

2023-2024

RADIATION HYGIENE

UNIVERSITY OF ZAGREB
FACULTY OF VETERINARY MEDICINE
Heinzelova 55
Tel. 01/2390 179
Division: Basic and preclinical science
Organisational unit: Department of Physiology and Radiobiology
Email: mvilic@vef.unizg.hr
Register no.:

Zagreb, 5 September 2023



170281	REPUBLIKA HRVATSKA	
Veterinarski fakultet u Zagrebu		
Primljeno:	06.09.2023	
Klasifikacijska oznaka	Org. jed.	
605-03/23-04/28	251-61-32;	
Uredbeni broj	Prilozi	Vrijednost
251-61-06/256-23-09	0	-

COURSE SYLLABUS

Course name: Radiation Hygiene

Academic year 2023-2024

Course leader: Marinko Vilić, DVM, PhD, Full Professor
Teachers: Jadranka Pejaković Hlede, DVM, PhD
Josip Miljković, DVM

First day of classes: 25 October 2023

Last day of classes: 11 January 2024

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Activities - Radiation hygiene (1/4)							
Start Dat	Start Tim	End Tim	Subject	Group	Instructor	Room	Length
25/10/2023	8:15	9:45	p01 Introduction to radiation hygiene	5E-1, 5E-2, 5E-3	Vilic M.	P_farmakologija	1:30
30/10/2023	12:00	13:30	p02 Basic of nuclear physics	5E-1, 5E-2, 5E-3	Vilic M.	P_fiziologija	1:30
31/10/2023	12:00	13:30	p03 Radioactive contamination	5E-1, 5E-2, 5E-3	Vilic M.	P_fiziologija	1:30
06/11/2023	14:00	15:30	p03 Sources of ionizing radiation	5E-1, 5E-2, 5E-3	Vilic M.	P_fiziologija	1:30
08/11/2023	10:00	11:30	p05 Effects of ionizing radiation - classification	5E-1, 5E-2, 5E-3	Vilic M.	P_fiziologija	1:30
14/11/2023	8:15	9:45	v01 Personnel dosimeters	5E-2	Nastavnici na predmetu	V_radiobiologija	1:30
14/11/2023	10:00	11:30	v01 Personnel dosimeters	5E-3	Nastavnici na predmetu	V_radiobiologija	1:30
15/11/2023	8:15	9:45	v01 Personnel dosimeters	5E-1	Nastavnici na predmetu	V_radiobiologija	1:30
16/11/2023	11:30	13:00	p04 Biologically significant radionuclides	5E-1, 5E-2, 5E-3	Vilic M.	P_fiziologija	1:30

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Activities - Radiation hygiene (2/4)							
Start Dat	Start Tim	End Tim	Subject	Group	Instructor	Room	Length
20/11/2023	10:00	11:30	v02 Radiation detectors	5E-1	Nastavnici na predmetu	V_radiobiologija	1:30
20/11/2023	12:00	13:30	v02 Radiation detectors	5E-3	Nastavnici na predmetu	V_radiobiologija	1:30
21/11/2023	10:00	11:30	v02 Radiation detectors	5E-2	Nastavnici na predmetu	V_radiobiologija	1:30
27/11/2023	14:00	15:30	v03 Gamma ray spectrometry	5E-3	Nastavnici na predmetu	V_radiobiologija	1:30
28/11/2023	8:15	9:45	v03 Gamma ray spectrometry	5E-2	Nastavnici na predmetu	V_radiobiologija	1:30
29/11/2023	12:00	13:30	v03 Gamma ray spectrometry	5E-1	Nastavnici na predmetu	V_radiobiologija	1:30
30/11/2023	14:00	15:30	p07 Effects of non-ionizing radiation	5E-1, 5E-2, 5E-3	Vilic M.	P_fizika	1:30
01/12/2023	14:00	15:30	p06 Effects of ionizing radiation - mechanisms	5E-1, 5E-2, 5E-3	Vilic M.	P_farmakologija	1:30
07/12/2023	12:00	13:30	v04 Radiation protection	5E-3	Nastavnici na predmetu	V_radiobiologija	1:30

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Activities - Radiation hygiene (3/4)							
Start Dat	Start Tim	End Tim	Subject	Group	Instructor	Room	Length
07/12/2023	14:00	15:30	v04 Radiation protection	5E-1	Nastavnici na predmetu	V_radiobiologija	1:30
08/12/2023	8:15	9:45	v04 Radiation protection	5E-2	Nastavnici na predmetu	V_radiobiologija	1:30
20/12/2023	10:00	11:30	v05 Radiation risk	5E-2	Nastavnici na predmetu	V_radiobiologija	1:30
20/12/2023	12:00	13:30	v05 Radiation risk	5E-1	Nastavnici na predmetu	V_radiobiologija	1:30
21/12/2023	12:00	13:30	v05 Radiation risk	5E-3	Nastavnici na predmetu	V_radiobiologija	1:30
08/01/2024	10:00	11:30	v06 Radiation protection- Radiation Emergencies	5E-1	Nastavnici na predmetu	V_radiobiologija	1:30
09/01/2024	8:15	9:45	v06 Radiation protection- Radiation Emergencies	5E-3	Nastavnici na predmetu	V_radiobiologija	1:30

