

COURSE 1

Measuring radiation-induced DNA damage, DNA repair and cell death: radiation biology in lab practice

Day	Time	Lecture
Monday 17 October	09:00 – 10:15	Lecture: Radiation-induced DNA damage, repair and cell death, Lecturer: Andrzej Wojcik
	10:30 – 12:00	Guided tour of radiation exposure facilities installed at the Stockholm University. Analysis of clonogenic cell survival results.
	13:30 – 17:00	Group 1: Lab: clonogenic cell survival – practical work Group 2: Lab: chromosomal aberrations – practical work
Tuesday 18 October	09:00 - 10:15	Lecture: Radiation-induced chromosomal aberrations and micronuclei, Lecturer: Prabodha Kumar Meher
	10:30 – 12:00	Microscopic analysis of chromosomal aberrations
	13:30 – 17:00	Group 1: Lab: chromosomal aberrations – practical work Group 2: Lab: clonogenic cells survival – practical work
Wednesday 19 October	09:00 - 10:15	Lecture: Factors influencing cellular radiosensitivity, Lecturer: Lovisa Lundholm
	10:30 – 12:00	Microscopic analysis of micronuclei
	13:30 – 17:00	Group 1: Lab: Fluorescence in situ hybridisation Group 2: lab: DNA repair gamma H2AX foci
Thursday 20 October	09:00 – 10:15	Lecture: Individual sensitivity to radiation – biomarkers and implications for radiological protection, Lecturer: Andrzej Wojcik
	10:30 – 12:00	Analysis of gammaH2AX foci and aberrations after fluorescence in-situ hybridisation
	13:30 – 17:00	Group 1: Lab: DNA repair gamma H2AX foci Group 2: lab: Fluorescence in situ hybridisation
Friday 21 October	09:00 – 11:30	Presentations of analysed results and general discussion
	11:30 – 13:00	Common lunch and end of course



COURSE 2

Patient dosimetry and occupational radiation exposure assessment arising from Lu-177, Ga-68, I-131 and Y-90 procedures

Day	Time	Lecture
ONLINE		
Monday 19 September	16:00 – 17:00	Fundamentals of I-131 treatments in Nuclear Medicine, Lecturer: Ismini Mainta (HUG)
	17:00 – 18:00	Fundamentals of Y-90 treatments in Nuclear Medicine, Lecturer: Nicola Bianchetto Wolf (HUG)
	18:00 – 19:00	Fundamentals of Theranostics with Lu-177/Ga-68 in Nuclear Medicine, Lecturer: Valeria del Valle (SERGAS) .
Tuesday 20 September	16:00 – 17:00	Computational models for nuclear medicine dosimetry calculations, Lecturer: Habib Zaidi (HUG)
	17:00 – 18:00	Dose calculation in patients treated with Y90, Lecturers: Azadeh Akhavanallaf and Yazdan Salimi (HUG)
	18:00 – 19:00	Overview of treatment planning system in nuclear medicine, Lecturer: Manuel Bardiès (IRCM)
Wednesday 21 September	16:00 – 17:00	Radiological protection basis, Lecturer: Lara Struelens (SCK CEN)
	17:00 – 18:00	Operational radiological protection applied to nuclear medicine, Lecturer: Jose Antonio Terrón León (Virgen de la Macarena Hospital)
	18:00 – 19:00	Operational radiological protection applied to interventional radiology, Lecturer: Roberto Sánchez Casanueva (Hospital Clínico San Carlos)
	19:00 – 20:00	Closing and Q&A session, Lecturers: Antonio López Medina (SERGAS), Mercedes Riveira Martín (FBGS)
ON-SITE		
Wednesday 28 September	09:00 – 10:00	Y-90 for hepatic radioembolization treatments, Lecturer: Mercedes Riveira Martín (FBGS)
	10:00 – 11:00	Dose calculation of Y-90 radioembolization treatments, Lecturer: Manuel Sánchez García (USC University Hospital)
	11:00 – 11:30	Break
	11:30 – 12:30	I-131 for treatment of thyroids malignancies and alterations, Lecturer: Gadea Castillo (SERGAS)
	12:30 – 13:30	Lu-177/Ga68 metabolism and basis of theranostics in neuroendocrine tumours (NET), Lecturer: Antonio López Medina (SERGAS)
	13:30-14:30	Break
	14:30 – 17:30	Practice*
Thursday 29 September	09:00 – 10:00	Dose calculation of Lu-177 treatment, Lecturer: Pablo Mínguez Gabiña (Cruces/Gurutzeta University Hospital)
	10:00 – 10:30	Break
	10:30 – 11:30	Practical approaches for reduction of staff doses in Lu-177 treatments, Lecturer: Pablo Mínguez Gabiña (Cruces/Gurutzeta University Hospital)
	11:30 – 12:30	Dose calculation in Ga-68 procedures, Lecturer: Nerea Encina Baranda (UCM)



	12:30 – 13:30	Practical approaches for reduction of staff doses in Ga-68 procedures, Lecturer: José Antonio Terrón León (Virgen de la Macarena Hospital)
	14:30 – 16:30	Practice*
Friday 30 September	09:00 – 10:00	Dose calculation of I-131 treatment, Lecturer: Alex Vergara Gil (Biomedica Group)
	10:00 – 11:00	Practical approaches for reduction of staff doses in I-131 treatments, Lecturer: Mercedes Riveira (FBGS)
	11:00 – 11:30	Break
	11:30 – 12:30	Practical approaches for reduction of staff doses in Y-90 radioembolization treatments, Lecturer: José Antonio Terrón León (Virgen de la Macarena Hospital)
	12:30 – 13:30	Closing seminar, Lecturers: Antonio López Medina and all lecturers

