Medical Physiology Course Syllabus

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Full professor of Medical Physiology

2012-2013 academic year
Course Chairperson:
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Welcome to Medical Physiology! This is an exciting course that you will find both challenging and interesting... after all, it is all about you! The goal of the Human Physiology course is to provide the student with a fundamental understanding of the physiological basis of medicine. The essential concepts of physiology and mechanisms of body function are presented at various levels of organization ranging from the cellular and molecular, to the tissue and organ system level. First, we will analyze cellular functions, as well as how the cells work together to coordinate organ function. Additionally, we will explore how the organs work together to maintain homeostasis and stability within the human body. In this regard, physiology may be distinguished from other basic biomedical sciences because it deals with the function of the whole organism and emphasizes those processes that regulate and control entire organ systems. Emphasis is also placed on understanding the integrated regulation of various body processes among several systems. This understanding will include learning many terms that you may not have been associated with before. The terminology is almost like learning another language because you need to learn how to use the terms and in what situations to use them. We are very complex organisms and you will analyze those complexities.

We hope that your efforts to learn physiology will equal our efforts to teach you this important subject. Together we will work hard because our overall aim is to help you to gain knowledge and skills that will serve as a basis for your understanding of clinical medicine. E.A. Starling, the famous physiologist of the early 20th century, said "The physiology of today is the medicine of tomorrow."

Dear Parents,
It is my pleasure to be your children’s chairperson for Medical Physiology Course this academic year. I am a dedicated and enthusiastic educator who will support their academic development. Please feel free to contact me anytime to discuss their progress. Thank you in advance for your support, as together we prepare your children for success!
Sincerely,
Gordana Maširević-Drašković, Chairperson for Medical Physiology Course

Your first instructions for the semester are to carefully read this syllabus. Many of your questions will be answered therein.

Education

- Undergraduate studies (in Serbian and English language)
  - Lectures
  - Seminars
  - Laboratory sessions
  - Election courses
  - Consultations
Postgraduate studies
- MS studies
- PhD studies
- Academic specialist and subspecialist studies in a basic branch of specialization in health profession

Departments at the Institute of Medical physiology “Richard Burian”

Undergraduate department
Medical physiology

Postgraduate departments
- Clinical and experimental physiology and pathophysiology
- Sports medicine
- Balneoclimatology

Department for undergraduate studies – Who’s in charge:

Chairman: Dr Dragan Đurić, Full professor
Deputy: Dr Zvezdana Kojić, Associate professor
Chief executive: Dr Ljiljana Šćepanović, Full professor
Chairperson for Medical physiology in English language: Dr Gordana Maširević- Drašković, Full professor

Teaching staff:
Dr Gordana Maširević- Drašković, Full professor
Dr Slavica Suzić, Full professor
Dr Dušan Mitrović, Full professor
Dr Ljiljana Šćepanović, Full professor
Dr Dragan Đurić, Full professor
Dr Olivera Stanojlović, Associate professor
Dr Zvezdana Kojić, Associate professor
Dr Sanja Mazić, Assistant professor
Dr Aleksandra Rašić- Marković, Assistant professor
Dr Dejan Nešić, Assistant professor
Dr Darko Stevanović, Assistant professor
Dr Miloš Petrović, Assistant professor
Dr Predrag Brkić, Teaching assistant
Dr Marina Đelić, Teaching assistant
Dr Dragan Hrnčić, Teaching assistant
Dr Igor Pantić, Teaching assistant
Dr Marija Stojanović, Teaching assistant
The material in this course is presented by way of a variety of large and small groups settings: lectures, seminars, exercises, and laboratory demonstrations. Each is designed to serve a different educational goal and together they provide an appropriately stimulating atmosphere for learning.

Course Description:

**Course duration** – two semesters  
**Total lecture hours** – 112/24 Units  
**Exercises:** 27 weeks (105 hrs)  
**Active learning activities:**  
  - Seminars 17 (34 hrs) and  
  - Colloquia 4 (3 – Medical physiology and 1 Biophysics in medicine)  
**Exams:** Practical exam and Final examination  
**Election courses:** 7 (30 hrs each)  
**Total course hours** – 268

**COURSE AREAS**

**Lectures**  
Lectures will be approximately 90 minutes in duration, twice a week, and generally will conform to the classical didactic pattern. Lectures are designed to introduce the student to a specific topic of physiology. Lecturers have designed their lectures to present physiological principles in an organized and comprehensive fashion. They may integrate recent advances in the field into their lectures; some of this material may not yet be found in textbooks.  
Because of time restraints, questions during a lecture are not recommended, write down any questions about content you are unsure about or don’t understand. Students are encouraged to ask questions between lectures or in the lecturer’s office. It is strongly recommended that students read the associated syllabus material and reading assignments prior to a scheduled lecture.  
The course takes a systems approach to physiology. Due to the close interrelationship between structure and function in biological systems, each functional physiology topic will include a brief overview of anatomic structure. The physical and chemical laws that are the basis of the physiological processes will also be covered.

**LECTURES AND MUST-KNOW TOPICS**

1. **Introduction to medical physiology. Homeostasis and control mechanisms (2 hrs)**  
The goal of medical physiology. Functional systems of the cell and intercellular communication. Homeostasis and control mechanisms that maintain homeostasis. Strict and plastic homeostatic variables.

2. **Transports through the biological membranes (2 hrs)**  
Transport proteins. Facilitated diffusion. Diffusion through protein channels (control of permeability of the channels). Active transport (primary and secondary); vesicular transport (exocytosis and endocytosis). Transport through cellular sheets.
3. The body fluids (2 hrs)

4. Physiology of excitable tissues (4 hrs)

5. Muscle physiology (6 hrs)

6. General principles of neurophysiology (4 hrs)
7. Sensory physiology (4 hrs)

8. Special senses physiology. (Special sensory systems) (6 hrs)
The sense of taste. Primary sensations of taste; taste buds and its function, transmission of taste signals into the central nervous system, control of the diet, taste reflexes. The sense of smell. The olfactory membrane, stimulation of the olfactory cells, transmission of smell signals into the central nervous system. Adaptation and affective nature of taste and smell.

