# MORPHOLOGY 2

**FIRST YEAR OF STUDIES**

year 2025/2026.

BIOPHYSICS

Course:

# BIOPHYSICS

The course is evaluated with 3 ECTS. There are 3 hours of active classes per week (2 hours of lectures and 1 hour of work in a small group.)

# TEACHERS AND ASSOCIATES:

| No | Name and surname | email | Звање |
|---|---|---|---|
| 1. | Vladimir Vukomanović | vukomanovic@gmail.com | associate professor |
| 2. | Vesna Ignjatović | vesnacokanovic@yahoo.com | assistant professor |
| 3. | Valentina Opančina | valentina.opancina@gmail.com | assistant professor |
| 4. | Marija Živković Radojević | makizivkovimarija@gmail.com | assistant professor |
| 5. | Neda Milosavljević | neda.milosavljevic@yahoo.com | assistant professor |
| 6. | Katarina Vuleta | kvuleta87@gmail.com | assistant |
| 7. | Vladan Marković | drjack.vm@gmail.com | assistant |
| 8. | Jelena Đorđević | jeladj997@gmail.com | teaching assistant |

# COURSE STRUCTURE:

| **Module** | **Title of the module** | **Weeks** | **Lectures weekly** | **Work in a small group weekly** | **Teacher-module manager** |
|---|---|---|---|---|---|
| 1 | Basics of biophysical laws of the organism, nuclear physics and radiological physics | 5 | 6 | 3 | Prof. Vladimir Vukomanović |
| | | | | | ∑ 30+15=45 |

# EVALUATION:

The student masters the coure by modules. The grade is equivalent to the number of points earned (see tables). Points are earned in two ways:

**1. ACTIVITY DURING CLASSES**: In this way, the student can earn up to 30 points, by answering 3 exam questions from that week of class (one for each lecture week), and in accordance with the demonstrated knowledge, earns 0-6 points.

**2. FINAL EXAM:** The final exam is organized as a final test. In this way, the student can earn up to 70 points, according to the attached table. The test consists of 35 questions. Each question is worth 2 points. If the student achieves 36 or more points on the test, the final exam has been passed.

| MODULE | | MAXIMUM POINTS | | |
|---|---|---|---|---|
| | | **activity during classes** | **final test** | **Σ** |
| **1** | Basics of biophysical laws of the organism, nuclear physics and radiological physics | 30 | 70 | 100 |
| **Σ** | | **30** | **70** | **100** |

**TEACHING CONSULTATIONS**: Consultations can be scheduled with the head of the department, Assoc. Prof. Vladimir Vukomanović, vukomanovic@gmail.com

**The final grade is formed as follows:**

In order to pass the course, the student must obtain a minimum of 51 points.
To pass the course the student must:
1. acquires more than 50% of the points provided for the activity
2. pass the final exam, i.e. have more than 50% correct answers on the final test.

| **the number of earned points** | **grade** |
|---|---|
| 0 - 50 | **5** |
| 51 - 60 | **6** |
| 61 - 70 | **7** |
| 71 - 80 | **8** |
| 81 - 90 | **9** |
| 91 - 100 | **10** |

# TESTS

## FINAL TEST
**0-70 POINTS**

**EVALUATION OF THE FINAL TEST**

Test consists of 35 questions
Each question is worth 2 points

## LITERATURE:

| title of the textbook | authors | publisher | library |
|---|---|---|---|
| Diagnostic Radiology, Volume one and two | A.Adam, A.K. Dixon, Grainger&Allison's Churchill Livingstone Has | Churchill Livingstone | Has |
| The Radiology Handbook : A Pocket Guide to Medical Imaging | Benseler, J.S. | Athens, United States: Ohio University Press | Has |
| Fundamentals of Diagnostic Radiology, Fourth Edition | W.E. Brant, C.A. Helms | Wolters Kluwer Health / Lippincott Williams & Wilkins | Has |
| Nuclear Medicine: A Core Review. 2nd edition | Shah C, Bradshaw M, Dalal I. | Philadelphia: Wolters Kluver Lippincott Williams&Wilkins; 2021. | Has |
| Nuclear Medicine and Molecular Imaging: The Requisites. | O'Malley J, Ziessman H. 5th edition. | Elsevier Science; 2020. | Has |
| Nuclear Medicine Physics. 8th edition. | Chandra R, Rahmim A. | Philadelphia: Wolters Kluwer; 2018. | Has |