For the **practice sessions** the students were divided into six groups:

Practice	28/09/2022			29/09/2022	
	14:30 – 15:30	15:30 – 16:30	16:30 – 17:30	14:30 – 15:30	15:30 – 16:30
	Practice 1: Dose rate monitoring and shielding considerations in Lu-177 and I-131 treatments. Optimisation with real time monitoring (Mercedes Riveira)	G1	G5	G4	G2
Practice 2: Dosimetry calculation with Simplicity90 (Boston Scientific)	G3	G1	G5	G4	G2
Practice 3: Dose rate monitoring and shielding considerations in Ga-68 diagnostic procedures. Optimisation with real time monitoring (Isaac Sánchez Díaz)	G2	G3	G1	G5	G4
Practice 4: Dosimetry calculation with MIM	G4	G2	G3	G1	G5
Practice 5: Dosimetry calculation with PlanetDose (RaySafe)	G5	G4	G2	G3	G1



COURSE 3

Running external beam radiotherapy on the virtual radiation therapy simulator (VERT)

Day	Time	Lecture
Monday 26 September	09:00 – 10:30	Lecture: Basic elements of radiotherapy, Lecturer: Piotr Kedzierawski
	10:45 – 12:15	Lecture: Introduction to VERT, Lecturer: Tomasz Kuszewski
	13:30 – 17:00	Simulation of prostate cancer therapy: delineation of tumour, creating a therapy plan using Ray Search stations, Instructor: Tomasz Kuszewski
Tuesday 27 September	09:00 - 10:30	Lecture: Overview of radiotherapy techniques, Lecturer: Katarzyna Wnuk
	10:45 – 11:30	Lecture: Biological basis of radiotherapy and the problem of second primary cancers, Lecturer: Andrzej Wojcik
	13:00 – 15:00	Simulation of prostate cancer therapy: implementation and verification using, VERT, Instructor: Katarzyna Wnuk
Wednesday 28 September	09:00 - 10:30	Lecture: Cancer types and optimal cancer therapies, Lecturer: Piotr Kedzierawski
	10:45 – 12:15	Lecture: Radiation safety of the patient and the personnel, Lecturer: Agata Wałęcka-Mazur
	13:30 – 17:00	Simulation of breast cancer therapy: delineation of tumour, creating a therapy plan using RaySearch stations, Instructor: Krzysztof Bulinski
Thursday 29 September	09:00 – 10:30	Lecture: Use of cancer biomarkers for therapy selection, Lecturer: Artur Kowalik
	10:45 – 12:15	Lecture: Selection of optimal therapy for a patient and clinical routine, Lecturer: Jacek Sadowski
	13:30 – 17:00	Simulation of breast cancer therapy: implementation and verification using VERT, Instructor: Krzysztof Bulinski
Friday 30 September	09:00 – 11:30	Visit of the units PET, cancer biomarkers, medical physics and radiotherapy at the Holy Cross Cancer Centre
	11:30 – 13:00	Common lunch and end of meeting



COURSE 4

Introduction to Machine Learning / Deep Learning

Day	Lecture
Monday 12 September	Introduction to neural networks (5h), Lecturer: Andrés Gómez Tato, PhD (Head of Applications and Projects Department, CESGA)
	<ul style="list-style-type: none"> ▪ Basic concepts ▪ Methodology of Machine Learning projects ▪ Classification and regression ▪ Supervised training ▪ More frequent APIs
Tuesday 13 September	Deep Learning (5h), Lecturer: Andrés Gómez Tato, PhD (Head of Applications and Projects Department, CESGA)
	<ul style="list-style-type: none"> ▪ Convolutional networks and deep networks. ▪ Networks for temporal analysis: RNN / LSTM. / GRU ▪ Transfer Learning ▪ Autoencoders
Wednesday 14 September	Other algorithms I (5h), Lecturer: Andrés Gómez Tato, PhD (Head of Applications and Projects Department, CESGA)
	<ul style="list-style-type: none"> ▪ Support Vector Machines ▪ Decision trees ▪ Ensembles ▪ Random Forest ▪ AdaBoost / XGBoost ▪ Naive Bayes
	Clustering Lecturer: Jorge Fernández Fabeiro, PhD (SINFONIA Project Senior Technician, CESGA)
	<ul style="list-style-type: none"> ▪ Basic concepts ▪ Unsupervised training ▪ K-means / K-Modes / K-Prototypes
Thursday 15 September	Other algorithms II: Advanced computational techniques (5h), Lecturer: José Carlos Mouriño Gallego, PhD (SINFONIA WP5 Leader – Applications Senior Technician, CESGA)
	<ul style="list-style-type: none"> ▪ Reinforcement learning
	Lecturer: Jorge Fernández Fabeiro, PhD (SINFONIA Project Senior Technician, CESGA)
	<ul style="list-style-type: none"> ▪ Parallel training ▪ Best architecture and parametric search
	Guided tour to Finis Terrae III supercomputer facilities (CESGA Technical Staff)



Friday
16 September

Machine learning and exposure to ionizing radiation from medical imaging procedures (5h)

Machine learning in Nuclear Medicine

Lecturer: Prof Habib Zaidi (*Geneva University Hospital, Geneva, Switzerland*)

Machine learning in X-ray imaging

Lecturer: Prof. John Damilakis (*SINFONIA Scientific Leader – School of Medicine, University of Crete, Greece*)