9. Motor neurophysiology (6 hrs)
substrate for motor, cognitive and affective functions of the basal ganglia. Voluntary (purposeful) motor activity: cooperation of motor and other areas of the cerebral cortex, basal ganglia and thalamus.

10. Autonomic nervous system (4 hrs)

11. Higher brain functions and the limbic system (6 hrs)

12. Heart physiology (8 hrs)
Organization of the circulatory system. Heart – central organ of the cardiovascular system. Morphological and functional characteristics of cardiac muscle, conductive system and heart valves. Conductive system of the heart. Excitation-contraction coupling. The cardiac cycle; phases of the cardiac cycle. Heart sounds. Stroke volume output, end-diastolic volume, end-systolic volume and ejection fraction. Cardiac output and venous return: physiological variations and factors that affect the cardiac output and venous return. Work output of the heart (volume and pressure load - preload and afterload); energy required for cardiac contraction. „All-or-nothing principle” and law of the heart (The Frank-Starling mechanism). Regulation of heart pumping: autoregulation, neural and humoral. Physiological basis of the electrocardiography (EKG). Recording and principles of analysis of EKG. Mean electrical axis of the heart.

13. Physiology of the circulation (8 hrs)

14. Blood physiology (8 hrs)

15. Kidney physiology (6 hrs)

16. Respiratory physiology (6 hrs)

17. Acid – base balance (2 hrs)
Acid-base buffering systems in the organism. Inorganic (bicarbonate, phosphate and ammonia) and organic (proteins) buffers. Distribution of buffering systems. Physiological buffers – respiratory and renal control of acid-base balance.

18. Physiology of the gastrointestinal system (6 hrs)
19. Energetics and metabolism (4 hrs)

20. Physiology of nutrition (2 hrs)

21. Thermoregulation (2 hrs)

22. Introduction to endocrinology and neuroendocrine integration: hypothalamic-hypophysial system (2 hrs)

23. Physiology of endocrine glands (8 hrs)

24. Physiology of reproductive system

* Parts of Medical physiology that will be presented by Department of Biophysics in medicine are marked by Italic font (15 hours)

* Parts of Medical physiology that will be presented by Department of Chemistry in medicine are marked by Italic font (2 hours)
Acid-base balance. Body chemical buffers

Exercises/Laboratory reports

There are several aims of the laboratory exercises in physiology: the laboratories will enable you to acquire additional information that will help you to better understand some of the lecture material and related subjects. Laboratories will furnish you with the very valuable experience of working with human subjects and developing manual dexterity. Participation in exercises will enable you to evaluate and draw conclusions from data, and in general, become familiar with methods of obtaining information in a biological system. These experiences will
help you in the future to evaluate claims concerning new methods of therapy and will also enable you to read the scientific literature more critically.

As Medical Physiology is a experimental and laboratory science you will participate in many practical work throughout the school year. Some exercises will be done in your interactive laboratory classroom and others will be done in laboratory classroom. Following the scientific method and discussing the implications of your results in relation to the topic we are studying; consistency and attention to detail will be of the utmost importance!

Your participation in exercises will be possible only if you read the related material outside of class time. In this way you can receive the maximum benefit from the exercises. A basic familiarity of the material prior to each lab is critical. The entire class will be divided into two groups of students. These groups of students should be able to work together in a spirit of cooperation in order to complete the exercise assignments most efficiently and accurately. At the end of each exercise period, each student will hand in the data sheets with all calculations or write a detailed laboratory report. All questions should be answered. Failure to hand in the exercise reports will result in a loss of signature for that exercise.

You must wear a lab coat during all exercises.
Safety rules MUST be followed at all times during exercises; e.g. you must wear gloves during all hematological exercises.

**EXERCISE**

Programme of exercises, seminars and colloquia in Medical physiology

III (winter) semester 2012-2013 (I colloquium)

*Italic font indicates laboratory sessions that will be held in computerised classroom and seminars by Teaching Staff of Biophysics. Seminars in Biophysics will be held at the Institute of Biophysics according to the schedule announced by Teaching Staff of Biophysics.*


**SEMINAR: Biophysics in Medical physiology - Osmosis. Osmotic pressure (total and effective osmotic pressure). Reflection coefficient. Surface tension (2 hours)**

**Exercise I (3 hours)**

1. Introduction to educational plan and program and evaluation of knowledge in Medical physiology
2. Working protocol for the exercises in Medical physiology
3. Experiment as a method for scientific research in medicine (selection of animals, acute and chronic experiment)
Exercise II (3 hours)
1. General principles and the ways of giving injections (practicing on a model)
2. Usage of computers in virtual laboratory (interactive laboratory simulations)
3. Interactive presentation of preparation of the nervus ischiadicus of a frog (SimNerv)

Exercise III (4 hours)
1. Obtaining of blood samples for laboratory analysis from the finger tip
2. Maintaining of a cell volume:
   a) bearing of erythrocytes in iso-, hypo- i hypertonic solution
   b) exploring of the osmotic fragility of the red blood cells in the hypotonic solutions
   c) investigation of the importance of osmotic reflection coefficient
3. Interactive presentation of homeostasis of the body water (A.D.A.M.)
4. Hydro-electrolitic balance: compartemnts, examples and calculations (Darrow-Yannet)
5. Interactive presentation of homeostasis of the body electrolytes (A.D.A.M.)

