# NATIONAL POSTGRADUATE MEDICAL COLLEGE OF NIGERIA

# RESIDENCY TRAINING CURRICULUM IN RADIODIAGNOSIS AND RADIATION AND CLINICAL ONCOLOGY

## FACULTY OF RADIOLOGY

## APPROVED BY THE SENATE ON 5TH MARCH, 2020

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COLLEGE REGISTRAR

# NATIONAL POSTGRADUATE MEDICAL COLLEGE OF NIGERIA

## FACULTY OF RADIOLOGY

# CURRICULUM AND GUIDELINES

## RESIDENCY TRAINING PROGRAMMES

## IN

## RADIODIAGNOSIS AND RADIATION & CLINICAL ONCOLOGY

# 2020

## Preamble

This sixth Curriculum reviewed for the 43years of training in the Faculty of Radiology of the **National Postgraduate Medical College of Nigeria (NPMCN) is a 240 paged document, aimed at meeting the identified needs of the Resident Doctors in Nigeria, her environs, and therefore the healthcare radiologic needs of the citizenry; accommodating new information and technologies, thus giving the Trained, both local and global relevance.**

The Curriculum is therefore, designed as a six year programme to accommodate flexibility for those Candidates who in addition to their Professional Degrees also desire Academic degrees in accordance with the National Universities Commission benchmarks. (Appendix 1)

It is a Document, jointly owned by the Radiologists (Diagnostic Radiologists) and the Radiation and Clinical Oncologists.
For ease of reading and understanding the Document has been divided into four major parts, the viz: Introduction/Preamble, Radiodiagnosis, Radiation and Clinical Oncology, the last few pages to Recommendations and Appendices.

### About the College

The **National Postgraduate Medical College of Nigeria (NPMCN)** is a regulatory College which acts as a national, nonprofit organization established to oversee the medical education of specialists in Nigeria, by the National Postgraduate Medical College Decree No. 67 of 24th September,1979, now Cap N59 Laws of the Federation 2004.
It is a body corporate with perpetual succession and a common seal.

**The Postgraduate College** is also an association of Medical and Dental Specialists concerned with setting national standards for medical education and Continuing Professional D evelopment in Nigeria for 15Medical and Dental specialties, one of which Radiology (Radiodiagnosis and Radiotherapy) is.
As such, **NPMCN** is neither a licensing nor a disciplinary body. Instead, it is a regulatory authority that helps ensure that the training and evaluation of Medical and Dental specialists maintain certain standards of quality.

All Specialists in Nigeria must be certified by the **NPMCN** before they obtain a National license to practise.

To become certified, a physician or dentist must pass **NPMCN** examinations.

Access to these examinations is usually gained by completing an **NPMCN** -accredited Residency program at one of the National, State or Private Teaching Hospitals or Medical Centres.
Access to NPMCN examinations is also available for medical or dental residents who complete their residency program at certain international training programs approved by the **NPMCN.**

Since its establishment, **NPMCN** has been granted the patronage of the President and Commander- in Chief of the armed forces of the Federal Republic of Nigeria

### Vision of NPMCN

The National Postgraduate Medical College of Nigeria aims to produce medical and dental specialists of the highest standards who will provide world class services in teaching, research and health care.

### Mission of NPMCN

The mission of the college is to PLAN, IMPLEMENT, MONITOR and EVALUATE postgraduate programmes required to produce medical and dental SPECIALISTS of the highest quality,

competence and dedication, who will provide TEACHING and optimal HEALTHCARE for the people. Lifelong learning will be maintained by Continuing Professional Development programmes of the College.

**Objectives of NPMCN**

The duties of **NPMCN** centre on its prime objective — to ensure the highest possible standards of specialist training and specialist care.

The **NPMCN**'s duties are therefore as follows:

- prescribing the requirements for specialty education in medical, surgical and laboratory medicine.
- accrediting specialty residency programs,
- assessing the acceptability of residents' education,
- conducting certifying examinations,
- setting standards for professional and ethical conduct among its members.
- continuing Professional Development (CPD) aimed at tracking and documenting the **skills**, knowledge and experiences acquired both formally and informally beyond any initial training is a key and mandatory Program of NPMCN for all her members.
- carrying out any other activities necessary for the furtherance of postgraduate medical education in the country.

**The Associations**

In this year 2018 **NPMCN** has more than 2,000 Radiologists worldwide, including Fellows, Resident Doctors, Honorary Fellows, retirees, and Emeritus members.

Fellows of the **NPMCN's** Faculties use the appellation **FMC…** (Fellow of The Medical College in ….. ) the last letter of the appellation, being the first letter of the Fellow's Faculty.
Fellows of the NPMCN's Faculty of Radiology therefore use the appellation – FMCR (Fellow of the Medical College in Radiology)

**NPMCN** has a Directory, the listing of which includes details of all current and retired Fellows.

**Registration as Associate Fellow**

The trainee is required to register as an associate fellow after passing the primary FMCR examination and has secured a placement in an accredited training centre.

**About Faculty of Radiology**

**COMPOSITION OF THE FACULTY OF RADIOLOGY**

- **Faculty Chairman** –
- **Faculty Secretary** -
- **Third Senate Member**
- **Faculty Board – 12-man Board**
- **Examiners' Board**
- **Fellows**
- **Associate Fellows**

**Vision of the Faculty of Radiology**

To produce outstanding and altruistic Radiologists, fully engaged in self inspired lifelong learning in all walks of medical practice, including patient care, education, research and administration, irrespective of being in private practice, university/other academic practice, government, industry or Charitable organization.

**Mission**

a. **Patient Care** that is compassionate, appropriate, and effective for the treatment of health problems and the promotion of health
b. **Medical Knowledge** about established and evolving biomedical, clinical, and cognate sciences and the application of this knowledge to patient care
c. **Practice-Based Learning and Improvement** that involves investigation and evaluation of their own patient care, appraisal and assimilation of scientific evidence, and improvements in patient care
d. **Interpersonal and Communication Skills** that result in effective information exchange with the patient care team, patients and their families
e. **Professionalism**, as manifested through a commitment to carrying out professional responsibilities, adherence to ethical principles, code of conduct, respect to senior colleagues and sensitivity to a diverse patient population.

**Pre-Requisites for Training**

**Institutional:** The Department of Diagnostic Radiology or Radiation and Clinical Oncology or both Departments, as applicable, must have been approved by the National Postgraduate Medical College of Nigeria for residency training in Radiology following recommendation by the Faculty of Radiology.

**Candidate:** Must satisfy **ALL** the admission requirements listed in the section below

**Admission Requirements**

To be admitted into the programme, the trainee must must:

- be registered with the Medical and Dental Council of Nigeria
- have completed the National Youth Service.
- have a minimum of years' clinical experience after MBBS or equivalent qualifications;
- have passed the Radiology Primaries Qualifying exaimnation
- have secured a fulltime employment or supernumerary status or be affiliated to an accredited institution for Residency training in Radiology (Diagnostic Radiology or Radiation and Clinical Oncology).

**Duration of Training**

A minimum of 6 years full-time training in either Radiodiagnosis or Radiation and Clinical Oncology at Parts I and II levels must be undertaken in an accredited institution after passing the Primary examination. Only the primary level of the examination may be written without a formal training. Candidates are strongly advised to seek training posts only after passing the Primary examination, as any period spent in preparing for the Primary examination before gaining admission into an accredited institution may not likely be counted as part of training.

**General Learning Goals and Objectives**

The Diagnostic Radiology residency training program in an accredited institution has a minimum of 6-academic year course comprising of Part I and Part II stages.

The curriculum is designed to achieve graded responsibility and an increasing fund of knowledge in General Radiology. The goal is for each resident to achieve independent competency in performance of basic radiologic procedures, interpretative and report writing skills as well as acquire the tools with which to continue self-education and life-long learning techniques.
The general educational content of the program is also intended to include the integration of medical and surgical concepts as appropriate to the specialty and opportunities for the resident to follow patients to surgery for the purpose of correlating radiologic findings and to follow cases to pathology to develop an understanding of the gross pathology.

During the six years of rotations through various clinical services, the resident will be expected to demonstrate the following progressive abilities during training:

**Years One and Two Rotations** See Appendix 2

1. Assimilate knowledge-based objectives unique to individual services, particularly with regard to normal and variant anatomy, and common clinical abnormalities.
2. Develop proficiency in technical, communication, and decision making skills.
3. Undertake formal instruction in radiation biology including, the cellular and sub-cellular effects of radiation, tissue kinetics and responses, radiological facts modifying effects, total body effects and histo-pathological responses.
4. Undertake lectures, tutorials and seminars in the principles of x-ray, ultrasound, MRI and Nuclear Physics.
5. Gain understanding of standard patient positioning for plain film radiography

6. Develop skills to communicate effectively with referring clinicians, supervisory staff, ancillary personnel, and peers.
7. Learn to accurately and concisely dictate a radiologic report that includes patient name, patient medical record number, date of exam, date of comparison exam, type of exam, indication for exam, brief and concise description of the findings, and a short impression.
8. Learn to obtain pertinent patient information relative to requested and indicated radiologic examinations.
9. Demonstrate a responsible work ethics.
10. Directly notify ordering or referring physicians about all significant or unexpected radiologic findings and document who was called and the date and time of the call in the dictated report.
11. Obtain relevant patient history from computer records, dictated reports, or by calling referring clinicians.
12. Understand when it is appropriate to obtain help from supervisory faculty in interpreting radiographs when answering questions for referring clinicians.
13. Begin to demonstrate the ability to effectively present cases in a conference setting by presenting a brief discussion of the radiographic findings and a basic list of differential diagnosis.
14. Undertake informal and formal teaching responsibilities to fellow residents in other departments, interns, clinical clerks, and medical students. Teaching others is an important part of the resident's training program and learning course.

**Year Three Rotations.** During this period the resident will undergo rotations through various clinical services, demonstrate progressive learning of the knowledge-based objectives unique to individual services, particularly with respect to more complex or unusual pathologic processes and pertinent findings in the setting of in-house call.

1. Continue to improve interpretive skills.
2. Understand the technical principles of US, CT, and MR applications.
3. Develop skills in the use of protocols, monitoring, and interpreting cross-sectional imaging examinations.
4. Be able to monitor all CT exams and determine if additional imaging is needed before the examination is completed.
5. Demonstrate an understanding of ACR appropriateness criteria for various disciplines.