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Activities - Radiation hygiene (4/4)							
Start Dat	Start Tim	End Tim	Subject	Group	Instructor	Room	Length
09/01/2024	10:00	11:30	v06 Radiation protection-Radiation Emergencies	5E-2	Nastavnici na predmetu	V_radiobiologija	1:30
10/01/2024	12:00	13:30	v07 Non-ionizing radiation	5E-2	Nastavnici na predmetu	V_radiobiologija	1:30
10/01/2024	14:00	15:30	v07 Non-ionizing radiation	5E-1	Nastavnici na predmetu	V_radiobiologija	1:30
11/01/2024	8:15	9:45	v07 Non-ionizing radiation	5E-3	Nastavnici na predmetu	V_radiobiologija	1:30
16/01/2024	12:00	13:30	Midterm	5E-1, 5E-2, 5E-3	Vilic M.	P_fiziologija	1:30
Total: 30							45:00

Timetable for LECTURES academic year 2023-2024

LECTURES				
Date	Methodological unit	Teacher	Location / time	Literature
25/10/2023	Introduction to radiation hygiene	Marinko Vilić, DVM, PhD, Full Professor	Pharmacology and Toxicology/ 8:15-9:45 h	(see the list of the required literature)
30/10/2023	Basic of nuclear physics	Marinko Vilić, DVM, PhD, Full Professor	Physiology and Radiobiology/ 12-13:30 h	(see the list of the required literature)
31/10/2023	Sources of ionizing radiation	Marinko Vilić, DVM, PhD, Full Professor	Physiology and Radiobiology/ 12-13:30 h	(see the list of the required literature)
6/11/2023	Radioactive contamination	Marinko Vilić, DVM, PhD, Full Professor	Physiology and Radiobiology/ 14-15:30 h	(see the list of the required literature)
8/11/2023	Biologically significant radionuclides	Marinko Vilić, DVM, PhD, Full Professor	Physiology and Radiobiology/ 10-11:30 h	(see the list of the required literature)
16/11/2023	Effects of ionizing radiation - classification	Marinko Vilić, DVM, PhD, Full Professor	Physiology and Radiobiology/ 11:30-13 h	(see the list of the required literature)
30/11/2023	Effects of ionizing radiation - mechanisms	Marinko Vilić, DVM, PhD, Full Professor	Physics and Biophysics/ 14-15:30 h	(see the list of the required literature)
1/12/2023	Effects of non-ionizing radiation	Marinko Vilić, DVM, PhD, Full Professor	Pharmacology and Toxicology/14-15:30 h	(see the list of the required literature)

Timetable for PRACTICALS academic year 2023-2024

PRACTICALS						
Date	Methodological unit	Teacher	Type of practical	Group	Location / time	Literature
14/11/2023	Personnel dosimeters	Course leader or Teachers	Exercise in practicum	2	Physiology and Radiobiology/8:15-9:45 h	PowerPoint presentation Handouts
14/11/2023	Personnel dosimeters	Course leader or Teachers	Exercise in practicum	3	Physiology and Radiobiology/10-11:30 h	PowerPoint presentation Handouts
15/11/2023	Personnel dosimeters	Course leader or Teachers	Exercise in practicum	1	Physiology and Radiobiology/8:15-9:45 h	PowerPoint presentation Handouts
20/11/2023	Radiation detectors	Course leader or Teachers	Exercise in practicum	1	Physiology and Radiobiology/10-11:30 h	PowerPoint presentation Handouts
20/11/2023	Radiation detectors	Course leader or Teachers	Exercise in practicum	3	Physiology and Radiobiology/12-13:30 h	PowerPoint presentation Handouts
21/11/2023	Radiation detectors	Course leader or Teachers	Exercise in practicum	2	Physiology and Radiobiology/10-11:30 h	PowerPoint presentation Handouts
27/11/2023	Gamma ray spectrometry	Course leader or Teachers	Exercise in practicum	3	Physiology and Radiobiology/14-15:30 h	PowerPoint presentation Handouts
28/11/2023	Gamma ray spectrometry	Course leader or Teachers	Exercise in practicum	2	Physiology and Radiobiology/8:15-9:45 h	PowerPoint presentation Handouts
29/11/2023	Gamma ray spectrometry	Course leader or Teachers	Exercise in practicum	1	Physiology and Radiobiology/12-13:30 h	PowerPoint presentation Handouts
7/12/2023	Radiation protection	Course leader or Teachers	Exercise in practicum	3	Physiology and Radiobiology/12-13:30 h	PowerPoint presentation Handouts
7/12/2023	Radiation protection	Course leader or Teachers	Exercise in practicum	1	Physiology and Radiobiology/14-15:30 h	PowerPoint presentation Handouts
8/12/2023	Radiation protection	Course leader or Teachers	Exercise in practicum	2	Physiology and Radiobiology/8:15-9:45 h	PowerPoint presentation Handouts
20/12/2023	Radiation risk	Course leader or Teachers	Exercise in practicum	2	Physiology and Radiobiology/10-11:30 h	PowerPoint presentation Handouts