SEMINAR 1: Body fluids and physiological solutions (types and application) (2 hours)

Exercise IV (4 hours)
1. Introduction to recording and analysis of the membrane potentials
2. Recording and analysis of an action potential (AP) of a single nerve fiber and determination of a threshold stimulus parameters (AP7)
3. Investigation of changes in the extracellular concentrations of Na⁺, K⁺ and Ca⁺ on the resting membrane potential, action potential amplitude and excitability
4. Investigation of excitability of a single nerve fiber (voltage-duration curve)
5. Demonstration of the accommodation of a nerve fiber applying threshold stimuli of slowly rising amplitudes
6. Investigation of the effects of temperature on the Nernst potential for certain ions
7. Recording and analysis of ion currents under condition of normalcomposition of the extracellular and intracellular fluid and at the temperature of 37°C
8. Recording and analysis of the origin of inward and outward currents using blockers of Na⁺, K⁺ and Ca⁺ channels

Exercise V (4 hours)
1. Anesthesia in experimental research
   a. Introduction to anesthesia in surgery (types and stages)
   b. Demonstration of anesthesia on the experimental animals (frog, mouse, rat)
   c. Interactive session on types and application of different anesthetics in rat (Rat Blood Pressure)
2. Investigation of the nerve compound action potential properties (SimNerv)
   d. Recording and analysis of the compound action potential of the nervus ischiadicus of the frog
   e. Change the polarity sign of the voltage pulse. What effect on the action potential is noted?
   f. Demonstration that the cathode is an active electrode
   g. Demonstration of the induced polarization currents
3. Demonstration of the minimal and maximal stimulus intensity (demonstration of the graded response)

4. Demonstration of absolute and relative refractory periods and calculation of its duration

5. Calculation of the nerve conduction velocity of the action potential

3. Interactive video presentation of central nervous system (A.D.A.M.)

SEMINAR 2: Excitation and contraction of skeletal and smooth muscles (2 hours)

Exercise VI (4 hours)

1. General principles and practicing of obtaining blood samples by venipuncture and intravenous application of drugs (individual practicing on a model)
2. Separation of blood plasma and serum
3. Interactive presentation of skeletal muscles' physiology (A.D.A.M.)
4. Interactive presentation of preparation of nerve-muscle preparation of a frog (m. gastrocnemius and n. ischiadicus) (SimMuscle)
   a. Recording of the single isotonic skeletal muscle twitch (myogram)
   b. Determination of the intensity of the threshold and maximal stimulus and demonstration of the graded response
   c. Recording of summation of two muscle twitch
   d. Recording of the sustained muscle contraction (tetanus)
   e. Demonstration of the effect of loading on amplitude of a muscle contraction
   f. Demonstration of fatigue effects on myogram
   g. Recording of the single isometric contraction of skeletal muscle
   h. Demonstration that amplitude of the muscle contraction is a function of the stimulus intensity (graded response)

SEMINAR 3: Physiology of pain (2 hours)

Exercise VII (3 hours)

1. Analyse the sense of taste and smell
   a. a qualitative and quantitative analysis of smell
   b. a qualitative analysis of taste
   c. analyse interdependence between the sense of taste and smell
2. Recording of the single isometric contraction (myogram) (PhysioEx 4.0) and analysis of the obtained myograms
3. Recording of sustained muscle contraction and determination of the obtained developing force
4. Demonstration of a »treppe« phenomenon
5. Demonstration of the effect of muscle length on muscle tension due to application of a constant intensity stimulus (maximal stimulus) and drawing a length-tension diagram
6. Demonstration of the effect of stimulus intensity on muscle tension on the base of resting muscle length and construction of diagram
7. Demonstration of the effect of loading on the velocity of the isotonic muscle contraction and construction of the diagrams under different muscle length

Exercise VIII (4 hours)
1. Construction of an image of object in a complex optical system
2. Determination of the near and far point of vision and visual acuity testing
3. Demonstration of the blind spot – Mariotte’s assay
4. Charting the visual field by perimetry and confrontation method
5. Testing of the color vision
6. Testing of binocular depth perception of objects
7. Examination of the conjugated eyeball movements
8. Examination of the role of contrast in a visual image interpretation (background and illumination)
9. Demonstration of afterimages and optical illusions
10. Examination of visual attention (Brain Metric)

SEMINAR 4: Neurophysiology of vision (2 hours)

Exercise IX (4 hours)
1. Examination of the ocular fundi with an ophthalmoscope
2. Testing of air and bone conduction of the sound
3. Somatic sensations testing: exteroceptive (sensation of touch and thermal sensation); proprioceptive (vibration, position sense and sense of movement – kinesthesia)
4. Cortical sensations testing (graphesthesia, stereognosis, barognosis)
5. Multimedial presentation of the visual system physiology (Power Point)
6. Multimedial presentation of the auditory system physiology (Power Point)
7. Assessment of auditory threshold for the sounds of different frequencies (audiometry – Brain Metric)

Exercise X (4 hours)
1. Performing of the clinically important reflexes: corneal and conjunctival reflexes; papillary light reflex; reflex of accommodation; cutaneous reflexes and stretch reflexes
2. Testing of muscle strength and muscle tone
3. Performing of tests for evaluation of the cerebellar motor functions
4. Examination of the functional specialization of the cerebral hemispheres: dominance for hand, leg and eye
5. Performing of POSOV (“Programme for evaluation of the subjective sense of vertical position”) for evaluation of the vestibular system function
6. Reaction time testing
7. Withdrawal reflex and coordinated frog response (Pro dissector frog)

SEMINAR 5: Spinal cord reflexes (2 hours)

Exercise XI (4 hours)
1. Tests for evaluation of the vestibular system function: rotatory test; Romberg test; compass walk test
2. Electroencephalography (EEG) – principles of recording and basic analysis,
3. Electromyoneurography (EMNG) – determination of nerve conduction velocity
4. Analysis of a representative sample of normal EEG record
5. Testing of attention characteristics: range of attention, split (Trail-Making test) and nonsplit
(Stroop test) attention
6. Testing of immediate and short-term memory

SEMINAR 6: Control of posture and locomotion: brain stem (2 hours)

Exercise XII (3 hours)
1. Palpation of heart apical impulse (ictus cordis)
2. Auscultation of heart sounds
3. Determination of heart rate and the rhythmicity of heartbeats
4. Interactive presentation of rat's heart preparation (SimHeart) and apparatuses for recording by Langendorff Method
5. Recording and analysis of rat's heart muscle contractions
6. Demonstration and analysis of the effects of adrenaline, acetylcholine, and other substances on the heart rate and amplitude of the heart contraction
5. Interactive presentation of heart activity (A.D.A.M.)
6. Demonstration of Frank-Starling's law of the heart

SEMINAR 7: Learning and memory (2 hours)

Colloquium I: 1. Introduction to medical physiology. Homeostasis and control mechanisms;