6. Demonstrate the ability to effectively present cases in a conference setting to other residents by appropriately selecting cases, interacting with residents, and presenting a brief discussion of the diagnosis for each case, using more advanced educational resources.
7. Demonstrate the ability to manage an intravenous contrast reaction that occurs during a CT examination.
8. Be able to act as a junior consultant for referring clinicians and house staff and recommend the appropriate use of imaging studies.
9. Improve interventional skills, particularly with respect to fluoroscopic-guided and angiographic techniques.
10. Increase comfort level and confidence with respect to autonomous decision-making in the setting of in-house call and emergency department radiology. However, residents at this level should not allow their confidence to outstrip their abilities (i.e. know when to ask for advice from senior residents, fellows, and faculty)

**Years Four, Five and Six Rotations**

After completion of the fourth to sixth year rotations through various clinical services, the resident will:

1. Demonstrate thorough understanding of the knowledge-based objectives introduced in Years 1 and 2 as listed above.
2. Refine interpretive skills in all modalities.
3. Develop the **ability to work independently** in the image reading room and during in-house on call, assisting clinicians with radiologic interpretation, and teaching junior residents and medical students assigned to various rotations.
4. Understand the clinical significance of radiographic findings and be able to direct clinical colleagues with recommendations for management and appropriate selection of any other indicated radiologic examinations.
5. Demonstrate proficiency in the use of protocols, monitoring, and interpreting of all cross-sectional imaging modalities.
6. Become a more autonomous consultant and teacher. The resident will be able to prepare conferences suitable for presentation in multidisciplinary venues utilizing more detailed technical references from books, peer-reviewed journal, electronic media, and supplemented by state-of-the-art technical publications in radiology journals.
7. Correlate pathologic and clinical data with plain film and cross-sectional images.

8. Continue to improve interventional skills, augmenting fluoroscopic-guided and angiographic techniques with CT and US guided procedures. By the end of the fourth year, residents will be able to independently perform common interventional procedures including, but not limited to, abscess drainage, percutaneous biopsy, paracentesis, and thoracocentesis, as well as basic selective and non-selective angiography.
9. Be able to dictate accurate, concise reports.
10. Thoroughly understand the clinical indications and contraindications for radiographic examinations and procedures.
11. Be familiar and comfortable with discussion of the correlation between pathologic and radiologic studies.

**Radiological and radiographic Anatomy, techniques and procedures**

These have been incorporated into the various systems in this curriculum and will be further discussed under each system.

In the case of plain film radiography however, Trainees should become familiar with the radiographic technique even if they do not take the radiographs personally.

**Communication, interpretation and report writing:** In the first year of training the trainee must begin to acquire some of the interpretation, reporting and communication skills that will eventually be required of a consultant radiologist.

The Committee recommends a minimum requirement of two sessions per week to be devoted to reporting. For the core, the trainee will have interpreted and formally reported the following under the supervision of a recognized trainer.

*Core objectives*

- All core procedures and techniques performed by the trainee.
- A selection of radiographs taken for trauma.
- A selection of in-patient and out-patient radiographs.

*Optional*

- Reporting of US, radionuclide, CT and magnetic resonance investigations.
- Reporting of special procedures not performed by the trainee
- Reporting of paediatric investigations

## GENERAL COMPETENCIES IN RADIOLOGY RESIDENCY TRAINING WITH SKILLS, EDUCATION AND ASSESSMENT

The general areas of evaluation of competency during residency training in diagnostic radiology and Radiation and clinical Oncology includes: patient care, medical knowledge, interpersonal and communication skills, professionalism, practice-based learning and improvement and system-based practice.

**PATIENT CARE:** Provide patient care that is compassionate, appropriate and effective.

**A. Skills**

1. Gather essential and accurate information about patients
2. Develop a diagnostic/therapeutic plan (taking into account the cost and availability), based upon the clinical question(s) and relevant clinical, radiologic and pathologic information and appropriately select and interpret diagnostic test used for screening and diagnosis of common/important illnesses.
3. The ability to perform both a complete and focused physical examination, including a mental status examination.
4. The ability to relieve pain and ameliorate the suffering of patients, including the provision of end-of-life care.
5. Counsel patients concerning preparation for diagnostic testing/therapeutic intervention
6. Oversee diagnostic imaging/therapeutic intervention to ensure adequacy of studies performed
7. The ability to recognize patients with immediate life-threatening (e.g., cardiac, pulmonary, or neurological, superior vena cava obstruction syndrome, etc) conditions regardless of etiology and to institute appropriate initial therapy
8. Demonstrate a basic understanding of electronic patient information systems
9. Demonstrate the ability to use the Internet as an educational instrument to expandmedical knowledge
10. Establish regular, timely and effective communication with referring clinicians
11. Be cognizant and respective of patient confidentiality
12. Demonstrate knowledge of the levels of ionizing radiation related to specific imaging procedures and employ measures to minimize radiation dose to the patient
13. The ability to care for patients with common conditions (acute, chronic and terminal), taking into consideration benefits, risks, functional status and patient preferences.
14. Perform radiologic examinations/therapeutic intervention appropriately and safely, assuring that the correct examination is ordered and performed
15. The ability to recognize ethical dilemmas and develop a framework for resolution.
16. The ability to identify medico-legal risks and resources.

B. **Education** (with graduated faculty supervision and feedback)

1. Practical experience in developing a differential diagnosis and management plan based upon clinical data, imaging findings and other medical test results
2. Active participation in journal reviews to determine the effectiveness of diagnostic imaging for specific diagnostic questions
3. Graduated responsibility in performing radiologic procedures
4. Didactic instruction in radiation safety
5. Preparation and presentation of radiologic cases to other members of the healthcare team

**C. Assessment**

1. Written Examination
2. Oral examination
3. Procedure log
4. Objective structured clinical examination

**MEDICAL KNOWLEDGE:** Residents must demonstrate knowledge about established and evolving biomedical and clinical sciences and the application of this knowledge to patient care.

**A. Skills**

1. Demonstrate sufficient knowledge of medicine (with emphasis on the pathological basis of medicine) and apply this knowledge to radiological studies in a clinical context to generate meaningful differential diagnoses
2. Knowledge of the important environmental, economic, social, and cultural factors that contribute to the development, chronicity and mitigation of maladies.
3. The knowledge and ability to identify factors that place individuals at risk for disease, injury, or disability and to select appropriate methods for screening or early detection for radiological interventions
4. Demonstrate progressive acquisition of radiological knowledge
5. Generate a clinically appropriate diagnostic treatment plan
6. Demonstrate knowledge of the principles of research design and implementation
7. Demonstrate the ability to use all relevant information resources to acquire evidence-based data
8. Understand how radiologic equipment can be used to generate appropriate and diagnostic images

**B. Education**

1. Didactic lectures and self-directed learning on the science and practice of radiology
2. Participation in departmental and inter-departmental clinical conferences
3. Participation in the clinical activities of the radiology department
4. Interdepartmental rotations in other clinical departments including Pathology, Internal Medicine, Surgery, Pediatrics, Obstetrics and Gynecology
5. Departmental or institutional training programs on research design and Implementation

**C. Assessment**

1. Written examinations
2. Procedure Log book
3. OSCE
4. Oral examination

**INTERPERSONAL AND COMMUNICATION SKILLS:**

Residents must demonstrate interpersonal and communication skills that result in effective information exchange with patients, patient family members, medical students, other residents,supervising faculty, referring physicians, technologists, nurses and other members of thehealth care team.

**A. Skills**

1. Provide a clear and informative written radiologic report including a precise diagnosis whenever possible, a differential diagnosis when appropriate, and recommended follow-up or additional studies when appropriate
2. Provide direct communication to the referring physician or appropriate clinical personnel when interpretation reveals an urgent or unexpected finding and document this communication in the radiologic report
3. Demonstrate effective skills of face-to-face listening and speaking with other health professionals, patient's families and support personnel
4. Demonstrate appropriate telephone communication skills
5. The ability to work within a patient care team to provide safe and effective patient care.
6. The ability to use understanding of the patient-doctor relationship in a therapeutic, supportive and culturally sensitive way for patients and their families.
7. The ability to critically evaluate the medical literature and to seek opportunities to expand understanding and appreciation of scientific discoveries and their applications.
8. Demonstrate skills in obtaining informed consent, including effective communication to patients of the procedure, alternatives and possible complications

B. **Education** (with graduated faculty supervision and feedback)

1. Participation as an active member of the radiology team by communicating faceto-face with clinicians, answering the telephone, providing consults, problemsolving and decision-making
2. Act as the contact person for technologists and nurses in managing patient andimaging issues
3. Active participation in preparing and moderating multi-disciplinary conferences
4. Practical experience in writing radiological reports

**C. Assessment**

1. Global rating
2. Oral examination
3. OSCE
4. Record review (Systematic evaluation of residents preliminary reports)

**PROFESSIONALISM:**

Demonstrate a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to a diverse patient population.

**A. Skills**

1. Demonstrate altruism (putting the interests of patients and others above own self-interest)
2. Demonstrate compassion: be understanding and respectful of the patients, patient families, and staff and other health care professional caring for patients
3. Demonstrate excellence: perform responsibilities at the highest level and continue active learning throughout one's career
4. Be honest with patients and all members of the health care team
5. Demonstrate honor and integrity: avoid conflicts of interest when accepting gifts from patients or vendors

6. Interact with others without discriminating on the basis of religious, ethnic, sexual or educational differences and without employing sexual or other types of harassment
7. Demonstrate knowledge of issues of impairment (i.e. physical, mental and alcohol and substance abuse), obligations for impaired physician reporting, and resources and options for care of self-impairment or impaired colleagues
8. Demonstrate positive work habits, including punctuality and professional decorum and appearance
9. Demonstrate an understanding of broad principles of biomedical ethics
10. Demonstrate principles of confidentiality with all information transmitted during a patient encounter
11. Demonstrate knowledge of regulatory issues pertaining to the use of human subjects in research

**B. Education**

1. Discussion of conflicts of interest and the ethics of conducting research during departmental or institutional conferences and daily clinical work
2. Training programs (i.e. videotapes) on the issues of harassment and discrimination.
3. Didactic presentations on the recognition and management of the "impaired physician"
4. Presentation of research proposals during departmental seminars.
5. Participation in hospital-sponsored core curriculum educational activities (i.e. lectures, web-based programs)
6. Didactic lecture/training program on the broad principles of medical ethics
7. Institutional web-based self-directed learning and assessment programs on human subjects research guidelines, eg, Update courses, Research Methodology by NPMCN, CITI, etc.

**C. Assessment**

1. Global ratings
2. Conference attendance logs
3. Resident self-assessment
4. Written examination

**PRACTICE BASED LEARNING AND IMPROVEMENT:**

Residents must be able to investigate and evaluate their patient care practices, and appraise and assimilate scientific evidence in order to improve their radiologic practices.

