|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **I** | **Applications of Liquid Scintillation Spectrometry (LSC) for NORM measurements** | **Units** | **Type** | **Lecturer** |
| 1 | General information about LSC:  Background, history, environmental monitoring, NORM and artificial radionuclides | 4 | L | S. Chalupnik |
| 2 | LSC - basic information, applications for NORM monitoring | 2 | L | S. Chalupnik |
| 3 | Drinking Water Directive Euratom/51/2013 | 2 | L | S. Chalupnik |
| 4 | Radium isotopes in water – the main source hazard for general public | 2 | L | S. Chalupnik |
| 5 | Monitoring of drinking and mineral waters |  |  | I. Chmielewska |
| 6 | Typical scenarios of environmental risk caused by (NORM liquid, gaseous and solid NORM) and Natural Radionuclides migration in environment, radionuclides fractionation, fragmented decay series | 2 | L | B. Michalik |
| 7. | Radiochemistry in NORM measurements | **2** | **L** | I. Chmielewska |
| 8. | Radon isotopes - sources and migration in human environment, exposure scenarios, decay product and radioactive aerosols - application of LSC for calibration and monitoring | 2+2 | L | M. Wysocka  K. Skubacz |
|  |  | **18** |  |  |
| **II** | **LSC applications for environmental monitoring and dose assessment** |  |  |  |
| 1 | Application of LSC for the assessment of NORM Intake - important natural radionuclides , uranium vs its decay product | 2 | L | K. Samolej/M. Bonczyk |
| 2 | LSC techniques in workplace monitoring in underground mines | 2 | L | S. Chalupnik |
| 3 | QA/QS in LSC laboratory – the NORM issues | 2 | L | M. Bonczyk |
| 4. | Validation of LSC methods | 2 | L | S. Chalupnik |
| 5. | Validation – radium isotopes | 1 | E | S. Chalupnik |
| 6. | Validation – tritium in water | 1 | E | I. Chmielewska |
| 7. | Implementation of Euratom/51/2013 Directive – results of monitoring and dose assessment | 2 | L | I. Chmielewska |
|  |  | **12** |  |  |
| **III** | **Radiochemistry for LSC** |  |  |  |
| 1 | Sample preparation techniques | 3 | L | I. Chmielewska |
| 2 | Radium in water | 2 | E | I. Chmielewska |
| 3. | Radon in water | 1 | E | I. Chmielewska |
| 4. | Artificial radionuclides – Sr-90 | 1 | E | I. Chmielewska |
|  |  | 7 |  |  |
| **IV** | **NORM metrology by LSC** |  |  |  |
| 1 | Gamma-ray spectrometry vs. LSC | 1 | L | M. Bonczyk |
| 2 | Alpha spectrometry vs. LSC | 1 | L | K. Samolej |
| 3 | Application of LSC spectrometry for Radon and DP measurements | 1 | L | K. Skubacz |
| 4 | Application of LSC spectrometry for Radon and Thoron DP measurements (calibration) | 2 | L+E | A. Grygier |
| 5 | Monitoring and sampling strategies with LSC use - identification of sampling units, preparation of the sampling plan | 1 | L | B. Michalik |
| 6 | Interpretation of results obtained by LSC, disequilibrium in natural decay series, natural background subtraction : overview of laboratory and field measurements methods | 2 | L | B. Michalik |
|  |  | **8** |  |  |
| **V** | **Special applications of LSC** |  |  |  |
| 1 | Water treatment techniques – the use of LSC | 1+1 | L | K. Samolej S. Chałupnik |
| 2 | Possible applications of LSC for environmental monitoring (artificial radionuclides) | 2 | L | I. Chmielewska |
| 3 | In-situ LSC measurements (radon, thoron, DPs in water and in the air) | 1 | L | M. Wysocka |
| 4 | Monitoring of aerosols in the air | 2 | L | K. Skubacz |
|  |  | **7** |  |  |
| **VI** | **LSC applications - exercises** |  |  |  |
| 1 | Water analyses with use of LSC | 3 | E | I. Chmielewska |
| 2 | Detection limits etc. | 3 | E | S. Chałupnik |
| 3 | PAEC measurements | 2 | E | A. Grygier |
| 4 | Summary | 2 | L | S. Chałupnik |
|  |  | **10** |  |  |
|  | RAZEM | **62** |  |  |