20/12/2023	Radiation risk	Course leader or Teachers	Exercise in practicum	1	Physiology and Radiobiology/12-13:30 h	PowerPoint presentation Handouts
21/12/2023	Radiation risk	Course leader or Teachers	Exercise in practicum	3	Physiology and Radiobiology/12-13:30 h	PowerPoint presentation Handouts
8/1/2024	Radiation protection-Radiation Emergencies	Course leader or Teachers	Exercise in practicum	1	Physiology and Radiobiology/10-11:30 h	PowerPoint presentation Handouts
9/1/2024	Radiation protection-Radiation Emergencies	Course leader or Teachers	Exercise in practicum	2	Physiology and Radiobiology/10-11:30 h	PowerPoint presentation Handouts
9/1/2024	Radiation protection-Radiation Emergencies	Course leader or Teachers	Exercise in practicum	3	Physiology and Radiobiology/8:15-9:45 h	PowerPoint presentation Handouts
10/1/2024	Non-ionizing radiation	Course leader or Teachers	Exercise in practicum	2	Physiology and Radiobiology/12-13:30 h	PowerPoint presentation Handouts
10/1/2024	Non-ionizing radiation	Course leader or Teachers	Exercise in practicum	1	Physiology and Radiobiology/14-15:30 h	PowerPoint presentation Handouts
11/1/2024	Non-ionizing radiation	Course leader or Teachers	Exercise in practicum	3	Physiology and Radiobiology/8:15-9:45 h	PowerPoint presentation Handouts
16/1/2024	Colloquium	Course leader or Teachers	Physiology and Radiobiology	1,2,3	Physiology and Radiobiology/12-13:30 h	

STUDENT OBLIGATIONS

Lecture attendance	During semester a student must attend 8 lecture hours in order to gain minimal 3 points. The maximum number of points from this evaluation element is 6 (16 lecture hours).
Seminars attendance	
Practicals attendance	During semester a student must attend 10 exercise hours in order to gain minimal 8 points. The maximum number of points from this evaluation element is 12 (14 lecture hours). The points will be added if a student is justifiably absent from up to 30 % of the exercises.
Active participation in seminars and practicals	During the practical part of the lesson (exercises), the student will write two tests. For correct answers the student will get a maximum of 10 points. By one test the student will be able to collect a maximum of five points. The minimum number of points from this evaluation element is 5.
Final exam	In order to take the final exam a student must gain minimal 16 points from attending at lectures and exercises, active participation at exercises and minimal 20 points from continuous knowledge checking.
Examination requirements	Student requirements are defined in the Regulations on the Integrated Undergraduate and Graduate Study of Veterinary Medicine (2022). Given the above, the student must acquire a minimum number of points from all assessment elements in order to take the final exam. Article 41: a student can justifiably be absent from up to 50 % of the lectures; 30% of the seminars and 30 % of the exercises.

GRADING AND EVALUATING STUDENT WORK

Continuous knowledge-checking (mid-terms)	<p>During the course of the Radiation Hygiene one assessment of knowledge (colloquia) will be organized. The colloquium includes content (subjects) of exercises. The maximum number of points scored from this grading element is 32 points and the minimum is 20 points. A student who does not achieve the necessary points during the course of instruction is entitled to three times access to a correctional colloquium that will be organized in certain terms.</p> <p>Colloquium date: 16/1/2024 The terms of repeated colloquium during the winter exam period of the academic year 2023/2024 will be held according to the following schedule: 23/1/2024 8/2/2024</p>
Final exams (dates)	8/2/2024; 21/2/2024
Form of final exam	Written exam

