European School of Advanced Studies
on
Nuclear and Ionising Radiation Technology
7th International Master Course
on
Industrial Applications of the Ionising Radiations
Radioisotopes Techniques and Nuclear Medicine
Environmental Radiochemistry
Radioprotection, Nuclear Decommissioning
Academic year 2004-2005

ORGANIZED IN PARTNERSHIP WITH THE
INTERNATIONAL ATOMIC ENERGY AGENCY
(IAEA, VIENNA)

IUSS-UNIVERSITY OF PAVIA
II LEVEL MASTER
on
NUCLEAR AND IONISING RADIATIONS
TECHNOLOGIES
Academic year 2004-2005

ONE ACADEMIC YEAR

THEORETICAL
LECTURES AND
LABS: 400 hrs
4 MODULES

TRAINING
STAGES :
6 MONTHS

FINAL MASTER
EXAMINATION;
II LEVEL MASTER
DIPLOME

MODULES

• BASIC NUCLEAR THEORY
• INDUSTRIAL APPLICATIONS OF RADIATION TECHNOLOGY
• RADIOCHEMISTRY AND RADIOISOTOPES TECHNIQUES
• a) RADIOPROTECTION (PROGRAM FOR QUALIFIED EXPERTS)
  b) NUCLEAR DECOMMISSIONING
ADMISSION TO THE COURSE

- MSc DEGREES ON PHYSICS, CHEMISTRY, ENGINEERING, PHARMACEUTICAL CHEMISTRY, ARE REQUESTED
- THE SELECTION IS BASED ON THE CURRICULUM AND A COLLOQUIUM
- THE FREQUENCY TO THE COURSE IS MANDATORY

EXAMINATIONS

- INTERMEDIATE WRITTEN EXAMINATION AT THE END OF EACH OF THE 4 MODULES
- FINAL DIPLOME MASTER EXAMINATION BASED ON THE DISSERTATION OF THE STAGE THESIS. THE STAGE TUTORS ARE INVITED AS MEMBERS OF THE COMMISSION

FELLOWSHIPS

A LIMITED NUMBER OF FELLOWSHIPS AS TWICTION WEAVERS AND REIMBURSEMENT OF LODGING EXPENSES.
BASIC NUCLEAR THEORY: 90 hrs

- RADIATION PHYSICS
- RADIATION CHEMISTRY
- RADIOCHEMISTRY AND NUCLEAR CHEMISTRY
- RADIATION DOSIMETRY
- RADIATION BIOLOGY

2. INDUSTRIAL APPLICATIONS OF RADIATIONS: 110 hrs

- INDUSTRIAL RADIATION DOSIMETRY
- 60-Co SOURCES AND E-BEAM ACCELERATORS
- APPLICATION OF RADIATIONS TO:
  - MATERIAL SCIENCE AND TECHNOLOGY (polymer crosslinking and functional modification, polymer composites, surface curing, curing of semiconductors, e-beam microlithography, e-beam applications in metallurgy)
  - ENVIRONMENTAL PROBLEMS (water remediation, industrial fuel gas treatment, waste sterilization, recycling of waste materials)
  - INDUSTRIAL STERILIZATION (medical and pharmaceutical industries)
  - FOOD INDUSTRY AND AGRICULTURE
3. RADIOCHEMISTRY AND RADIOISOTOPES TECHNIQUES: 90 hr

• BASIC RADIOCHEMISTRY LABORATORY TECHNIQUES
• RADIATIONS SPECTROMETRY AND DETECTION
• INAA AND ITS APPLICATIONS (MATERIAL SCIENCE, MEDICAL AND ENVIRONMENTAL RESEARCH, FORENSIC RADIOCHEMISTRY, CULTURAL HERITAGE)
• ENVIRONMENTAL RADIOCHEMISTRY AND RADIOECOLOGY
• NUCLEAR MEDICINE: A) CYCLOTROPE AND RADIONUCLIDES PRODUCTION
  B) SYNTHESIS OF RADIOPHARMACEUTICALS

4-A. RADIOPROTECTION: 110 hrs
This part of the course is based on the official program for the 1th, 2th and 3th level Qualified Expert patent examinations.

• LEGISLATION OF RADIOPROTECTION
• RADIATION SOURCES (γ, X, e-beam, neutrons) AND RELATED RADIOPROTECTION AND SAFETY REGULATIONS
• RADIATION SHIELD CALCULATION
• INSTRUMENTS FOR RADIOPROTECTION
• QUALITY CONTROLS
• HEALTH CONSEQUENCES UPON EXPOSURE TO RADIATIONS
• PERSONNEL DOSIMETRY
• RADIOPROTECTION IN RADIOISOTOPES MANIPULATIONS
• PLANNING OF RADIOCHEMISTRY LABS
• MANAGING NUCLEAR EMERGENCIES
• RADIOACTIVE WASTES TREATMENT AND TRANSPORT
4-B. NUCLEAR DECOMMISSIONING: 24 hrs