Exercise XIII (4 hours)
1. Observation of the function of a valves on isolated beef heart (Gad's experiment)
2. Recording and analysis of human electrocardiogram (EKG)
3. Video presentation of EKG: assessment of basic ECG analysis
4. Interactive presentation of frog's heart function: (PhysioEx 4.0)
   a. recording of the baseline frog heart activity (mechanogram)
   b. induction and analysis of an extrasystole
   c. assessing the effect of temperature on the frog heart activity
   d. examining the effect of vagus nerve stimulation on the frog heart activity
5. Signatures, makeup of exercises and seminars

SEMINAR 8: EKG: recording and analysis (2 hours)

WINTER HOLIDAY – February 1 – 15, 2013

IV (summer) semester 2012-2013
Programme of exercises, seminars and colloquia in Medical physiology II and III colloquium)

Exercise XIV (4 hours)
1. Palpation of arterial pulse oscillations on various sites of the body
2. Estimation of radial artery pulse qualities in humans
3. Recording and analysis of arterial pulse oscillations (sphygmogram)
4. Measurement of velocity of fluid flow (ml/min) on the various models of piezometer
5. Video presentation of vascular system (A.D.A.M.)
6. Principles of hemodynamics (PhysioEx 4.0): Measurement of blood flow (ml/min) under condition of changes in the blood vessel radius, viscosity of blood, length of the blood vessel and pressure gradient

SEMINAR 9: Cardiac cycle: variations in different physiological conditions. Cardiac output and cardiac output regulation (2 hours).

Exercise XV (4 hours)
1. Measurement of arterial blood pressure using palpatory and auscultatory methods in human
2. Demonstration of the effects of hydrostatic pressure and the role of venous valves on venous blood flow
3. Assessment of functional capacity of the heart and circulation during physical activity in human (Lorentz and Harvard step tests)
4. Explanation of oculocardiac reflex
5. Interactive presentation of the experiment: the direct measurement of arterial blood pressure and influence of vasopressor and vasodepressor agents on the value of arterial blood pressure (Dog Blood Pressure)
6. Interactive videosimulation of the effects of vasoactive substances on the isolated blood vessel (SimVessel)

SEMINAR 10: Regulation of arterial blood pressure (2 hours)

Exercise XVI (4 hours)
1. Obtaining of blood samples for laboratory analysis from the finger tip
2. Preparation and staining of the blood smear by Pappenheim's method
3. Identification of blood cells
4. Determination of reticulocyte count staining a slide using brilliant cresyl blue stain
5. Determination of erythrocyte sedimentation rate (ESR)

Exercise XVII (4 hours)
1. Determination of red blood cell count by haemocytometer and erythrocyte suspension optical density
2. Hematocrit (Htc) or Packed Cell Volume (PCV) determination (microhematocrit method)
3. Hemoglobin determination
4. Calculation of the mean corpuscular values (MCV, MCH, MCHC) using the former obtained values

Exercise XVIII (3 hours)
1. OAB blood typing on the slide and in test tubes
2. Rh typing (RhD)
3. Performing of cross matching reaction and direct Coombs’ test

SEMINAR 11: Blood groups (OAB, Rh system), transfusion and transfusional reactions (2 hours)
Exercise XIX (4 hours)
1. Determination of white blood cell count
2. Determination of differential white blood cell count
3. Calculation of absolute white blood cell count
4. Interactive video presentation of homeostasis of body electrolytes (A.D.A.M.) – repetition

Exercise XX (4 hours)
1. Determination of platelet count by Fonio (indirect method)
2. Determination of platelet count by hemocytometer method
3. Determination of bleeding time – Duke’s method
4. Determination of blood coagulation time – Bürker method
5. Determination of prothrombin time (PT)

Exercise XXI (3 hours)
1. Calculation of the clearance of inulin, creatinine and para-aminohippuric (PAH) acid
2. Calculation of GFR in dependence on changed values of renal blood flow (RBF), hydrostatic pressure (HP) and colloid-osmotic pressure (COP)
3. Calculation of diuresis in dependence on osmotic load of the kidneys (osmolar clearance and “free water clearance”)
4. Interactive video simulation of function of the nephron (PhysioEx 4.0): studying the effect of factors that affect glomerular filtration rate, volume and osmolality of final urine
5. Interactive video presentation of functions of the urinary tract (A.D.A.M.)

SEMINAR 12: Renal regulation of extracellular fluid volume and composition. Hormones of the kidney. (2 hours).


Exercise XXII (4 hours)
1. Demonstration of the role of the diaphragm in respiration (Donders' model)
2. Spirometry: determination of the static lung volumes and capacities
3. Performing of the ergometric step-test and indirect determination of the maximal oxygen consumption (VO₂max)

SEMINAR: Chemistry in Medical Physiology: Acid-base balance. Body chemical buffers (2 hours)

Exercise XXIII (4 hours)
1. Auscultation of breathing
2. Interactive video simulation of alveolar ventilation (PhysioEx 4.0):
   a. measuring respiratory volumes and capacities (simulating spirometry)
   b. examining the effect of changing airway resistance, the action of surfactant and the effect of changing intrapleural pressure on the lung functions
3. Analysis of the effect of various breathing patterns on \( \text{PCO}_2 \) values in the alveolar air and blood

SEMINAR 13: Regulation of respiration (2 hours)

Exercise XXIV (4 hours)
1. Spirometry: measuring dynamic lung volumes: \( \text{FEV}_1 \), the maximal voluntary ventilation (MVV), and recording of the flow-volume curve
2. Cardiopulmonary resuscitation: basic principles of performing CPR by various methods (practicing on a model)
3. Interactive video presentation of acid-base balance (A.D.A.M.)
4. Acid-base balance – computer simulation (PhysioEx 4.0): demonstration of buffering action of the lung and the kidney in acid-base homeostasis (compensation of acidosis and alkalosis)

SEMINAR 14: Role of the hypothalamus in the control of homeostatic control systems of the body (2 hours)

Exercise XXV (4 hours)
1. Calculation of the basal metabolic rate (BMR) for students
2. Calculation of the daily energy turnover in students
3. Assembling of the nutritious meal on the basis of the determined turnover of the energy
4. Interactive video session of the gastric antrum contractile response (SimVessel): demonstration of the effects of substances that affect the spontaneous activity and the effect of passive stretching
5. Interactive video presentation of gastrointestinal system (A.D.A.M.)