**A. Skills**

1. Analyze practice experience and perform practice-based improvement incognitive knowledge, observational skills, formulating a synthesis andimpression, and procedural skills
2. Demonstrate critical assessment of the scientific literature
3. Demonstrate knowledge of and apply the principles of evidence-based medicinein practice
4. Use multiple sources, including information technology to optimize life-long learning and support patient care decisions
5. Facilitate the learning of students, peers and other health care professionals

**B. Education**

1. Participate in critical assessment of the scientific literature through journal clubs, clinical conferences and independent learning
2. Didactic lectures on the assessment of scientific literature, study designs and statistical methods
3. Teaching students, peers and other health care professionals, with graduated supervision and feedback from supervising faculty

4. Active participation in departmental or institutional quality assurance (QA)/quality improvement (QI) activities with faculty supervision

C. **Assessment**
1. Global ratings by faculty
2. Written examination (Departmental assessment for submission to NPMCN)
3. Conference attendance logs
4. Procedure log

**SYSTEMS BASED PRACTICE:**

Demonstrate an awareness and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide optimal care.

**A. Skills**
1. Demonstrate the ability to design cost-effective care plans based on knowledge of best practices
2. Demonstrate knowledge of the sources of financing for health care including National Health Insurance Scheme (NHIS), employer-based private health plans, and patient's own funds
3. Demonstrate knowledge of basic health care reimbursement methods
4. Demonstrate knowledge of the regulatory environment including state licensing authority, state and local public health rules and regulations, and regulatory agencies such as Medical and Dental Council of Nigeria, Nigerian Nuclear Regulatory Authority, etc
5. An understanding of the impact of system-based errors on patient care and of methods available to identify and address these errors.
6. Demonstrate knowledge of basic practice management principles such as budgeting, record keeping, medical records, and the recruitment, hiring, supervision and management of staff

**B. Education**
1. Systematic review of appropriate literature, to develop knowledge of evidence based indications for imaging procedures
2. Attendance and active participation in departmental and multi-disciplinary conferences where there is discussion of the imaging evaluation of specific diseases and most appropriate and cost-effective methods for establishing a diagnosis
3. Interaction with department administrators and knowledgeable faculty to gain an understanding of the costs of diagnostic examinations and the influence of the type of payer system on reimbursement
4. Membership and active participation in local and national radiological societies
5. Departmental or institutional presentations on health care funding and regulation

**C. Assessment**
1. Global ratings by faculty
2. Written examination
3. Multi-disciplinary conference attendance logs
4. Documented membership and participation in radiologic societies and other health care organizations

The National Postgraduate Medical College of Nigeria NPMCN (Faculty of Radiology) is increasing emphasis on educational outcomes in the accreditation of residency programs.

The impetus for this project is based on a system of medical education that relies heavily on public funding and is therefore accountable to the public in terms of meeting public needs and preparing well-

qualified new physicians in the most cost-effective way possible. The current model of accreditation focuses on the potential of a Residency Programme to educate residents (in compliance with the program stipulated requirements, such as established objectives, organized curriculum, regular evaluation of the Residents as well as Training Programme). However, measuring program quality by examining structure and process is not a direct or complete measure of the quality of the educational outcomes of a program. In the future, accreditation will focus on actual accomplishments of a program, through assessment of program outcomes (i.e. whether the Residents achieve the learning objectives set by the program, whether the program provides evidence of this achievement, and whether the program demonstrates continuous improvement in its educational process).

These are the set goals of this Curriculum, the achievement of which is the reward of the members of the 2018 Curriculum Review Committee look forward to.

To the Residents and the Trainers who will use this 2018 Curriculum, may the appropriate use of it make the whole exercise worthwhile.

To satisfy the NUC requirements, considerations have been made for those who want to progress along the Academic Doctorate program as a choice or as an addition to the Professional programme (see Appendix 1)

KEYS to Abbreviations

| | |
|---|---|
| RDL | Radiology |
| RCO | Radiation and Clinical Oncology |

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# CURRICULUM FOR THE PRIMARY IN RADIOLOGY

## (PRE-PART 1) **TRAINING**

### RADIODIAGNOSIS AND RADIATION & CLINICAL ONCOLOGY

**PRIMARY TRAINING (Pre-Part I)**

While Parts I and II of the Residency Training Programme are carried out in Institutions that the Resident has been admitted into, the Primary Training is rests on the premise of the individual Candidate as it is a pre-requisite for admission into a formal Training Programme.

This Curriculum was put together as a guide for the Candidate's personal training

1. **Syllabus for Primary Examination and Course credit weighting**

The syllabus for this part covers General Physics, Basic Medical Sciences and Clinical Sciences as relevant to diseases in all sub-specialties of Medicine and Surgery.
The topics covered in standard undergraduate medical textbooks are recommended for comprehensive coverage. This should be supplemented by sources of current updates.
This syllabus is weighted in accordance with standard definition of credit units for the college- Summary as shown below . The trainee is expected to acquire a minimum of 30 units

## 2.1 Update courses and workshops.

The Faculty Board of Radiology organizes update and revision courses on an annual basis. Different topics in in the Syllabus are covered. The courses are intended to refresh and broaden knowledge as well as provide a sound basis for further training in Radiology for the acquisition of pre-requisite knowledge, skills and desired competences.

## 2.2 Course Content for Primary Training (Pre- Part 1)

The curriculum for the Primary examination in Radiology comprises the General Physics, Basic Medical Sciences and Clinical Medical Sciences. Relevant areas of anatomy, physiology, biochemistry, pharmacology and principles of pathology are covered. A revision/Update Course is mandatory.

### 7.2.1 General Physics -

A basic knowledge of physics is required. The following items are intended to serve only as a guide to candidates:

- **Fundamental Ideas in physics 2 units**
  - Matter including metals and non-metals; properties of matter; density, inertia
  - Structure of matter, structure of atom, radioactivity, isotopes
  - Force, work, power and energy
  - Different forms of energy: internal potential, chemical, kinetic energies.
  - Other forms of energy: heat, electricity, magnetism, sound, light, x-rays, gamma-rays etc.
  - Relationship between matter and energy; the nature of energy as particles or packets, Planck's idea of energy.
  - Energy of waves; mechanical energy waves; waves caused by radiant energy; characteristics of waves.
  - Law of conservation of matter, energy and momentum. Capacity for holding or retaining energy.
  - Mechanics: Statics, Motion, States of matter and their properties
  - Machines, hydrostatics
  - Speed, velocity, acceleration, momentum
  - Newton's laws of motion; motion in a circle, rotator or spin motor
  - Solids and properties of solids, liquids and surface tension; gases and gas laws
  - Friction in solids and liquids, static, kinetic, viscosity
  - Osmosis, diffusion, dynamics and laws of fluid flow

- Biological application of the laws of mechanics:
- Flow or air through the respiratory system
- Diffusion of gases through tissues
- Osmotic relationships between body compartments
- Elastic resistance to ventilation
- Surface tension of the alveolar liquid-air interface: The Law of Laplace
- Airway resistance
- Alimentary tract and the flow of food
- Renal system and flow of urine in it
- Haemodynamics of the cardiovascular system
- Factors which influence viscosity of blood
- Equilibrium of the blood vessel wall
- Energetics of the circulation.
- Heat energy and work
- Sources of heat energy
- Heat energy factors
- Measurement of heat: calorimetry
- Thermal effects
- Coefficients of expansion
- Latent heat
- Laws of thermodynamics
- Conversion of heat into work
- Transfer of heat conduction, radiation, convection

- **SOUND ENERGY** **1 unit**
  - The speed of sound
  - Properties of sound: Intensity, loudness, frequency and pitch
  - Doppler effect, resonance, fundamental tones
- **LIGHT ENERGY** **2 units**
  - Effects produced when light encounters an form of matter speed of light
- Interference, reflection, refraction and transmission of light
- Refractive index, formation of images by reflection
- Images formed by plane and curved mirrors
- Lens optics converging and diverging lenses
- Dispersion of light by a prim: the rainbow

- **ELECTRICAL ENERGY** **2 units**

- Static electricity
- How electric chages are produced' induced charges
- Conductors and insulators; capacitors
- electric potential' power
- Electricity in motion; electrical circuits; resistances

- **MAGNETIC ENERGY**
  1 **Credit units**

- The nature of magnetism
- Mapping magnetic fields of force
- Electromagnetism; electric generators

### 2.2.2 BASIC MEDICAL SCIENCES-

❖ **Anatomy:** **2 Units**

Embryological, Gross and Cross- Sectional anatomy of the individual organ systems namely:

- Cardiovascular
- Haematopoietic / Lymphoreticular
- Gastrointestinal
- Central and Peripheral Nervous Systems
- Renal/Urinary
- Skin/Connective Tissue
- Reproductive
- Musculoskeletal
- Endocrine

❖ **Physiology:** **2 Units**

Normal Processes of the individual organ systems including:

- Normal development, structure and changes associated with aging
- Normal processes e.g metabolism, system role in host defense, repair and regeneration, immunologic process.

❖ **Biochemistry:** **2 Units**

- Protein, carbohydrate, fat, vitamin, mineral and water metabolism.
- Haemoglobin metabolism.
- Molecular pathways and enzymology (including purines, pyrimidines, nucleoside, nucleotide pathways, genes and molecules). DNA/RNA and the Human Genome
- Overview of the molecular basis of diseases that affect cellular function.

❖ **Pharmacology:** **1 Unit**

- Basic pharmacokinetics – transport, metabolism, excretion of drugs.
- Basic mechanisms of drug action.
- Indications for use of various drug formulations.
- Principles of therapeutics, including adverse effects

❖ **Pathology:** **3 Units**

**(Anatomic Pathology, Chemical, Microbiology, Immunology, Parasitology, Haematology)**

- Abnormal Processes of the individual organ systems including
- infections, neoplasms, degenerative, metabolic changes and trauma
- Environmental influence on diseases.

❖ **Genetics:** **1 Unit**

- Mendelian genetics.
- Molecular, physical and biochemical basis of inheritance.
- Chromosomal aberrations and common genetic problems (e.g. Haemoglobinopathies, Down's and Turner's syndrome etc.) and their modes of inheritance.

### 2.2.4 CLINICAL SCIENCES –

- **Medicine** **2 Units**
- Understanding mechanisms of disease, establishing a diagnosis and applying principles of management to common medical diseases and emergencies

- **Surgery** **2 Units**
- Understanding mechanisms of disease, establishing a diagnosis and applying principles of management to common surgical diseases and emergencies

- **Paediatrics** **2 Units**
- Understanding mechanisms of disease, establishing a diagnosis and applying principles of management to common paediatric diseases and emergencies

- **Obstetrics and Gynaecology** **2 Units**
- Understanding mechanisms of disease, establishing a diagnosis and applying principles of management to common obstetrics and gynaecological diseases and emergencies.
- Basic principles of Reproductive health

### 2.2.4. REVISION/UPDATE COURSE: 3 Units

*****The Revision /Update course IS a compulsory requirement for primary examination******

### 2.3 Total Credit Units 30 Units

### 2.4 Assessment and Condition for successful completion of the Program (a Pass):

The objective of the Primary examination is to screen suitable candidates for training in Radiology. Applicants can sit the Primary examination as Private candidates not attached to any accredited training Centre or as candidates from a training Centre.