• LEGISLATION
• CHARACTERIZATION OF WASTES
• PACKAGING OF WASTES
• IAEA REGULATIONS FOR TRANSPORTATION OF RADIONUCLIDES
• WASTE DISPOSAL
• SITE CURING AND SITE RELIESE

TRAINING STAGES

• THE TRAINING STAGES ARE REGULATED BY AN OFFICIAL AGREEMENT BETWEEN THE SCHOOL AND THE EXTERNAL INSTITUTIONS
• THE TRAINING STAGES HAVE A DURATION OF 6 MONTHS STARTING FROM AUGUST-SEPTEMBER.
• THE STAGE ACTIVITY ENDS WITH A FINAL REPORT (STAGE THESIS) AND IT TAKES PLACE UNDER THE SUPERVISION OF A LOCAL TUTOR AND A CO-TUTOR NOMINATED BY THE SCHOOL.
• THE LOCAL TUTOR AND THE CO-TUTOR ARE INVITED AS MEMBERS OF THE COMMITTEE AT THE FINAL DIPLOME MASTER EXAMINATION.
PARTNERS OF THE SCHOOL

INDUSTRIES

• BIOSTER (E-BEAM)
• GAMMARAD (60 Co CELL)
• GAMMATOM (60 Co CELL)
• IBA (E-BEAM, X RAY)
• IZOTOP (GAMMA CELLS, Hungary)
• NOVICO (Ascoli Piceno)
• METALLURGICA BRESCIANA
• SI-MICROELECTRONICS (Catania)
• MEGARAD (Mignano Montelungo, Caserta)
  • So.G.I.N (Roma)
• NUCLECO (Roma)
• PROEL TECNOLOGIES (Firenze)
• TECNOTESSILE (Prato)
• ELSE (Trezzano S/N, Milano)
• COMECER (Ravenna)
• PIRELLI (Advanced Research Labs, Milano)
• ENI (MILANO)

NUCLEAR INSTITUTIONS AND RESEARCH CENTRES

• IAEA (Vienna, Austria)
• RADIOPROTECTION RESEARCH CENTRE (Cadarache, France)
• ENEA (Reseach centres at Casaccia, Bologna and S. Tesresa di Leric)
• ITALIAN NATIONAL RESEARCH COUNCIL (ISOF-CNR at BOLOGNA; IENI-CNR at Pavia)
• ISTITUTO SUPERIORE DI SANITA’ (ISS, ROME)
• ELECTRA (TRIESTE)
• ICTP (Trieste)
• FEDERAL INSTITUTE FOR FOOD RESEARCH (KARLSRUHE, GERMANY)
• INFN (PAVIA SECTION, AND NATIONAL LABS AT FRASCATI AND LEGNARO)
• AGENCIES FOR THE ENVIRONMENTAL PROTECTION (APAT AND REGIONAL AGENCIES IN MILANO, PAVIA AND PIAZENZA)
• HEALTH PHYSICS AND RADIOPROTECTION LABS IN HOSPITALS (MILANO, PAVIA, NOVARA, BOLOGNA)
• PET CENTRES (CNR-Pisa, Milano S.Raffaele, Pavia –LENA)
PARTNERS OF THE SCHOOL

UNIVERSITIES

- THE EMNT NETWORK (Univ of Pavia, Rome, Grenoble, Kaunas, Thursto and CEA-France)
- POLYTECHNIC OF MILAN
- POLYTECHNIC OF TURIN
- UNIVERSITY OF PALERMO
- UNIVERSITY OF BOLOGNA
- UNIVERSITY OF PADOVA
- UNIVERSITY OF URBINO
- TECHNICAL UNIVERSITY OF LODZ (POLAND)
- UNIVERSITY OF STRATHCLYDE (GLASGOW, U.K.)

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<th>ACADEMIC YEAR</th>
<th>NO. OF MASTER GRADUATED</th>
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<td>2004</td>
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<td>7 Ind. Chem. Chem. Eng Biol. Environment Sci</td>
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NUCLEAR FACILITIES AT THE PAVIA’S UNIVERSITY
• TRIGA RESEARCH NUCLEAR REACTOR M II 0.25 Mev
• 16 Mev IBA CYCLOTRON
• 4 kCi 60-Co GAMMA CELL
• 50 kCi 60-Co PANORAMIC GAMMA CELL (to be installed)
• Industrial X–RAY GENERATOR (250 KEV)
• Facilities for high energy physics experiments

PAVIA’S NUCLEAR RESEARCH CENTRES
• THE LABORATORY OF APPLIED NUCLEAR ENERGY (LENA)
• THE NUCLEAR AND THEORETICAL PHYSICS DEPARTMENT
• THE RADIATION CHEMISTRY LAB (CHEMISTRY DEP.)
• THE RADIOCHEMISTRY LAB (CHEMISTRY DEP.)
• THE INFN SECTION of Pavia (HIGH ENERGY PHYSICS INTERNATIONAL PROJECTS)
• IN THE NEAR FUTURE: CNAO