SEMINAR 15: Physiology of the liver. Endocrine function of gastrointestinal system (2 hours)

Exercise XXVI (3 hours)
1. Assessment of the oral glucose tolerance test (OGTT)
2. Interactive video simulation of the endocrine system physiology (PhysioEx 4.0):
   a. determination of rat’s basal metabolic rate and demonstration of the effects of thyroxine, TSH and propylthiouracil on the rat’s basal metabolic rate
   b. demonstration of the effect of estrogen on the morphological and functional characteristics of the uterus
   c. measurement of plasma glucose concentration using spectrophotocolorimetric method and demonstration of the effect of insulin on glucose concentration in the blood
3. VIRTUAL PATIENT: assessment of disturbed homeostatic variables in (“SimBioSys Physiology”)

SEMINAR 16: Homeostasis of calcium and magnesium; bone physiology (2 hours)


Exercise XXVII (4 hours)
1. Examination of vaginal smear cytological features in the time course of menstrual cycle
2. Early diagnosis of the pregnancy: laboratory tests
   a. Analysis of the blood cells (number of cell types, ESR, and mean corpuscular values) in physiological conditions
3. Analysis of the plasma composition in physiological conditions
4. Analysis of the urine composition in physiological conditions
5. Signitures, makeup of exercises and seminars

SEMINAR 17: Life cycles of female reproductive system

Seminars – Self directed small group discussions (2 hrs):

General Purpose: In order to foster active learning and to develop presentation skills, students will be expected to present the selected topics of physiology during two semesters of the course. Distributed well in advance, all students will have adequate time to prepare using their lecture notes, readings, and internet.

- Power point presentation and computer simulation if necessary.
- Student directed discussion. This course will require a moderate to heavy reading load. You will be required to be able to engage in class conversations and it will be possible only if you read the material assigned prior to seminar.
- Material not covered in lectures.

PROGRAMME OF SEMINARS IN MEDICAL PHYSIOLOGY 2011-2012 (34 hours)
Seminars will be held in the Library at the Institute of Medical physiology on Monday (Group I) and Tuesday (Group II)

Winter (III) semester: 16 hours
1. Body fluids; physiological solutions (types and application) (2 hrs)
2. Excitation and contraction of skeletal and smooth muscle (2 hrs)
3. Physiology of pain
4. Neurophysiology of vision (2 hrs)
5. Spinal cord reflexes (2 hrs)
6. Control of posture and locomotion: brain stem (2 hrs)
7. Learning and memory (2 hrs)
8. ECG: recording and analysis (2 hrs)

Summer (IV) semester: 18 hours
9. Cardiac cycle: variations in different physiological conditions. Cardiac output and cardiac output regulation (2 hrs)
10. Regulation of arterial blood pressure (2 hrs)
11. Blood groups (OAB, Rh system); transfusion and transfusional reactions (2 hrs)
12. Renal regulation of extracellular fluid volume and composition. Hormones of the kidney (2 hrs)
   Chemistry in medicine: Acid – base balance. Body chemical buffers (2 hrs)
13. Regulation of respiration (2 hrs)
14. Role of the hypothalamus in the control of homeostatic control systems of the body (2 hrs)  
15. Physiology of the liver. Endocrine function of gastrointestinal system (2 hrs)  
16. Homeostasis of calcium and magnesium; bone physiology (2 hrs)  
17. Life cycles of female reproductive system (2 hrs)  

ELECTION COURSES IN MEDICAL PHYSIOLOGY  

**Topic: Hormonal regulation of metabolic processes**  
Organizer of course: Dr Ljiljana Šćepanović, Full Professor  
Performer: Institute of Medical physiology  
N° of hours: 15 hours (lectures) + 15 hours of student individual work  
N° of students: 30 – 60  
Place: Institute of Medical Physiology  
Election course will take place in summer semester – May 2013  
Lectures will be hold in the Library at the Institute of Medical Physiology  
Course objective: Presentation of interrelation between hormonal functions and metabolic processes in different physiological conditions  
Final examination: test – multiple-choice format  

**Lectures:**  
1. Hormonal regulation of carbohydrate metabolism – 2 hrs – Dr Ljiljana Šćepanović, Full Professor  
2. Hormonal regulation of protein metabolism – 2 hrs – Dr Ljiljana Šćepanović, Full Professor  
3. Hormonal regulation of lipid and lipoproteins metabolism: disorders – as a base for pathogenesis of diseases – 3 hrs – Dr Zvezdana Kojić, Associate Professor  
4. Bone and minerals metabolism – 2 hrs – Dr Slavica Suzić, Full Professor  
5. Hormonal activity during intensive metabolic processes (exercising) – 2 hrs – Dr Gordana Maširević-Drašković, Full Professor (2 hrs)  
6. Adaptation on stressors – 2 hrs – Dr D. Nešić, Teaching assistant  
7. Biological rhythms – 2 hrs – Dr Olivera Stanojlović, Associate Professor  

**Topic: Exercise physiology**  
Organizer of course: Dr Sanja Mazić, Assistant Professor  
N° of hours: 15 hours (lectures) + 4 hours (exercise) + 11 hours of student individual work  
N° of students: 30 – 60  
Place: Institute of Medical Physiology  
Election course will take place in summer semester – May 2013  
Lectures will be hold in the Library at the Institute of Medical Physiology  
Course objective: The influence of physical activity on homeostatic control systems of organism  
Presentation of interrelation between hormonal functions and metabolic processes in different physiological conditions  
Final examination: test – multiple-choice format  

**Lectures:**  
1. Physical activity leading to improved health – 2 hrs – Dr S. Mazić, Assistant Professor
2. Specifics of the sports nutrition – 2 hrs – Dr S. Suzić, Full Professor
3. Biological sources of energy - anaerobic and aerobic physical activity – 2 hrs – Dr S. Mazić, Assistant professor (Dr P. Brkić, Assistant professor) (2 hrs)
4. Physiological adaptation on the regular intensive physical activity – 2 hrs – Dr D. Stevanović, Assistant professor
5. Oxidative stress in sport – 2 hrs – Dr Lj. Šćepanović, Full Professor
6. Limiting factors for maximum oxygen uptake – 2 hrs – Dr D. Mitrović, Full Professor
7. The influence of environmental factors on physical activity – 3 hrs – Dr G. Maširević-Drašković, Full professor