The examination comprises only one paper of 100 Multiple Choice Questions (MCQs) of the "one best answer" format.

To satisfy the examiners, the candidate must score at least 50% in the paper or norm reference determined pass score based on general performance in the paper.

### 2.4.1 VALIDITY OF THE RESULT:

The validity of the Pass in the Primary Examination is FIVE years.

A candidate must commence residency training within 5 years of passing the examination failing which he/she will have to retake the examination.

### 2.5 SUMMARY OF CURRICULUM AND CREDIT UNITS

| TOPICS | KNOWLEDGE | CREDIT UNITS |
|---|---|---|
| 1. GENERAL PHYSICS | Fundamental Ideas in physics | 2 |
| | Sound Energy | 1 |

| | | |
|---|---|---|
| | Light Energy | 2 |
| | Electrical Energy | 2 |
| | Magnetic Energy | 1 |
| | | |
| 2. BASIC MEDICAL SCIENCES | Anatomy | 2 |
| | Physiology | 2 |
| | Biochemistry | 2 |
| | Pharmacology | 1 |
| | Pathology | 3 |
| | Genetics | 1 |
| | | |
| 3. CLINICAL MEDICAL SCIENCE | Medicine | 2 |
| | Surgery | 2 |
| | Paediatrics | 2 |
| | Obstetrics and Gynaecology | 2 |
| 4. REVISON /UPDATE Course | | 3 |
| TOTAL | | 30 |

# CURRICULUM FOR THE PART I IN RADIOLOGY TRAINING

# RADIODIAGNOSIS

# PART I FMCR RADIOLOGY TRAINING (36 months) Appendix 2

- Didactic Lectures in Physics for 9 months, Demonstrations on equipment and sighting imaging materials etc
- Rotation through Anatomy and Pathology Departments (one month each)
- Rotation through the 10 Clinical Disciplines (2 weeks per Rotation)
- One month of Elective
- Rotations through Radiodiagnostic service sections (Each Rotation lasts 3months long
- Eg of Service Areas - Lagos University Teaching Hospital's

1. Genito-urinary systems investigations IVU, RUCG, MUCG, HSG stc. Mondays
2. MRI Tuesdays
3. Special studies eg Barium studies, fistulography etc, Unit Call Duty, Resident's personal Study day Wednesday
4. CT Thursdays
5. USS Fridays

A Consultant mans a Unit, supervising the Residents in his/her Unit. The days of service rendering suggested above. The Radiology Resident rotates through the Units, under the tutelage and supervision of the Unit Head, each Rotation, three months long. At the end of the Rotation, the Unit Head assesses the Resident and the Outcome of the Assessment, is submitted to the Residency Training Coordinator to act upon as earlier described.

At the end of this three-month rotation, the Candidate is moved to another Unit.

The Resident is expected to go through all 13 Rotations in the course of his/her Part 1 Training (See Appendix 2)

In addition, Time is marked out for all the Didactic Lectures (as listed in the following pages), Interdepartmental/ Interdisciplinary meetings, Intradepartmental Meetings, Seminars, Presentations intradepartmental and at Conferences.

Presentations of Research finding at two Conferences is one of the Pre-requisites at admission into the Part I examination

**The table below shows the Detailed Training Curriculum with Course Units for Part I Radiology Total number of Units = 286**

**Every Course is described under the following subheadings:**

**COURSE TITLE**
**COURSE CODE**
**COURSE UNITS**
**COURSE CONTENT**
**LEARNING OBJECTIVES**
**DELIVERY METHODS**
**LEARNING OUTCOMES (Skills, Competences and Attitudes)**
**ASSESSMENT METHODS**

| S/No | Course Title | Course Code | Learning outcomes | Delivery Methods | Assessment Methods | Course Unit |
|---|---|---|---|---|---|---|
| 1 | ACLS | CBC701 | Advanced Life Support (ALS) is a set of life-saving protocols and skills that extend Basic Life Support to further support the circulation and provide an open airway and adequate ventilation (breathing). | Didactic Lectures **Demonstrations** | **Written Examinations Oral examination Procedure log Objective structured clinical examination** | 2 units |
| 2 | Radiological physics | RDL 710 | Understanding physical properties of radiation and imaging techno-logy for purposes of producing quality images for diagnostic purposes | Didactic Lectures Demonstrations | MCQs OSCE Viva Voce | 12units |
| 3 | Principles of Imaging Technology & Molecular Imaging | RDL 711 | Acquiring basic knowledge of biomedical techniques for personalizing patient management | Didactic lectures Clin. Rotations Hands on practical sessions Call duties | Written Examinations Oral examination Procedure log Objective structured clinical examination | 12units |
| 4 | Clinical Radiology | RDL 712 -716 721-726 731-736 | Application of knowledge of Anatomy, techniques and pathology in the adequate interpretations of images | Didactic lectures Clin. Rotations Hands on practical sessions Call duties | Written Examinations Oral examination Procedure log Objective structured clinical examination | 218 Units |
| 5 | Communication and Management | RDL 720 | Developing excellent management knowledge and skills for interaction with patients and all Healthcare workers with all categories of people | Didactic lectures Clin. Rotations Hands on practical sessions Call duties | Written Examinations Oral examination Procedure log Objective structured clinical examination | 10units |
| 5 | Clinical Rotations | RDL 717, 727, 737 | Rotating on three-month Basis through them service areas total of 13 rotations | Hands-on practicals, Film Reporting and Unit discussions | Procedure log | 34units |

## COURSE CBC 710

### Outline for Full ACLS Provider Course

**Approximate course duration: 10 hours 15 minutes**
**(Student-instructor ratio for learning stations is 6:1)**

American Heart Association.

| Lesson Map | Course Event | Duration (min) | Type of Lesson |
|---|---|---|---|
| ACLS START | Welcome, Introductions, and Course Administration | 5 | |
| ACLS 1A-B | ACLS Course Overview and Organization | 5 | |
| ACLS 2A-B | BLS and ACLS Surveys | 20 | |
| ACLS 3A-F | Management of Respiratory Arrest | 45 | PWW T |
| ACLS 4A-C | CPR and AED Practice and Testing | 45 | PWW T |
| ACLS 5A-B | The Megacode and Resuscitation Team Concept | 25 | |
| ACLS 6A-D | Cardiac Arrest (VF/Pulseless VT) | 90 | |
| ACLS 7A-J 8A-K | ACS and Stroke Learning Station | 90 | |
| ACLS 9A-E | Bradycardia/PEA/Asystole | 45 | |
| ACLS 10A-E | Tachycardia, Stable and Unstable | 45 | |
| ACLS 11A-D | Putting It All Together | 95 | |
| ACLS T3-5 | Megacode Test | 60 | T |
| ACLS T6-7 | Written Test | 45 | T |
| ACLS REM | Remediation | Variable | T |
| **Total instructional time with 6:1 student-to-instructor ratio: approximately 10 hours 15 minutes (not counting breaks and transition times)** | | | |

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**Course Code: RDL 710 Course Title RADIOLOGICAL PHYSICS 12 Units**

| | Subheadings of Course Contents | Course Units |
|---|---|---|
| 1. | General Radiological Physics | 2 Units |
| 2. | Diagnostic Radiology Physics | 4 Units |
| 3. | Nuclear Medicine Physics | 2 Units |
| 4. | Radiation Protection (& Regulation) | 2 Units |
| 5. | Radiation Biology | 2 Units |
| | **TOTAL** | **12Units** |

**General Radiological Physics 2 Units**

**Structure of the Atom and Radiation Principles**

**Learning Objectives:**

Learn the structure of the atom, including types of nucleons, relation between atomic number and atomic mass, as well as electron orbits and binding energy;

Be able to relate energy to wavelength and rest mass, and understand and describe an energy spectrum;

Learn about radioactivity, including decay processes, & half-life.

**Topics to be covered:**

Electromagnetic Radiation-x-rays and gamma-rays; Electronic Structure of the Atom; Characteristic X-rays; Atomic Nucleus;

Radioactivity; Radioactive Decay – alpha, beta, gamma, x-ray, electron and positron decay

Internal Conversion (and Auger) Electrons

**Interaction of Radiation with Matter**

**Learning Objectives:**

The physical description, random nature, and energy dependence of the four scatter and absorption interactions that x-ray photons undergo with individual atoms (coherent scatter, photoelectric effect, Compton effect, and pair production).

Definitions of the key terms such as attenuation, scatter, beam geometry, linear and mass attenuation coefficients, energy transfer, energy absorption, half-value layer, and how these terms relate to radiation scatter and absorption through the exponential attenuation equation;

The physical description and energy dependence of the elastic and inelastic collision processes in matter for directly and indirectly ionizing particulate radiation

Definitions of key terms such as linear energy transfer, specific ionization, mass stopping power, range, and how these terms relate to energy deposition by particulate radiation.

**Topics to be covered:**

Particle Interactions (emphasize electron interactions) – LET; Bremsstrahlung Interactions; Positron Annihilation; Neutron Interactions

X and Gamma Interactions – Rayleigh or Coherent Scattering; Compton Scattering; Photoelectric Effect; Pair Production

Attenuation of X and Gamma Ray – Linear Attenuation Coefficient; Mass Attenuation Coefficient; HVL

**Radiation Units/Quantities**

**Learning Objectives:**

Definitions and units for kerma, exposure, absorbed dose, dose equivalent; RBE dose;

The conditions under which each quantity applies; and,

The physical basis for measuring or computing each quantity.

**Topics to be covered:**

Absorbed Dose; Exposure; Equivalent Dose; Effective Dose; Quality factors; Tissue Weighting Factors

**Physics for Diagnostic Radiology** **4Units**

**X-ray Production**

**Learning Objectives:**

- The concepts of beam production; acceleration of electrons in diagnostic X-Ray tubes; Bremsstrahlung;
- X-Ray tube design and Characteristic radiation.

**Topics to be covered:**

Tube design elements; Bremsstrahlung Spectrum; Characteristic X-rays

**X-ray Tubes**

**Learning Objectives:**

- The concepts X-Ray tube design;Characteristics of the cathode, and anode;The concept of the heel effect;Filtration concepts (linear and K-edge);Collimation;
- X-ray tube heat loads (instantaneous and integral); Technique charts.

**Topics to be covered:**

- Cathode; Anode; Focal Spot; Heel Effect; Off-focus Radiation
- X-ray Tube Insert and Housing; Filtration; Collimators
- Heat Loading; Rating Charts

**X-ray Generators**

**Learning Objectives:**

- The individual components of an x-ray generator;
- The properties of a timer and phototimer.

**Topics to be covered:**

Generator Components; Timer and Phototimer; Power Ratings

Generator Types; Ripple effects from various generator types

**Film-Screen Radiography**

**Learning Objectives:**

The basic theory of film/screen radiography including magnification radiography; properties of film/screen cassettes, screens, radiographic film, and grids.