All lectures are available on the website of the Faculty of Medical Sciences: www.medf.kg.ac.rs

# THE PROGRAM

## MODULE: BASICS OF BIOPHYSICAL LAWS OF THE NUCLEAR PHYSICS AND RADIOLOGICAL PHYSICS

TEACHING UNIT 1 (11th WEEK):

### INTRODUSTION TO MEDICAL BIOPHYSICS

| lecture 2 hours | practice 1 hour |
|---|---|
| Medical Biophysics for biological processes for development of methods and/or devices for clinical application in diagnosis and therapy.<br>Atom and nucleus structure. Conventional and quantum model of the atom. Atomic mass and nucleus size. Nuclear forces and bond energy. Stability of nuclides. Instability of nuclides. Radioactivity units. | Basics of medical physics. Consolidatio |

TEACHING UNIT 2 (11th WEEK):

### BASICS OF NUCLEAR PHYSICS 1

| lecture 2 hours | practice 1 hour |
|---|---|
| Radioactive decay: law and statistics. Types of radioactive decay. Alpha decay. Beta decay. Electronic capture. Gamma decay. Internal conversion. Characteristics of gamma radiation. | Basics of nuclear physics 1. Consolidation. |

TEACHING UNIT 3 (11th WEEK):

### BASICS OF NUCLEAR PHYSICS 2

| lecture 2 hours | practice 1 hour |
|---|---|
| Basic principles of interaction of gamma radiation with matter. Photoelectric effect, Compton scattering, pair creation, annihilation. X and γ rays: source and characteristics. Neutron radiation. Absorption and interaction of neutrons with matter. Radiation detection mechanism. Types of detectors. | Basics of nuclear physics 2. Consolidation. |

TEACHING UNIT 4 (12th WEEK):

### RADIATION DETECTION AND MONITORING SYSTEMS

| lecture 2 hours | practice 1 hour |
|---|---|
| Mechanism of detection of ionizing radiation. Gas detector. Ionization detector. Scintillation detector. Collimators and collimation. Gamma scintillation camera. Computer systems in medicine | Acquire knowledge about the basic principles of detector devices in medicine |

TEACHING UNIT 5 (12th WEEK):

## APPLICATION OF RADIOACTIVE ISOTOPES IN MEDICINE

| lecture 2 hours | practice 1 hour |
|---|---|
| Nuclear reactions. Radioactive isotopes obtained by reactors, accelerators and cyclotrons. Radionuclide generators. Application of radioactive isotopes in medicine. Radioactive isotopes as markers. Recording of radioactive isotope distribution (scintigraphy). | Acquire knowledge about the radioactive isotopes in medicine. Consolidation. |

TEACHING UNIT 6 (12th WEEK):

## METHODS OF SPECTROSCOPY AND SPECTROMETRY

| lecture 2 hours | practice 1 hour |
|---|---|
| In vitro diagnostics methods: transluminescence, UV luminescence and others. Basic principles of RIA. Alternatives to radioimmunology and analysis (FIA, IFMA, EIA, LIA...) Measuring devices in In vitro diagnostics (Gamma counter with pitted crystal. Fluorometer. Luminometer). Quality control of measuring devices | Acquire knowledge wide array of techniques, and highly specialized equipment |

TEACHING UNIT 7 (13th WEEK):