Testing sportsman – 4 hrs by arrangement – Dr S. Mazić, Assistant Professor (Dr M. Đelić, Teaching Assistant):
- Testing the functional capacity of the cardiovascular and respiratory system - 2 hrs
- Tests for assessing the power - 1 hr
- Tests for the evaluation of the speed - 1 hr

**Topic: From neurons to behavior**

Organizer of course: Dr G. Maširević-Drašković, Full Professor
Course objective: Connection and understanding of the relationships between brain structures and their functions with the behavior as a visible manifestation
Place: Institute of Medical Physiology
Performers: Department of Medical Physiology, Department of Anatomy, Department of Histology and embriology
Election course will take place in summer semester
Lectures will be hold in the Library at the Institute of Medical Physiology
No of hours: 15 hours (lectures) + 15 hours of student individual work
No of students: 30 - 60
Final examination: test – multiple-choice format

**Lectures:**
1. Anatomy of the common functioning of the limbic structures and neocortex –3 hrs – Dr S. Malobabić, Full Professor
2. Types of neurons and neuronal networks involved in learning and memory – 2 hrs – Dr B. Stefanović, Full Professor
3. Physiological implications of glutaminergic and cholinergic transmission – 2 hrs – Dr O. Stanojlović, Associate Professor
4. Encoding and decoding of information in the nervous system – 2 hrs – Dr G. Maširević-Drašković, Full professor
5. Instincts, emotions, and motivation – 3 hrs – Dr D. Nešić, Assistant professor
6. Consciousness and awareness. Learning, memory, and intelligence – 2 hrs – Dr D. Stevanović, Assistant professor

**Topic: Physiological regulatory mechanisms in extreme environmental conditions**

Organizer of course: Dr D. Mitrović, Full Professor
Course objective: Integration of knowledge of physiology applied to stay in extreme environmental conditions: diving, flying, staying at high altitudes and in conditions of weightlessness.

Place: Institute of Medical Physiology

Performers: Department of Medical Physiology and Department of Biophysics in Medicine

Election course will take place in summer semester

Lectures will be hold in the Library at the Institute of Medical Physiology

No of hours: 15 hours (lectures) + 15 hours of student individual work

No of students: 30 - 60

Final examination: test – multiple-choice format

Lectures:
1. The laws of physics relevant to physiology in conditions of high and reduced atmospheric pressure – 3 hrs – Dr M. Letić, Associate Professor, Dr D. Žikić, Assistant Professor
2. Physiology under conditions of elevated ambient pressure (2 + 2 hrs) – Dr D. Mitrović, Full Professor
3. Physiology in conditions of reduced atmospheric pressure – 3 hrs – Dr Lj. Šćepanović, Full Professor
4. Acclimation to long-term stay at high altitude and problems of acute exposure to low atmospheric pressure – 2 hrs – Dr D. Mitrović, Full Professor (Dr P. Brkić, Assistant professor)
5. Physiology in microgravity conditions – 3 hrs – Dr M. Petrović, Assistant professor

Topic: Physiological principles of nutrition

Organizer of course: Dr S. Suzić, Full Professor

Course objective: Integrated consideration of physiological basis of nutrition in different physiological states

Place: Institute of Medical Physiology

Performer: Department of Medical Physiology

Election course will take place in summer semester

Lectures will be hold in the Library at the Institute of Medical Physiology

No of hours: 15 hours (lectures) + 15 hours of student individual work

No of students: 30 - 60

Final examination: test – multiple-choice format

Lectures:
1. The principles of preparing nutritious meals – 2 hrs) – Dr D. Nešić, Assistant professor
2. Specificity of the nutrition in pregnancy and lactation – 2 hrs – Dr S. Suzić, Full professor (Dr.M. Đelić, Teaching assistant)
3. Brain-gut axis and regulation of food intake – 3 hrs – Dr D. Stevanović, Assistant professor
4. Specificity of the nutrition of children and adolescents – 2 hrs – Dr Lj. Šćepanović, Full Professor
5. Specificity of the nutrition in obese individuals – 2 hrs – Dr D. Nešić, Assistant professor (Dr P. Brkić, Assistant professor)
6. Physiological basis for enteral and parenteral nutrition – 2 hrs – Dr S. Mazić, Assistant professor
7. Specificity of the sports nutrition – 2 hrs – Dr S. Suzić, Full professor

Topic: Physiology of sleep

Organizer of course: Dr Olivera Stanojlović, Associate professor
Place: Institute of Medical Physiology
Performer: Department of Medical Physiology
Election course will take place in summer semester
Lectures will be held in the Library at the Institute of Medical Physiology

Number of hours: 15 hours (lectures) + 15 hours of student individual work
Number of students: 30-60

Course objective: Integrative understanding of the physiology of sleep by learning about the architecture of sleep, the mechanisms involved in maintaining sleep-wake cycle, research techniques in somnology, and the specificities of the homeostatic system during sleep

Final examination: test – multiple-choice format

Lectures:
1. Circadian physiology and sleep: regulation and physiological role – 2 hrs – Dr O. Stanojlović, Associate Professor
2. Sleep architecture – 2 hrs – Dr O. Stanojlović, Associate Professor
3. Humoral regulation of sleep – 3 hrs – Dr Aleksandra Rašić – Marković, Assistant Professor
4. EEG: assessment of sleep-wake cycle – 2 hrs – Dr O. Stanojlović, Associate Professor (Dr D. Hrnčić, Teaching Assistant)
5. Physiology of the cardiovascular system during sleep – 2 hrs – Dr A. Rašić-Marković, Assistant Professor
6. Specificity of functions of the endocrine system during sleep – 2 hrs – Dr Đ. Macut, Assistant Professor
7. The experimental approach to sleep research: methods of sleep deprivation and models of insomnia – 2 hrs – Dr O. Stanojlović, Associate Professor (Dr D. Hrnčić, Teaching Assistant)

Topic: Physiological basis of sexuality

Organizer of course: Dr Miloš Petrović, Assistant professor

Course objective: The aim of the elective course for students to learn about the basics of sexual medicine as a separate and independent multidisciplinary scientific field. Lectures will cover anatomy, physiology, and pharmacology of sexual response, as aetiology, pathogenesis, and treatment of sexual dysfunctions.

