is scalar!!

$$\vec{a} \cdot \vec{b} = |\vec{a}| \cdot |\vec{b}| \cdot \cos\varphi \quad , \quad \varphi = \sphericalangle(\vec{a}, \vec{b})$$

Example

Mechanical work

$$W = \vec{F} \cdot \vec{s} = |\vec{F}| \cdot |\vec{s}| \cdot cos\varphi$$

http://www.falstad.com/dotproduct

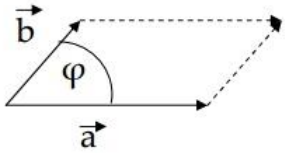
Vector product

Vector product of vectors

Vector product of vectors is vector!!

Magnitude of vector c is:

$$|\vec{c}| = |\vec{a} \times \vec{b}| = |\vec{a}| \cdot |\vec{b}| \cdot \sin \varphi \ , \quad \varphi = \sphericalangle(\vec{a}, \vec{b})$$



$|\vec{c}|$ is equal to surface area of parallelogram between vectors $\vec{a}$ i $\vec{b}$

Direction:

$\vec{c}$ is perpendicular to vectors $\vec{a}$ i $\vec{b}$

tj. $\vec{c} \perp \vec{a}, \vec{b}$

Orientation:

$\vec{a}, \vec{b}, \vec{c}$ are right oriented;
right hand rule