## PRINCIPLES OF WORK OF RADIOLOGY MACHINES. X RAY TUBE

| lecture 2 hours | practice 1 hour |
|---|---|
| Basic principles of physics in radiology, diagnostic devices used in radiology. X-ray tube, origin and spectrum of X-radiation; interaction of X-ray photons with biological tissues. Principle of X-ray tube operation. | Acquire knowledge about diagnostic devices used in radiology. Introducting the technical characteristics of the X-ray tube. |

TEACHING UNIT 8 (13th WEEK):

## X-RAY DEVICE. TYPES OF X-RAY DEVICES

| lecture 2 hours | practice 1 hour |
|---|---|
| Technical characteristics of the X-ray machine. Application of radiological methods in medicine - establishing a diagnosis, planning therapeutic procedures and monitoring the development of the disease. Types of x-ray machines depending on the purpose. | Acquire knowledge about the basic parts of the X-ray machine and the basic types of X-ray machines |

TEACHING UNIT 9 (13th WEEK):

## BASIC PRINCIPLES OF ULTRASOUND

| lecture 2 hours | practice 1 hour |
|---|---|
| Physics of ultrasound diagnostics, echogram resolution | Acquire knowledge about the basic principles of ultrasound diagnostics |

TEACHING UNIT 10 (14th WEEK):

## MULTIDETECTOR COMPUTERIZED TOMOGRAPHY

| lecture 2 hours | practice 1 hour |
|---|---|
| Basic principles of tomography. Creation of a computerized image multidetector tomography. | Acquire knowledge about the basic types of multidetector computerized devices for tomography |

TEACHING UNIT 11 (14th WEEK):

## MAGNETIC RESONANCE IN MEDICINE

| lecture 2 hours | practice 1 hour |
|---|---|
| Basic principles of magnetic resonance in medicine, basics of spectroscopy. | Acquire knowledge about the Basic principles of magnetic resonance in medicine, basics of spectroscopy. |

TEACHING UNIT 12 (14th WEEK):

## RADIOLOGICAL INFORMATION SYSTEM RIS, IMAGE ARCHIVING SYSTEM-PACS

| lecture 2 hours | practice 1 hour |
|---|---|
| A radiological information system (RIS).<br>Picture archiving and communication system (PACS) | Acquire knowledge about the RIS and PACS systems. |

TEACHING UNIT 13 (15th WEEK):

## THE PHYSICAL BASIS OF RADIATION THERAPY

| lecture 2 hours | practice 1 hour |
|---|---|
| Dosimetric principles, sizes and units. Radiotherapy devices with external beams - teletherapy devices. Passage of the photon beam through the medium, brachytherapy. | The physical basis of radiation therapy. Consolidation. |

TEACHING UNIT 14 (15th WEEK):

## RADIATION BIOLOGY

| lecture 2 hours | practice 1 hour |
|---|---|
| A Natural sources of radiation; artificial radiation sources; DNA damage caused by ionizing radiation; types of ionizing radiation; effects of radiation on the human population; cell survival curves clinical; radiobiology. | Radiation biology. Consolidation. |

TEACHING UNIT 15 (15th WEEK):

## BIOPHYSICAL EFFECTS OF RADIATION. RADIATION PROTECTION

| lecture 2 hours | practice 1 hour |
|---|---|
| Biological effects of ionizing radiation. Radiosensitivity and radioresistance. Mechanisms of cell damage. Stochastic and deterministic effects of radiation. Radiation protection (professionally exposed personnel, patients, other persons). | Biological effects of ionizing radiation. Consolidation. |