Performer: Department of Medical Physiology, Department of Anatomy, Clinic of Urology KCS, Clinic for Endocrinology, Diabetes and Metabolic Diseases KCS, and Clinic of Psychiatry KCS

Election course will take place in X semester

Number of hours: 16 hours (lectures) + 14 hours of student individual work
Number of students: 30 - 60

Final examination: test

Lectures:
1. Introduction to medical sexology and sexual medicine. The historical development of medical sexology. Sexual behavior (1 hr) – Dr Đorđe Nale, Assistant professor
3. The physiological mechanisms of erection and ejaculation (2 hrs) – Dr Miloš Petrović, Assistant professor
4. Erectile dysfunction – etiology, pathogenesis, and treatment (2 hrs) - Dr Đorđe Nale, Assistant professor
5. Premature ejaculation (1 hour) – Dr Đorđe Nale, Assistant professor
6. Disorders of sexual activity in diabetes mellitus (2 hours) – Dr Srdan Popović, Professor
7. Sexual hormones and sexuality (2 hours) – Dr Svetlana Vujović, Professor
8. Sexual dysfunction in men and women (4 hours) – Dr Maja Lačković, Clinical assistant

The detailed course schedule with the dates, times, and location of all activities (lectures, seminars, exercises, examination, etc.) will be delivered to students at the beginning of III (winter) semester.

Classroom Procedures: be kind and supportive!!!
1. Be in your seat silently working on the Warm Up when class begins.
2. Raise your hand! And never speak while others are speaking!
3. At the end of class: You will be dismissed by teacher (clean table / sit quietly)
4. Follow all school rules.

Student Responsibilities
1. Spread positive energy by smiling, helping others, respecting the process of learning, taking care of classroom materials, participating in all class activities, and never speaking when others are speaking.
2. Speak in academic/professional language
3. Participate professionally, productively and safely in lab
4. Activate your neurons (Brain Cells) by always thinking about what you are learning...make 1. connections!
5. Bring your supplies (e.g. a stethoscope, glaves)
6. Maintain a detailed, reflective and creative Lab notebook.
7. Complete your assignments on time.
8. Study for colloquia and exams
9. Help others understand by explaining concepts and directions to those around you.
10. Lab safety rules must be followed at all times
11. Come see me whenever you need extra help!

Attendance
Attendance is required to all of the course activities (class session), including: lectures, exercises, seminars, and examinations and to arrive on time for each of the above. Recording lectures is permitted, video taping or taking pictures in class is not permitted. If you miss a class session, it is your responsibility to obtain the lecture notes, to make up laboratory experiments and to obtain handouts, assignments or other materials distributed in class, especially because we meet only twice a week. Any student whose absences, whether excused of unexcused, exceed 25% of the total lectures hours is not going to get 2 points. What counts as an “excused absence” is solely the judgment of the professor. Typically an excused absence
is defined as an absence due to personal illness, or death of a relative. You must have a letter from your physician before an excused absence is granted if you miss due to illness. Many laboratory exercises must be completed in the laboratory. Students who miss a laboratory exercise must schedule a make-up session at the end of semester to get a signature. In addition, any behavior that interferes with the conduct of a class is classified as disruptive behavior and will not be tolerated. Although not exhaustive, examples of disruptive behavior would include: routinely entering class late or departing class early without specific permission from the instructor; talking in class without being recognized; threatening faculty or fellow students or verbal abuse of faculty or fellow students; physical or verbal displays of anger; etc.

**Ethical Considerations**

Although almost all Medical students are honest and abhor cheating, there are a few who might consider it. Academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with Faculty regulations and procedures. Discipline may include suspension or expulsion from the Faculty. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts. Therefore, we along with other Basic Science Departments, have agreed on the following policy: It is expected that all students will maintain a high standard of honesty. It is our intention to guarantee that all students have an equal opportunity to demonstrate their academic achievement under the same circumstances; eliminating all possibility of unfair or unethical behavior. During examinations, any verbal or written communication will be with the examination proctors only. We trust our students in their commitment to honesty and professional ethics. If the proctors feel that your actions suggest that you are copying answers from another student or are engaged in similar acts of cheating, their responsibility is to seek other witnesses and gather all available evidence in an attempt to determine whether or not you are cheating. You will therefore be warned, or moved during the examination. In addition, signing an attendance sheet for someone else will be considered an act of cheating and will be dealt with in the same manner. Because no material (except calculators) are allowed at your examination seat, any extraneous material seen in your possession will be confiscated. Refusal to give such material to proctors upon their request will be construed as an attempt to cheat. In all cases, you will be not allowed to finish the examination; appropriate and very rigorous disciplinary measures will be taken.

All information concerning the course in Medical physiology will be announced on corresponding message boards in timely manner.

NOTE: I reserve the right to make any changes to this syllabus at any time

**Office Hours:** Students are encouraged to seek assistance from the teaching staff for clarification of material that is presented in the course. Two mechanisms have been established to do this: at the beginning of their lecture block, instructors may announce office hours during which time they will be available for student consultation. Alternatively, students may also seek
assistance without an appointment, although there is no guarantee that the faculty member will be available. There will be no assigned office hours for the now. Meetings will be setup as needed on mutually agreeable times.

Course materials – Books you must have!

Required!!!
3. Laboratory notebook for practical course in Medical physiology, Part One and Two, Medical faculty, University of Belgrade, CIBID, 2010

Highly recommended!

Examinations
Written examinations are the principal means utilized by the Department of Physiology to measure student’s achievement of their educational experiences. There will be four sectional examinations (colloquia) and a final examination prepared by our teaching staff. The four colloquia will consist of 35 multiple choice questions, there will be 5 answers for each multiple choice question, and out of these five answers, only one is correct. There will be no true-false questions. Since calculations may be part of answering some questions be sure to bring a scientific calculator to each exam. All aspects of the course, including lectures, exercises, demonstrations, and seminars, will form the basis for each departmental examination.