LITERATURE

Obligatory literature	<p>IAEA (2021): Nuclear and Radiological Emergencies in Animal Production Systems, Preparedness, Response and Recovery. I. Naletoski, A.G. Luckins and G. Viljoen Eds. 1st ed. Springer, Berlin, Heidelberg.</p> <p>IAEA (2021): Radiation protection and safety in veterinary medicine. IAEA safety reports series, no. 104</p> <p>Vilić, M. (2014): RADIATION HYGIENE, Selected chapters of radioecology, radiobiology and radiation hygiene. Faculty of Veterinary Medicine, Zagreb.</p> <p>IAEA (2010): Radiation biology: a handbook for teachers and students</p> <p>Howard, B. J., N. A. Beresford, G. Voigt (2001): Countermeasures for animal products: a review of effectiveness and potential usefulness after an accident. J. Environ Radioactivity 56, 115-137.</p> <p>Statkiewicz-Sherer, M. A., P. J. Visconti, E. R. Ritenour (2002): Radiation protection. 4th ed. Mosby, Inc. St. Louis.</p>
Optional literature	<p>Eisenbud, M. (1997): Environmental Radioactivity. 5th ed. Academic Press. London.</p> <p>IAEA (2019): IAEA Safety Glossary. Terminology Used in Nuclear Safety and Radiological. Protection. International Atomic Energy Agency, Vienna.</p> <p>Hall, J. E., A. J. Giaccia (2019): Radiobiology for the radiologist. 8th ed. Wolters Kluwer. Philadelphia.</p>

OBJECTIVES AND LEARNING OUTCOMES

Course objectives	<p>At the Radiation hygiene course students will learn how to be able to (1) protect their selves and their associates from radioactive contamination and irradiation; (2) use detectors of ionising radiation and dosimeters, detect ionising radiation, determine its type and calculate the radiation dose (3) to use high frequency spectrum analyzer and radiofrequency meters and to calculate the exposure limits (4) protect the housings, animal habitats, domestic animals, animal feed and foodstuff from radioactive contamination and radiation (5) perform decontamination of domestic animals, animal feed, meat, milk, water and other food of animal origin, animal habitats, various subjects and environment (soil, farmlands) and check-up the success of decontamination; (6) evaluate radiation hygiene properties of meat, milk and other food and their use as human food, and all intended to protect humans from radiation and radiation risks; (7) evaluate the risk of malignant diseases appearance in humans due to feeding with contaminated milk and meat; (8) conserve food by ionizing radiation. Besides, the students will obtain the</p>
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	basic knowledge about ionizing and non-ionizing (microwave) radiation effects on animals and humans. Both is necessary for course in radiology, nuclear veterinary medicine and for performing other activities in veterinary profession referring to electromagnetic radiation. Finally, without mastering this course, veterinarians are not legally allowed to perform X-ray examinations or examinations by application with radioactive isotopes (nuclear veterinary medicine). Neither is it allowed to perform veterinary inspection or other things relating to animal hygiene.
Learning outcomes	<p>After successfully mastering the course students will be able to:</p> <ol style="list-style-type: none"> 1) recognize the sources of ionizing radiation 2) describe the pathway of radioactive contamination and the biological effects of ionizing radiation 3) protect the housings, animal habitats, domestic animals, animal feed and foodstuff from radioactive contamination and radiation 4) perform decontamination of domestic animals, animal feed, milk, water and other food of animal origin, animal habitats, various subjects and environment (soil, farmlands) and check-up the success of decontamination 5) evaluate radiation hygiene properties of meat, milk and other food 6) use the dosimeters and detectors of ionizing radiation and calculate the radiation dose 7) recognize food conserving by ionizing radiation 8) recognize the sources of non-ionizing (microwave) radiation and describe the biological effects

GRADING SCHEME

<i>Points</i>	<i>Grade</i>
Up to 59	1 (F)
60-68	2 (E)
69-76	2 (D)
77-84	3 (C)
85-92	4 (B)
93-100	5 (A)

Course leader:

Gojinko Vilić

Head of Department/Clinic:

Gojinko Vilić

Note: The course leader is required to submit a Course Syllabus to all teachers and associates pertaining to the Course.

**GRADING AND EVALUATION OF STUDENT WORK ON COURSES WITH LECTURES,
SEMINARS and PRACTICALS**

Type of activity	Minimum number of points	Maximum number of points
Lectures attendance	3	6
Seminar attendance	4	6
Practicals attendance	4	6
Active participation in seminars and practicals	5	10
Continuous knowledge checking (mid-terms)	20	32
Final exam	24	40
TOTAL	60	100

**GRADING AND EVALUATION OF STUDENT WORK ON COURSES WITH LECTURES and
SEMINARS**

Type of activity	Minimum number of points	Maximum number of points
Lecture attendance	3	6
Practicals attendance	8	12
Active participation in practicals	5	10
Continuous knowledge checking (mid-terms)	20	32
Final exam	24	40
TOTAL	60	100

**GRADING AND EVALUATION OF STUDENT WORK ON COURSES WITH SEMINARS and
EXERCISES**

Type of activity	Minimum number of points	Maximum number of points
Seminar / practicals attendance	11	18
Active participation in seminars and practicals	5	10
Continuous knowledge checking (mid-terms)	20	32
Final exam	24	40
TOTAL	60	100