**Topics to be covered:**

Basic projection geometry, Magnification

Film Screen Cassettes – Screen Characteristics; Conversion; Efficiency; Absorption Efficiency; Noise

**Film – Physical characteristics; Optical density; HD curve; Contrast/Latitude; Film screen systems; Dose**

Anti-Scatter and Grids – Bucky Factor; Grid frequency; Grid Ratio; Thickness/Material

Artifacts

**Film Processing**

**Learning Objectives:**

The basic theory of film processing including formation of the latent image;

Wet and dry processing systems;

Film processing artifacts;

Film processing quality assurance.

**Topics to be covered:**

Film emulsion; Latent Image; Development; Automatic Film Processor

Artifacts; Quality Assurance

Laser Cameras; Dry processing

**Mammography**

**Learning Objectives:**

The basic theory of mammography including film/screen mammography and digital mammography;

The importance of compression, grid, mammography film/screen system, proper film processing;

About mammography image characteristics including contrast and resolution;

MQSA regulations and quality control for mammography.

**Topics to be covered:**

X-ray tube – Anode; Tube tilt; Focal spot; Filtration; Collimation; Energy spectrum/ HVL; Output

X-ray Generator – Automatic Exposure Control

Bucky – Grid Ratio and construction; Movement

Screen-film systems – Cassettes; Film; Film Sensitivity; Film Processing; Film viewing conditions

Imaging Parameters – Contrast; Noise; Resolution Dose-Average Glandular Dose

Compression; Magnification; Quality Control

More Topics – Stereotactic Breast Biopsy; Full Field Digital Mammography; CR Digital Mammography; Mammography Phantom

**Fluoroscopy**

**Learning Objectives:**

The basic principles of fluoroscopy, both analog and digital, continuous and pulsed;

The function of the imaging chain components including the image intensifier, TV system, digital recording equipment, automatic brightness control;

The magnitude of the dose to the patient and operator from fluoroscopy;

The regulations for fluoroscopy users.

**Topics to be covered**

Equipment description/resolution

Image Intensifier – Input screen; Optics; Output phosphor; Conversion Gain; Brightness Gain; Field of View--Magnification

Video System – Hardware; Video Resolution

Flat panel Digital Fluoroscopy

Modes of operation-continuous, high dose rate, pulsed etc

Automatic Brightness Control

Image Quality – Spatial Resolution

Include parts of imaging chain – Contrast Resolution and quantum noise

Radiation Dose – Patient dose rates-average, maximum, methods to reduce; Operator dose-effects of shielding

Recording Methods – Digital Photo-spot camera; Spot-film device; Cine Camera

Regulations; Quality Assurance – Collimation; Patient entrance dose; High and low contrast resolution measurements

**Image Quality**

**Learning Objectives:**

The basic theory of:Image formation;Image contrast; Resolution;MTF;Noise;Quantum detection; and,Sampling & aliasing.

The definition of ROC curves.

**Topics to be covered:**

Magnification

Contrast – Subject contrast; Detector Contrast; Film screen contrast; Digital image contrast; Displayed contrast; Radiographic Contrast; Displayed contrast (Digital Contrast)

Noise – Quantum Noise; Contrast Noise Ratio (Digital Images)

Quantum Detection efficiency

Spatial Resolution – Mechanisms of Blur or Unsharpness; Focal spot blur; Geometric blur; Motion blur; Detector blur; Composite blur; MTF (Point and line spread functions); Practical QA measurements und Resolution Phantoms

Sampling and Aliasing

Contrast/Detail Curves

Receiver Operating Characteristics (ROC)

**Digital Radiography**

**Learning Objectives:**

The basic theory of digital radiography;

The properties of different digital modalities:DR; CR; “digital” cassettes; CCD detectors;

Types of post-processing – Image processing;Image subtraction angiography.

**Topics to be covered:**

CR Technology; DR Technology – Indirect Flat Panel; Direct Flat Panel

CCD Detectors

Dose

Soft Copy Devices

Digital Image Processing – Corrections; Global Processing; Convolution; Filtering; Resolution

Digital Subtraction Angiography

**Conventional (Classic) Tomography**

**Learning Objectives:**

The basic concept of conventional linear tomography (as differentiated from stereoradiography and tomosynthesis).

**Topics to be covered:**

Section thickness and tube arc; Section Location; Artifacts

**Computed Tomography (CT)**

**Learning Objectives:**

The basic theory of Computed Tomography Scanner;

About the properties of CT detectors, helical and multislice CT units;

The definition of the Hounsfield unit;

Magnitude of dose from a CT scan;

The effect of kVp and mA on dose; and,

To recognize CT artifacts

**Topics to be covered:**

Basic Principles; History “4-7”Generations (depending upon count);

Detectors: Slice thickness – Single and Multi-Detectors; Helical CT-Pitch and collimation

Reconstruction Kernels – Bone and soft tissue; CT Number – Hounsfield Units; Display – Multi-image and 3D

Dose – Measurement; Patient; Pediatric; Modulated mA (CT-AEC).

Image Quality; Artifacts – Beam Hardening; Motion; Partial Volume; Hardware failure (Detector)

**MR: Basic Principles**

**Learning Objectives:**

The basic theory of magnetism and magnetic resonance

The definition of: The Larmor frequency;

Free induction decay;

Tissue contrast parameters – T1, T2, T2*, and proton density

To understand the principles of magnetic resonance, and the magnetic properties of tissue.

**Topics to be covered:**

Magnetism – Magnetic Nuclei; Tissue Magnetization – including net magnetization vector

Larmor Frequency; Resonance; Longitudinal Magnetization; Transverse Magnetization

RF pulses (90 degree, 180 degree, and arbitrary or alpha) – Free induction decay (FID)

Proton density (PD)

Relaxation effects – T1 Relaxation; T2 Relaxation; T2* Relaxation including Non-uniformity and magnetic susceptibility effects

Free Induction Decay (FID)

Basic Pulse Sequences – TR and TE; Weighted Images

Signal from Flow – Flow enhancement; Flow voids; Flow compensation

**MR: Imaging and Instrumentation**

**Learning Objectives:**

The basic theory of operation of an MRI unit;

The properties of magnetic coils such a the main magnetic, gradient coils, shim coils, and surface coils;

To understand slice encoding, frequency and phase encoding;

The different types of pulse sequences, signal to noise ratio of MR images;

What is K space;

To appreciate the need for safety around MR units;

To recognize MRI artifacts.

**Topics to be covered:**

Magnets – Magnetic Field Gradients Coils (X, Y, Z)

RF Coils – Body, head, surface, phased array

Shielding – Active; Passive; RF faraday cage

Slice Select Gradient (SEG); Frequency Encoded Gradient (FEG); Phase Encoded Gradient (PEG)

Gradient Sequencing and Pulse Sequence Diagrams

K-Space

Imaging Sequences – Spin Echo; Fast Spin Echo—echo train length; Inversion Recovery—Stir Flair; Gradient recalled echoes; Echo Planar imaging

T1, T2, PD weighting; Multi-planar Acquisition – 2D vs. 3D imaging; Scan time for 2D vs3D

Resolution – Pixel size; Slice thickness

SNR – Voxel size; Static magnetic field strength; RF bandwidth; NSA, RF Coil

Angiography – Time of flight; Phase Contrast

Artifacts – Chemical shift; Patient motion; Wraparound, truncation; Zipper; Ring

Clinical Contrast Agents-Gd-DTPA

Spectroscopy

MR Safety – Screening patients; SAR Limits

Quality Assurance – SNR; Resonant Frequency; ACR Accreditation phantom – weekly and annual tests

**Ultrasound (including Doppler)**

**Learning Objectives:**

The basic theory of how an ultrasound unit works;

About the properties of sound transmission, including reflection, refraction, scattering and attenuation;

About the properties of piezoelectric transducers, the ultrasound beam, its resolution;

About focusing and steering the ultrasound beam;

The different mode of ultrasound imaging including B mode scanning and real time imaging;

To understand Doppler ultrasound, its limitations, and understand the artifacts;

To recognize ultrasound artifacts.

**Topics to be covered:**

Characteristics of Sound

Pressure, Intensity and dB

Interactions of sound with matter – Acoustic Impedance; Reflection; Refraction; Scattering; Attenuation

Transducers – Piezoelectric Effect; Near field, Far field; Acoustic Profile; Focusing and lenses

Types of Transducers – Mechanical sector; Linear Array; Phased Array (Annular and Linear); Curvilinear Array

Focusing and steering – Mechanical; Electronic Transmit; Electronic Receive

Spatial Resolution – Axial; Lateral; Slice Thickness

Real Time Imaging – Registration of echo in image; Lines of Sight; Frame Rate; Pulse Repetition Frequency; Time Gain Compensation

Display Modes – A-mode; B-mode; M-mode

Image Quality, Contrast and Noise

3D/4D imaging; Harmonic Imaging

Image Processing – Time Gain Compensation; Logarithmic compression; Frame Averaging; Spatial Smoothing

Artifacts – Shadowing; Enhancement; Mis-registration; Reverberation; Comet Tail; Ring Down; Mirror Image; Side Lobe

Elastography

**Computers in Radiology**

**Learning Objectives:**

How computers are used in radiology;

About image display characteristics and monitor technology;

How PACS works and how networks operate;

To appreciate security problems associates with digital images;

What is needed for quality assurance in a PACS environment?

- **Topics to be covered:**

Image display characteristics –resolution and image pixel depth

Image processing; Computer Aided Detection

Networks; Teleradiology; Security; PACS

Image storage and transmission; Display of Images

Hardcopy Recording Device; QA (SMPTE Test Pattern)

## Nuclear Medicine Physics 2 Units

**Radioactivity**

Learning Objectives:

Learn about radioactivity and half life

Topics to be covered:

Decay; Half-life

Decay Schemes

Learning Objectives:

About decay processes including alpha decay, beta plus and minus decay, electron capture, isometric transition, nuclear fission and gamma decay.

Topics to be covered:

Alpha Decay; Beta Minus Decay; Beta Plus Decay; Electron Capture; Isomeric Transition; Nuclear Fission; Gamma Decay

**Radioisotope Production**

Learning Objectives:

How radioisotopes are produced by a cyclotron and a nuclear reactor;

About the properties of radionuclides;

About regulatory issues (and recent changes in those issues) associated with radionuclides.

Topics to be covered:

Cyclotron Produced Isotopes

Nuclear Reactor Produced Isotopes – Fission Products; Neutron Products

Radionuclide Generators – Transient Equilibrium; Secular Equilibrium

Radiopharmaceuticals – General Properties; Methods of Localization

Quality Control

Regulatory – Investigational Regulations; Written Directives; Medical Events; NRC Requirements

**Counting Instrumentation**

**Learning Objectives for Resident:**

About different technologies of counting equipment used in nuclear medicine;

How a NaI detector works.

