Programme Framework

Detailed course contents and laboratory activities:

Estimated number of hours dedicated to each topic (lessons/tutorship/exercises/tests &quizzes)

	title/topics	hours	Lecture/ Exercise
Block I	**Introduction to NORM and radon issues**	**18**	
1	General information about NORM: definitions and terminology, natural radionuclides occurrence and sources of NORM, sequential decay and disequilibrium in natural decay series, HBRA (high background radiation area), NORM vs. natural background, differences between NORM and TENORM, NORM/TENORM cases identification, occupational exposure, and possible interactions with environment.	4	L
2	Legal context of NORM - radiation protection and mutual interconnections with regulation dealing with non-radioactive waste, features of occupational exposure, protection of environment in the light of recent ICRP recommendations, clearance and exemption levels, liquid NORM, authority control - notification, application of graded approach.	3	L
3	Typical scenarios of environmental exposure caused by NORM (liquid, gaseous and solid NORM) and natural radionuclides migration in environment, radionuclides fractionation, features of fragmented decay series, accumulation in biota.	2	L
4	Radon isotopes - sources and migration in human environment, exposure scenarios, decay product and derived effective dose evaluation	2	L
5	NORM affected legacy sites characterisation	1	L
6	The systematic approach to identification of NORM involving industries and processes – four tiers method -mineral resources classification and modifications of European waste catalogue	2	L
	Multiple choice test and discussion	1	E
	Preparation of a country specific NORM inventory – group exercise	3	E
Block II	**Occupational exposure and exposure of members of the public caused by NORM**	**11**	
1	External exposure and radon: identification of exposure sources and typical exposure scenarios in NORM involving industries, radioactive aerosols and decay products fractions	2	L
2	Intake and internal exposure - important natural radionuclides , uranium vs its decay product, chemical toxicity vs. radiotoxicity.	2	L
3	Dose evaluation and workplaces/workers classification - graded approach to occupational exposure monitoring and evaluation, workplaces classification and reporting	1	L
4	Radiation protection programme preparation and mitigation methods; preparation for notification process	1	L
	Multiple choice test and discussion	1	E
	Dose calculation – individual exercise	1	E
	Preparation of industry specific requirements and decision criteria for notification process – group exercise	2	E
Block III	**Special considerations of NORM**	**4**	
1	NORM in building materials	1	L

2	NORM in drinking water	2	L
	Committed Dose calculation – individual exercise	1	E
Block IV	**NORM and radon metrology rudiments**	**10**	
1	Interpretation of results obtained in the light of sequential decay, disequilibrium in natural decay series, natural background subtraction: overview of laboratory and field measurements methods	2	L
2	Introduction to gamma-ray spectrometry	1	L
3	Introduction to alpha spectrometry	1	L
4	Introduction to radiochemical procedures for natural radionuclides separation	1	L
5	Introduction to LSC spectrometry	1	L
6	Introduction to TLD dosimetry	1	L
7	Introduction to Radon and Potential Alpha Energy Concentration (PEAC) measurement	1	L
8	Monitoring and sampling strategies - identification of sampling units, preparation of a sampling plan	1	L
9	Monitoring and sampling strategies - data interpolation/evaluation	1	L
10	Preparation of industry/legacy site specific monitoring plan	1	E
Block V	**Mitigation methods applied in NORM involving industries and legacy sites**	**5**	
1	Occupational exposure limitation, application of work hygiene and safety rules (H&S), work organisation	1	L
2	NORM residues, mixing, accumulation, storage, valuable materials recovery	1	L
3	Land reclamation - in the light further land use options	1	L
4	Water purification	2	L
Block VI	**Exercises -real example evaluation and proposed solutions discussion***	**12**	
1	A company reprocessing NORM residues (tin and lead re-melting processes)	3	E
2	A natural lake contaminated by radium rich brines	3	E
3	A metal ore mine	3	E
4	Examples of practical solutions applied in cases of planned and existing exposure situations monitoring based on coal mining	3	E2/L1
	in total	**60**	

** the content of the Block VI can be changed on trainees demand.*