Examination Instruction - Summary:
Students should arrive 10 minutes prior to the start of the exam. Books, notes, paper, coats, backpacks, etc. are to be left outside or in the back of the examination room.
No student will be allowed to take a colloquia or final exam if the student arrives 30 minutes after the start of the examination. Late arrival to an exam does not mean that the student will be allowed to remain extra time to finish the exam. The student will have only the remaining allotted time for the examination and the exam will be collected at the end of the established exam period.
Students encountering problems, should notify the proctor in the examination room. Queries regarding examination questions will not be addressed during an examination.
You may leave at any time after completing the examination.
Final grades will be assigned based upon the following Grading Policy:
GRADING POLICY – Components and Evaluation Method in Assessment of Medical Physiology
According to Declaration of Bologna

<table>
<thead>
<tr>
<th>Regular Attendance in Course in Medical Physiology (maximum 6 points):</th>
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<tbody>
<tr>
<td>1. Regular attendance at lectures</td>
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<tr>
<td>2. Regular attendance at practicals</td>
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<tr>
<td>3. Regular attendance at class discussion</td>
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Colloquia – maximum 24 points for 4 colloquia
(Each colloquium in Medical Physiology from 2 to 6 points in accordance with marks from 6 to 10; makeup of colloquium decrease acquired points for 1 point)

<table>
<thead>
<tr>
<th>Number of correct answers</th>
<th>Mark</th>
<th>Points</th>
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<tbody>
<tr>
<td>&gt; 18</td>
<td>5</td>
<td>0</td>
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<tr>
<td>18-21</td>
<td>6</td>
<td>2</td>
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<tr>
<td>22-24</td>
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<td>3</td>
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<td>25-28</td>
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<td>4</td>
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<td>29-31</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>31-35</td>
<td>10</td>
<td>6</td>
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Practical Exam Score (two tasks) (maximum 20 points)
(Mark and number of points are determined by Professor, Teaching Assistant mark is descriptive)

Final Exam Score (number of correct answers, mark and points)
(Part One and Part Two maximum 50 points)

| (51 – 64 ) 6 | 30 points |
| (65 – 76) 7 | 36 points |
| (77 – 86) 8 | 40 points |
| (87 - 94) 9 | 44 points |
| (95 – 100) 10 | 50 points |

<table>
<thead>
<tr>
<th>Final course grade based upon total points</th>
<th>Total Points from Regular Attendance, Colloquia, Practical exam, and Final Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 (fail; F)</td>
<td>&gt; 50 points</td>
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<tr>
<td>6 (sufficient; D; D+; D-)</td>
<td>51 – 60 points</td>
</tr>
<tr>
<td>7 (satisfactory; C; C+; C-)</td>
<td>61 – 70 points</td>
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<tr>
<td>8 (good; B; B-)</td>
<td>71 – 80 points</td>
</tr>
<tr>
<td>9 (very good; A; A-; B+)</td>
<td>81 – 90 points</td>
</tr>
<tr>
<td>10 (excellent; A+)</td>
<td>91 – 100 points</td>
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</tbody>
</table>

In order to finish the Medical Physiology Course successfully, you should pay attention to the following:
- Physiology requires total dedication.
- Read before each lecture.
- Take your seminars seriously!
- Attend all lectures.
- Visit the website regularly.
- By all means don’t fall behind in your studies.
- Visit your professors and chairperson when necessary.
UNIVERSITY OF BELGRADE SCHOOL OF MEDICINE

PROGRAMME OF LECTURES IN MEDICAL PHYSIOLOGY
III (winter) semester – 2012-2013. academic year
Lectures will be held in the Head Building on:
Monday and Tuesday from 8:30 to 10:00 am for both groups (I and II)

INTRODUCTION TO MEDICAL PHYSIOLOGY.
HOMEOSTASIS AND CONTROL MECHANISMS
Dr. Dragan Đurić, Full Professor
October 23 2 hrs

TRANSPORTS THROUGH THE BIOLOGICAL MEMBRANES
Dr. Dušan Mitrović, Full Professor
October 29 2 hrs

BODY FLUIDS
Dr. Slavica Suzić, Full Professor
October 30 2 hrs

PHYSIOLOGY OF EXCITABLE TISSUES
Dr Zvezdana Kojić, Associate Professor
November 5 2 hrs 4 hrs
November 6 2 hrs

MUSCLE PHYSIOLOGY
Dr Aleksandra Rašić-Marković, Assistant Professor
November 12 2 hrs 6 hrs
November 13 2 hrs
November 19 2 hrs

GENERAL PRINCIPLES OF NEUROPHYSIOLOGY
Dr Aleksandra Rašić-Marković, Assistant Professor
November 20 2 hrs 4 hrs
November 26 2 hrs

SENSORY PHYSIOLOGY
Dr. Gordana Maširević-Drašković, Full Professor
November 27 2 hrs 4 hrs
December 3 2 hrs

SPECIAL SENSES PHYSIOLOGY
(SPECIAL SENSORY SYSTEMS)
Dr Dejan Nešić, Assistant Professor
December 4 2 hrs 6 hrs
December 10 2 hrs
December 11 2 hrs
MOTOR NEUROPHYSIOLOGY
Dr. Gordana Maširević-Drašković, Full Professor
December 17 2 hrs 6 hr
December 18 2 hrs
makeup 2 hrs

AUTONOMIC NERVOUS SYSTEM
Dr. Olivera Stanojlović, Associate Professor
makeup 2 hrs 4 hrs
January 8 2 hrs

HIGHER BRAIN FUNCTIONS AND THE LIMBIC SYSTEM
Dr. Olivera Stanojlović, Associate Professor
January 14 2 hrs 6 hrs
January 15 2 hrs
January 21 2 hrs

PHYSIOLOGY OF HEART
Dr Sanja Mazić, Assistant Professor
January 22 2 hrs 8 hrs
January 28 2 hrs
January 29 2 hrs
makeup 2 hrs

Belgrade, October 17, 2012

Medical Physiology Course Director
Prof. Dr. Gordana Maširević-Drašković