**Topics to be covered**

Detector types – Gas Filled; Scintillation; Semiconductor

Data collection

Spectroscopy – Single Channel Analyzer; Multi Channel Analyzer

NaI Detector – Thyroid; Wel

Dose Calibrator; Survey Meter – GM; Other types

**Geiger Muller Counter**

**Learning Objectives for Resident:**

To understand counting statistics and sources of error;

About different probability distributions including Binomial, Poisson and Gaussian distributions.

**Topics to be covered:**

Sources of Error

Characterization of Data

Accuracy and Precision

Mean, Mode, and Median; Variance; Standard Deviation

Probability Distributions; Binomial; Poisson; Gaussian

Confidence Levels; Propagation of Error

**Scintillation Cameras**

**Learning Objectives for Resident:**

How a gamma camera works;

About the performance of nuclear medicine gamma camera including the effect of collimators;

To understand artifacts produced by gamma cameras;

The use of computers in nuclear medicine.

**Topics to be Covered:**

Anger Camera – Crystals; PM tubes

Collimators

Image formation

Performance

Spatial Linearity and Uniformity

Artifacts

Whole body scanning

Computers in Nuclear Medicine – Image processing; Subtraction; Ejection Fraction-grated studies; Spatial Filtering; Other corrections

**Emission Tomography (PET & SPECT)**

**Learning Objectives for Resident:**

How a SPECT and PET camera works;

Understand attenuation correction methods and issues;

CT (or Fusion Imaging) attenuation correction;

Emission attenuation correction; and,

Lack of attenuation correction, with its effects on images.

To understand artifacts produced by SPECT and PET.

**Topics to be covered:**

Sinograms and Image Reconstruction Algorithms

SPECT – Image reconstruction; Attenuation corrections; Multi headed Cameras; Center of Rotation (COR)

PET – Principles of Detection; Scanner Design; Data Acquisition

Image Fusion – PET/CT and SPECT/CT

**Radiation Protection (& Regulation) 2 Units**

**Overview of Radiation Protection**

**Learning Objectives for Resident:**

The magnitude and source of natural background radiation;

The units used in radiation protection and methods used to measure these units;

How to reduce dose to patient and operator: time, distance and shielding;

How to design radiation shielding.

**Topics to be covered:**

Sources of Ionizing radiation – Natural; Artificial; Medical; Background

Dosimetry – Dose Equivalent; GSD; Personal Monitoring Equipment

Film Badges; TLD badges – Survey Instruments

GM Counter; Ionization Chamber

Radiation Protection Methods – Time; Distance; Shielding; Avoiding Internal Deposition (Nuclear Medicine)

Protective Barriers – CT Scanner; Radiographic; Fluoroscopic; Nuclear Medicine

**Radionuclide Therapy**

**Learning Objectives for Resident:**

What isotopes are used in radionuclide therapy and precautions needed in giving this treatment.

**Topics to be covered:**

Isotopes; Dose; Waste Disposal; Patient Isolation; Patient Release

**Regulatory Bodies and Regulations**

**Learning Objectives for Resident:**

The different regulatory agencies and their rules and influence;

What ALARA means;

The dose limits applied in their local area.

**Topics to be covered:**

Agencies – State (FDA; NRC0; International (MQSA; BEIR; NCRP; ACR; CRCPD)

Units; Dose Limits; ALARA; NRC requirement

**Patient Dosimetry**

**Learning Objectives for Resident:**

The patient and users dose from typical diagnostic and therapy procedures;

How to calculate the dose from these procedures.

**Topics to be Covered:**

CT Dose; Radiographic; Fluoroscopy; MIRD

Occupational Exposures; Patient Exposures and Estimation

Application in Clinical Practice – Mammography Screening; Pediatric CT; Recommendations for Therapeutic Abortion; Management of Pregnant Worker; Management of Pregnant Patient

**Radiation Biology** **2Units**

- **Learning Objectives for the Resident:**

  -The basic principles of radiation biology including how energy is transferred to the cells, cell survival properties;

  -The definition of genetic effects Stochastic effects and Non-stochastic effects;

  -Probability of cancer induction by radiation;

  -Risk estimate as applied to radiation biology.

- **Topics to be covered:**

  i. Ionization and biomolecules – Microdosimetry; Direct and indirect effects; Oxygen effect –OER; Linear Energy Transfer (LET)

  ii. Cellular interactions (with radiation)

     - Cell survival studies; Radiosensitivity and the cell cycle; Effects of dose, dose-rate and fractionation; Target theory; Apoptosis; Radioprotectors and radiosensitizers

  iii. Genetic Effects – Genetically significant dose; Doubling dose

  iv. Stochastic effects – Threshold versus non-threshold; Dose-effect models

  v. Nonstochastic (Deterministic) Effects – Acute Radiation Syndrome (ARS)

  vi. Organ Syndromes – Hematopoetic, GI and Neurovascular; Tissue and Organ Effects; Skin and Eye Injury

  vii. Population Dosimetry

  viii. Risk Estimation – Genetic Risks; In utero Risks –Time of fetal maturation; Cancer Risks – Leukemia, Thyroid, Breast

## RADIOLOGICAL TECHNIQUES

**Course Code: RDL 711**

**Course Title: Principles of Imaging Technology and Molecular Imaging**

**Course Units 12 units**

**Knowledge**

- To have an in-depth understanding of the physical basis of image formation of conventional X-ray
- To explain the concept of electromagnetic waves
- To describe X-ray production, with emphasis on the effects on dose and image quality of altering kV and mA and on the trade-off between diagnostic quality imaging and minimizing the effective dose
- To describe the interaction between X-rays and matter
- To describe the structure, role and function of filters, collimators and grids
- To explain the principles of radiographic image acquisition
- To explain the principles of digital image acquisition / digital radiography
- To list and describe the factors affecting image quality in conventional and digital radiography
- To describe the indications for the use of X-ray contrast media in the study of various organs / organ systems
- To describe the principles of fluoroscopy
- To describe the indications for fluoroscopy including the principles of contrast application and to list optimized protocols
- To list techniques to enhance image quality and to reduce radiation in fluoroscopy
- To describe the principles of soft tissue radiography, e.g. in mammography
- To explain the principles of specimen radiography
- To have an in-depth understanding of dosimetry
- To have an in-depth understanding of radiation biology

COMPUTED TOMOGRAPHY - CT

- To explain the relative value of a CT examination for the various organ systems and indications
- To have an in-depth understanding of the physical basis of image formation of computed tomography and of the physics of helical and multidetector CT
- To have a basic understanding of dual-source CT
- To list the major sources of artefacts in CT
- To define the scale of Hounsfield units and to explain the principle of window centre and width
- To list the optimal setting of window centre and width for various organs and tissues
- To list the normal levels of attenuation (in HU) for the various organs and pathological processes in the body
- To describe the principles of optimising sequence protocols for a variety of CT scanner types • To

understand the principles of perfusion imaging with CT
- To understand the principles of CTA protocols, including contrast materials used and reconstruction techniques
- To define CT protocols for the various organs and pathological processes in the body • To explain the principles of reconstruction algorithms and kernels
- To describe the indications for the use of CT contrast media in the study of various organs / organ systems
- To have a detailed understanding of CT-dosimetry

MAGNETIC RESONACE IMAGING - MRI
- To explain the relative value of an MRI examination for the various organ systems and indications
- To explain the fundamentals of MR physics
- To have a basic understanding of the physical basis of image formation in MRI
- To explain the principles of pulse sequences and relaxation times
- To explain the principles of spin echo and gradient echo sequences
- To describe the principles and main diagnostic applications for the most commonly used sequences in MRI, including T2-weighted sequences, T1-weighted sequences, STIR sequences, FLAIR sequences, other inversion recovery sequences, and T2*- / susceptibility weighted sequences
- To describe the typical appearance of tissues, organs and pathological processes on these MR sequences
- To understand the sequence technology for MR angiography (MRA) including time of flight (TOF) pertaining to MRA
- To discuss advantages and disadvantages of MRA compared with other techniques
- To explain the principles of dynamic contrast-enhanced (DCE) MRI
- To explain the principles of diffusion-weighted imaging (DWI) and diffusion tensor imaging (DTI)
- To have an appreciation of the principles of functional MRI (fMRI) using BOLD contrast
- To outline the principles of spectroscopy using 1H, 31P, 13C
- To describe typical artefacts on MR imaging and to discuss their respective causes
- To describe the indications for the use of MR contrast media in the study of various organs / organ systems
- To explain the absolute or relative contraindications against MR imaging and how to handle MR examination of patients with relative contraindications requiring examination in special coils, etc.
- To explain the safety issues in the MR environment with regard to patients and staff

ULTRASOUND
- To explain the relative value of an ultrasound examination for the various organ systems and indications
- To describe the nature of ultrasound waves, their propagation, velocity, intensity and the equations that describe them
- To describe the principles of acoustic impedance and to list the tissue properties that determine it
- To describe the frequency of transmission to achieve satisfactory imaging
- To describe the physical principles of the piezoelectric phenomenon
- To list factors that determine the resonance frequency of the piezoelectric element
- To explain the principles of continuous and pulsed emission ultrasound
- To list the factors that focus and unify the ultrasound beam
- To describe the differences between the A, B and TM modes of ultrasound
- To explain the principles of spatial and temporal resolution of ultrasound images as applied to good

image formation
- To explain the principles of the Doppler effect and the application of angled beam and direction of flow
- To describe the application of pulsed and continuous wave Doppler and spectral waveform analysis
- To describe the thermal and mechanical biological effects of ultrasound waves, including production of the cavitation phenomenon
- To describe the different types of transducers in ultrasound imaging
- To list the appropriate transducers according to the organs imaged
- To explain the relative value of transcutaneous vs. endoluminal sonography
- To describe criteria for a good ultrasound image
- To describe the major artefacts on ultrasound imaging including reflection, diffusion and speckle and to list their respective causes
- To describe the indications for the use of ultrasound contrast media in the study of various organs / organ systems