**LESSON SCHEDULE FOR THE COURSE OF BIOPHYSICS**

| week | type | title of method unit | teacher |
|---|---|---|---|
| 11 | **L** | Introdustion to medical biophysics | Prof. Dr Vladimir Vukomanović |
| | | Basics of nuclear physics 1 | Prof. Dr Vladimir Vukomanović |
| | | Basics of nuclear physics 2 | Prof. Dr Vladimir Vukomanović |
| 11 | **P** | Introdustion to medical biophysics. Consolidation | Prof. Dr Vladimir Vukomanović<br>Dr Katarina Vuleta Nedić |
| | | Basics of nuclear physics 1. Consolidation | Prof. Dr Vladimir Vukomanović<br>Dr Katarina Vuleta Nedić |
| | | Basics of nuclear physics 2. Consolidation | Prof. Dr Vladimir Vukomanović<br>Dr Katarina Vuleta Nedić |
| 12 | **L** | Radiation detection and monitoring systems. | Prof. dr Vesna Ignjatovic |
| | | Application of radioactive isotopes in medicine | Prof. dr Vesna Ignjatovic |
| | | Methods of spectroscopy and spectrometry Consolidation | Prof. dr Vesna Ignjatovic |
| 12 | **P** | Radiation detection and monitoring systems. Consolidation | Prof. dr Vesna Ignjatovic<br>Dr Katarina Vuleta Nedić |
| | | Application of radioactive isotopes in medicine. Consolidation | Prof. dr Vesna Ignjatovic<br>Dr Katarina Vuleta Nedić |
| | | Methods of spectroscopy and spectrometry | Prof. dr Vesna Ignjatovic<br>Dr Katarina Vuleta Nedić |
| 13 | **L** | Principles of work of radiology machines. x ray tube | Prof. dr Valentina Opančina |
| | | X-ray device. types of x-ray devices | Prof. dr Valentina Opančina |

**LESSON SCHEDULE FOR THE COURSE OF BIOPHYSICS**

| week | type | title of method unit | teacher |
|---|---|---|---|
| | | Basic principles of ultrasound | Prof. dr Valentina Opančina |
| 13 | **P** | Principles of work of radiology machines. x ray tube. Consolidation | Prof. dr Valentina Opančina<br>Dr Vladan Marković |
| | | X-ray device. types of x-ray devices. Consolidation | Prof. dr Valentina Opančina<br>Dr Vladan Marković |
| | | Basic principles of ultrasound. Consolidation | Prof. dr Valentina Opančina<br>Dr Vladan Marković |
| 14 | **L** | Multidetector computerized tomography. | Prof. dr Valentina Opančina |
| | | Magnetic resonance in medicine | Prof. dr Valentina Opančina |
| | | Radiological information system, image archiving system-PACS | Prof. dr Valentina Opančina |
| 14 | **P** | Multidetector computerized tomography. Consolidation | Prof. dr Valentina Opančina<br>Dr Vladan Marković |
| | | Magnetic resonance in medicine. Consolidation | Prof. dr Valentina Opančina<br>Dr Vladan Marković |
| | | Radiological information system, image archiving system-PACS. Consolidation | Prof. dr Valentina Opančina<br>Dr Vladan Marković |
| 15 | **L** | The physical basis of radiation therapy | Prof. dr Marija Živković Radojević |
| | | Radiation biology | Prof. dr Neda Milosavljević |
| | | Biophysical effects of radiation. Radiation protection | Prof. dr Marija Živković Radojević<br>Prof. dr Neda Milosavljević |
| 15 | **P** | The physical basis of radiation therapy. Consolidation | Prof. dr Marija Živković Radojević<br>Prof. dr Neda Milosavljević |

**LESSON SCHEDULE FOR THE COURSE OF BIOPHYSICS**

| week | type | title of method unit | teacher |
|---|---|---|---|
| | | Radiation biology. Consolidation | Prof. dr Marija Živković Radojević<br>Prof. dr Neda Milosavljević |
| | | Biophysical effects of radiation. Radiation protection. Consolidation | Prof. dr Marija Živković Radojević<br>Prof. dr Neda Milosavljević |
| | **E** | **FINAL EXAM** (January-February term) | |