CONTRAST MEDIA

- To understand the molecular structure, pharmacology, classification, dose and side effects of all radiographic, MRI and ultrasound contrast media
- To explain the principles of contrast ultrasound media and the relation between the ultrasound beam and microbubbles
- To explain the principle of ionic and non-ionic contrast agents
- To describe the physiological principles, physical properties, toxic effects, anaphylactoid reaction and biological effects of iodinated contrast media
- To describe the physiological principles, physical properties, toxic effects, anaphylactoid reaction and biological effects of MRI contrast media
- To outline the best contrast material and its optimal use according to the imaging technique and the clinical problem
- To describe the various timing phases of contrast media application and their respective values according to the clinical problem
- To describe the fundamentals of intravascular bolus kinetics and constant rate input
- To describe the physiology of renal excretion of contrast medium
- To describe enhancement curves within renal compartments after injection of contrast agents
- To list concentrations and doses of contrast agents used intravenously
- To define the nephrotoxicity of contrast media
- To list risk factors of contrast media nephrotoxicity
- To identify patients at risk of contrast media nephrotoxicity
- To list methods to reduce the risk of contrast nephrotoxicity
- To describe precautions in diabetics taking metformin and requiring intravascular administration of contrast media
- To list measures to reduce the risk of contrast media nephrotoxicity
- To have an in-depth understanding of nephrogenic systemic fibrosis (NSF) including the definition of NSF, the clinical features and the risk factors
- To describe the use of Gadolinium-based contrast media in patients at risk

IMAGING INFORMATICS

- To explain the infrastructure of imaging informatics, including Picture Archiving and Records

- To list informatics standards, including DICOM, HL7 and IHE
- To have an understanding of image processing and analysis tools, including 2D and 3D reconstructions, 2D and 3D image analysis, quantitative imaging, image fusion, virtual reality, augmented reality, functional analysis, and computer aided diagnosis
- To explain e-learning tools
- To discuss relevant aspects of tele-radiology and telemedicine
- To have an understanding of structured reporting

SIGNAL PROCESSING AND POST-PROCESSING

- To have a basic understanding of the principles of signal processing
- To describe the principles of linear systems including convolution, Fourier transformation, Nyquist, image restoration, and deconvolution
- To describe the principles of image display
- To have an in-depth understanding of image quality, including noise, contrast, resolution, and noise amplification during processing
- To be familiar with the principles of quantification including ROI analyses, time–activity curves and factorial analysis
- To understand the principles of image processing including edge, detectors, smoothing, segmentation, image reconstruction, image fusion, registration, and display

MOLECULAR IMAGING

- To have an understanding of basic principles of cell biology and biochemistry including DNA and RNA activity, metabolism, apoptosis and hypoxia
- To have a basic understanding of stem cell migration and stem cell differentiation
- To understand the basic principles of the most commonly used molecular imaging methods, including nuclear medicine (PET, micro-PET, micro-SPECT) and optical imaging (fluorescence, bioluminescence)
- To have a basic understanding of principles of targeted contrast agents
- To have a basic understanding about demand on pharmacology and pharmacokinetics for a diagnostic probe
- To list the most common molecular targets for imaging
- To list the most commonly used tracers in molecular imaging
- To have an appreciation of the methods of molecular imaging, including its potential application to oncology, cardiovascular imaging, neurology and drug delivery
- To have a basic understanding of the strategies of gene therapy, including gene replacement, gene repair and silencing, and of cell therapy
- To have an understanding about chemistry and biotechnology methods relevant for probe development
- To understand PET image analysis and data processing

SKILLS

- To choose the optimal contrast medium for common clinical indications for all types of imaging studies
- To be able to perform an emergency treatment for adverse reactions to contrast media when required • To identify patients at risk of contrast media nephrotoxicity
- To take measures to reduce the risk of contrast nephrotoxicity
- To take precautions in diabetics taking metformin and requiring intravascular administration of contrast media

• To take measures to reduce the risk of contrast media nephrotoxicity
• To identify patients at risk to develop NSF
• To choose optimal exposure parameters for radiographic imaging
• To choose optimal acquisition parameters for common CT applications
• To choose optimal MR sequences for common indications for MR imaging
• To choose the appropriate transducer according to the organ imaged
• To choose optimal imaging parameters in ultrasound and Doppler sonography
• To obtain Doppler spectra on the various vessels of the body

COMPETENCES AND ATTITUDES

• To choose optimal imaging parameters for all imaging technologies
• To make informed purchasing decisions for imaging equipment for a radiological department respecting imaging technology, radiation protection and budget restrictions
• To devise strategies to reduce artefacts on conventional radiography, fluoroscopy, CT, MRI and ultrasound
• To appreciate the effect of the properties of the machine/scanner on image quality and to optimize the image quality for the machine/scanner available for all common imaging indications
• To appreciate the effect of the properties of image recording and display and to optimize the image quality in the available setting for all common imaging indications
• To appreciate the impact that image quality has on clinical performance and to enhance image quality to the best extent possible
• To confidently devise and conduct quality assurance programmes

# CLINICAL RADIOLOGY I Total 238 Units

| Course Codes | Course Titles | Course Units |
|---|---|---|
| 1. RDL 712 | Breast Imaging | 9units |
| 2. RDL 713 | Cardiac and Vascular Radiology | 12units |
| 3. RDL 714 | Chest Radiology | 17units |
| 4. RDL 715 | GIT and Abdominal Radiology | 19units |
| 5. RDL 716 | Gynaecologic and Obstetric Radiology | 20units |
| 6. RDL 717 | Clinical rotations | 10 units |
| 7. RDL 721 | Head and Neck Radiology | 11units |
| 8. RDL 722 | Musculoskeletal radiology | 17units |
| 9. RDL 723 | Emergency Radiology | 15 units |
| 10. RDL 724 | Interventional Radiology | 9 units |
| 11. RDL 725 | Neuroradiology | 15units |
| 12. RDL 726 | Urogenital Radiology | 16units |
| 13. RDL 727 | Clinical rotations | 10 units |
| 14. RDL 731 | Paediatric Radiology | 18units |
| 15. RDL 732 | Clinical and Research Ethics | 12units |
| 16. RDL 733 | Nuclear Medicine as Basic training | 12 units |
| 17. RDL 734 | Radiation Protection, Technology and Training | 12 units |
| 18. RDL 735 | Communication and Management | 10 units |
| 19. RDL 736 | Research and Evidence-Based Medicine | 14 units |
| 20. RDL 737 | Clinical rotations & Report writing | 14 units |

**RDL 712 Course Title: BREAST RADIOLOGY 9 Course Units**

**TRAINING GOAL**

The goal of this curriculum in breast imaging is to ensure that the trainee develops a core of knowledge in breast disease that will form the basis for further training (if desired). It will also provide transferable skills that will equip the trainee for working as a specialist in any branch of radiology. Physics and radiation protection are covered in separate courses and are not covered in detail unless specific to breast imaging.

| S/No | Course Content | Delivery Method | Assessment Method | Credit unit |
|---|---|---|---|---|
| 1 | Understanding the anatomy of the female breast, axilla and associated structures and how they change with age<br>To understand clinical practice relevant to breast imaging | Lectures, Tutorials, Seminars, Clinical rotations, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 2 | Recognize and describe normal variants and abnormalities of the female breast and be able to describe radiographic techniques employed in diagnostic mammography | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 3 | To describe the principles of digital imaging and image processing pertinent to mammography, including standard cranio-caudal and medio-lateral oblique views, additional views, and tomosynthesis | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1units |
| 4 | To describe the principles of digital imaging and image processing pertinent to mammography, including standard cranio-caudal and medio-lateral oblique views, additional views, and tomosynthesis | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 5 | To understand physics of image production in mammography, particularly how they affect image quality. To analyse and explain principles of current practice in breast imaging and breast cancer screening. To know the risk/benefit analysis associated with breast cancer screening. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 6 | To use the proper application of other imaging techniques in this specific field, such as ultrasound, MRI, or radionuclide imaging and to put these into a correct diagnostic pathway. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conference | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 7 | To understand the indications and contraindications for image-guided interventional breast procedures (fine needle aspiration, core needle biopsy, vacuum-assisted biopsy, presurgical localization) | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 8 | The different presentation of normal breast patterns at mammography, ultrasound, and MRI<br>To distinguish the appearance of common benign diseases and of breast cancer on mammography, ultrasound, and MRI | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |

| | | | | |
|---|---|---|---|---|
| | To understand principles and basic application of a standardized diagnostic categorization systems such as the ACR Breast Imaging Reporting and Data System (BI-RADS®) with reference to mammography, ultrasound, and MRI | | | |
| **9** | To describe the principles of communication specifically related to the breaking of bad news and consent | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **1unit** |

## COURSE CONTENTS:

- Anatomy of the female breast, normal variants and abnormalities of the female and male breasts, axilla and associated structures and how they change with age
- Role of Medical Imaging in diagnosis of Breast diseases
- Principles of imaging techniques, standard views, tomosynthesis, image formation, image processing and optimization of image quality.
- Principles of current practice in breast imaging and breast cancer screening
- Risk/benefit analysis associated with breast cancer screening.
- The indications and contraindications for image-guided interventional breast procedures (fine needle aspiration, core needle biopsy, vacuum-assisted biopsy, pre-surgical localization)
- Principles and basic application of a standardized diagnostic categorization systems such as the ACR Breast Imaging Reporting and Data System (BI-RADS®) with reference to mammography, ultrasound, and MRI
- principles of communication specifically related to the breaking of bad news and consent.

**CORE KNOWLEDGE**

- To understand the anatomy of the female breast, axilla and associated structures and how they change with age
- To understand clinical practice relevant to breast imaging
- To describe radiographic techniques employed in diagnostic mammography
- To describe the principles of digital imaging and image processing pertinent to mammography, including standard cranio-caudal and medio-lateral oblique views, additional views, and tomosynthesis
- To understand physics of image production in mammography, particularly how they affect image quality
- To analyse and explain principles of current practice in breast imaging and breast cancer screening
- To know the risk/benefit analysis associated with breast cancer screening
- To describe the proper application of other imaging techniques in this specific field, such as ultrasound, MRI, or radionuclide imaging and to put these into a correct diagnostic pathway

- To describe the indications and contraindications for image-guided interventional breast procedures (fine needle aspiration, core needle biopsy, vacuum-assisted biopsy, presurgical localization)
- To recognize the different presentation of normal breast patterns at mammography, ultrasound, and MRI
- To distinguish the appearance of common benign diseases and of breast cancer on mammography, ultrasound, and MRI
- To understand principles and basic application of a standardized diagnostic categorization systems such as the ACR Breast Imaging Reporting and Data System (BI-RADS®) with reference to mammography, ultrasound, and MRI
- To describe the principles of communication specifically related to the breaking of bad news and consent

**SKILLS**

- To perform ultrasound examinations of the breast under supervision
- To perform interventional breast procedures under ultrasound and X-ray guidance under supervision

**COMPETENCES AND ATTITUDES**

- To justify diagnostic imaging examinations of the breast
- To choose the best-suited method for evaluating disorders of the breast
- To communicate with the patient in order to obtain informed consent prior to interventional procedures of the breast
- To choose optimal imaging parameters for mammography
- To apply techniques to reduce exposure doses of mammography
- To supervise and teach technical staff to ensure that appropriate images are obtained
- To report mammography, breast ultrasound, and breast MRI with respect to common breast diseases, using descriptors and diagnostic categories according standardized systems such as BI-RADS®
- To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting breast images
- To communicate with patients and their relatives in order to explain the nature of benign breast disease
- To observe bad news being given to patients and their relatives
- To communicate with patients and their relatives to give bad news
- To participate in and to perform under supervision at multi-disciplinary breast conferences and tumour boards

**RDL 713 CARDIAC AND VASCULAR RADIOLOGY 12 Credit Units**

**TRAINING GOALS**

Cardiac radiology is an important and rapidly developing field in radiology. The use of cardiac imaging has progressed over the last decade to involve all modalities in diagnostic radiology. Interventional techniques in the heart have also progressed, and whether or not a radiologist is involved in cardiac intervention it is important that there is an understanding of the clinical and diagnostic implications of these techniques, hence this training.

The heart is not an isolated organ, and it is equally important that the relationship between the heart and the cardiovascular and cardiopulmonary systems are understood.

| S/No | Course Content | Delivery Method | Assessment Method | Credit unit |
|---|---|---|---|---|
| **1** | To describe the normal anatomy of the heart and vessels including the lymphatic system as demonstrated by radiographs, contrast-enhanced CT and MRI and describe normal variants of the cardiac, vascular and lymphatic systems | Didactic Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assign-ments Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **2units** |
| **2** | Mean exposure doses of radiographs and of CT examinations of cardiac and vascular systems<br>To describe the principles of digital imaging and image processing pertinent to radiology of the cardiac and vascular systems | Didactic Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assign-ments Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **1unit** |
| **3** | General principles and classifications of congenital heart disease and the diagnostic features on conventional radiographs and comprehend the natural history and anatomical deformities causing central cyanosis | Didactic Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assign-ments Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **3units** |
| **4** | Differentiating radiological features and causes of cardiac abnormalities including pericardial diseases | Didactic Lectures, Tutorials, Seminrs, Clinicals/practicals, Self-directed learning, Assign-ments Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **2units** |
| **5** | Analyzing and explaining the diagnostic evaluation of ischaemic heart disease, including radionuclide imaging and the basics of coronary angiography | Didactic Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assign-ments Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **2units** |
| **6** | Identify the typical features of arterial stenosis and femoral artery pseudoaneurysm on Duplex | Didactic Lectures, Tutorials, Seminars, Clinicals/practicals, | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY | **1unit** |

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|---|---|---|---|---|
| | ultrasound and identify the typical features of deep venous thrombosis on Duplex ultrasound | Self-directed learning, Assign-ments Conferences | LOG BOOK | |
| **7** | Differentiate the diagnostic features of vasculitis, atheroma, thrombosis and aneurysmal dilatation of arteries and veins | Didactic Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assign-ments Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **1unit** |

**CORE OF KNOWLEDGE**

The principle is to acquire:

- Basic clinical, pathological, and pathophysiological knowledge in cardiovascular disease.
- An understanding of the principles and practice of screening techniquesand risk factors in cardiac disease.
- Knowledge of: The indications, contraindications and potential hazards (especially radiation hazards) of procedures and techniques relevant to cardiovascular disease.

- Cardiovascular anatomy in clinical practice relevant to clinical radiology.

- Normal variants, which may mimic disease.

- Manifestations of cardiovascular disease including trauma as demonstrated by conventional radiography,

CT, MRI, angiography, radionuclide investigations and ultrasound.

- Differential diagnosis relevant to clinical presentation and imaging appearance of cardiovascular disease.

- Calcium scoring.

- Relevant embryological, anatomical, pathophysiological, biochemical and Clinical aspects of cardiac

disease.

Knowledge and management of procedural complications in cardiac treatment and diagnosis

.

**Modality Based:** Plain Radiography, Fluoroscopy, Ultrasound, CT, MRI

- An understanding of the various treatment modalities for cardiac disease and their relationship to cardiac imaging.

**Knowledge in clinical cardiac radiology**

The following manifestations of cardiovascular disease, including trauma, have to be covered during the general radiological training. This should include formal teaching and exposure to clinical case material.

Coronary artery disease including acute coronary syndromes

- Myocardial ischaemia
- Myocardial infarction
- Post myocardial infarction syndrome
- Ventricular aneurysm
- Coronary calcium
- Coronary disease in women and specific coronary disease patterns in different communities
- Heart disease in the elderly

**Valve disease**

- Stenosis and incompetence of cardiac valves
- Endocarditis
- Sub and supra-valvar disease
- Subvalvar apparatus disease

2.2.3. The pericardium

- Tamponade and restrictive disease
- Acute pericarditis
- Tuberculous disease
- Malignant pericardial disease

2.2.4. Cardiac tumors

- Intracardiac tumors, i.e. myxomas, haemangiomas, and sarcomas
- Secondary tumors
- Tumours invading the heart

2.2.5. Cardiomyopathy

- Acute myocarditis
- Dilated cardiomyopathy
- Restrictive and obstructive cardiomyopathy
- Cardiomyopathy related to systemic disease
- Infiltrative heart disease

- Diabetic and renal cardiac disease
- Athlete's heart

- Congenital heart disease
  - Neonatal heart disease, Congenital disease in childhood, Grown-up congenital heart disease

- Major vessel disease, Thoracic aneurysm, Marfan's syndrome Takayasu's disease, Relationship between peripheral and cerebro-vascular disease and cardiac disease
- Right heart Disease

Pulmonary embolism

Right heart disease related to pulmonary disease

Acute cardiac and thoracic vascular trauma

Aortic dissection

Aortic rupture and fracture

Blunt trauArrhythmias

Diagnosis of disease causing or predisposing to arrhythmias

Cardiac disease in endocrine conditions

Cardiac psychological related illness, i.e. manifestations of anxiety

Pacemakers

Defibrillators

Ablation

- Hypertension

  Hypertensive heart disease

  Diseases causing hypertension
- Medical and invasive treatment

  Abnormalities arising from cardiac therapy, i.e. amioderone treatment

  Complications of cardiac catheterisation and coronary angioplasty

  Appearance of stents and stent graft
- Post-operative cardiac disease and findings

  By-pass grafts

  Valve replacement

  Aortic replacement

  Ventricular surgery

  Pericardectomy

SKILLS

• To perform ultrasound examinations of arteries and veins under supervision

• To plan and to protocol a CT examination of the cardiac and vascular systems and to adapt it to the individual situation under supervision

• To plan and to protocol an MRI examination of the cardiac and vascular systems and to adapt it to the individual situation under supervision

• To perform proper common post-processing tasks for thoracic imaging studies, including multi-planar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (MinIP), and vessel analysis tools

• To perform femoral artery and venous puncture techniques under supervision

• To treat femoral artery pseudo-aneurysm under supervision

**COMPETENCES AND ATTITUDES**

• To justify diagnostic imaging examinations and/or interventional procedures of the cardiac and vascular systems under supervision

• To choose the best-suited method for evaluating disorders of the cardiac and vascular systems under supervision

• To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and interventional procedures of the cardiac, vascular and lymphatic systems

• To choose optimal imaging parameters for radiographic, ultrasonographic, CT and MRI examinations of the cardiac and vascular systems under supervision

• To apply techniques to reduce exposure doses for radiographic and CT examinations of the cardiac and vascular systems under supervision

• To supervise and teach technical staff to ensure that appropriate images are obtained

• To report radiographic, ultrasonographic, CT and MRI examinations of the cardiac and vascular systems with respect to common diseases under supervision

• To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the cardiac and vascular systems

• To identify urgent and/or unexpected findings in imaging examinations of the cardiac and vascular systems and to communicate these timely and properly

• To communicate with patients and their relatives in order to explain their imaging findings of the cardiac and vascular systems

• To participate in and to perform under supervision at multi-disciplinary conferences and tumour boards for diseases of the cardiac and vascular systems

**Course Code: 714 Course Title: Chest Radiology I Course Unit – 17Units**

| S/No | Course Title | Delivery Method | Assessment Method | Credit unit |
|---|---|---|---|---|
| 1 | Anatomy, some physiological considerations and Normal variations in the normal chest Radiology | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **2units** |
| 2 | Imaging of benign and malignant Mediastinal masses | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **2units** |
| 3 | Imaging of congenital lung disease. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **3units** |
| 4 | Imaging of pleural diseases. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **2units** |
| 5 | Benign and Malignant tumors of the lung | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **3units** |
| 6 | Imaging of pulmonary infections | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **3units** |
| 7 | Imaging of diffused lung diseases | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | **3units** |

**COURSE CONTENTS IN CHEST RADIOLOGY RDL 714**

Anatomy, some physiological considerations and Normal variations in the chest Radiology

- To describe the anatomy of the respiratory system, and vessels, the mediastinum and the chest wall on radiographs, CT and MRI
- To describe normal variants of the respiratory system, heart and vessels, the mediastinum and the chest wall
- To understand the mean exposure doses of chest radiographs and of chest CT examinations
- To understand techniques to reduce exposure doses of chest radiographs and of chest CT examinations
- To describe the principles of digital imaging and image processing pertinent to chest radiology
- To understand the significance of generic signs on chest radiographs and CT

Imaging of lung tumors and diffuse lung diseases.
To comprehend the features on radiographs and CT and the differential diagnosis of diffuse interstitial and alveolar lung disease, airways and obstructive lung disease

• To differentiate solitary and multiple pulmonary nodules, benign and malignant neoplasms, hyperlucencies and their potential aetiology and evaluation

• To differentiate thoracic diseases in immunocompromised patients and congenital lung disease

• To analyze and explain disorders of the pulmonary vascular system and great vessels

• To understand the diagnostic role of radiographs, radionuclides, CT and MRI in the diagnostic evaluation of disorders of the pulmonary vascular system and great vessels

• To differentiate abnormalities of the chest wall, mediastinum and pleura

**Imaging of pleural diseases.**

To describe the typical chest radiography appearances of pleural effusion on erect, supine and lateral decubitus chest radiographs, and to list four causes of a large unilateral pleural effusion

• To describe the imaging features of pleural-based masses with bone destruction or infiltration of the chest wall on a radiograph or chest CT, and to list four likely causes

• To describe the imaging features of a unilateral elevation of one hemidiaphragm on chest radiographs and to list five causes (e.g. subdiaphragmatic abscess, diaphragm rupture and phrenic nerve involvement with lung cancer, post-cardiac surgery, eventration)

• To describe the imaging features and clinical features of tension pneumothorax

**CONGENITAL LUNG DISEASE**

- To describe the typical imaging features and basic clinical features of pulmonary venolobar syndrome (scimitar syndrome)
- To describe the typical imaging features and basic clinical features of intralobar pulmonary sequestration and cystic adenomatous malformation
- To describe the typical imaging features and basic clinical features of bronchial atresia on a chest radiograph and chest CT, and to list the most common lobes of the lungs in which it occurs
- To describe the typical imaging features and basic clinical features of pulmonary venolobar syndrome (scimitar syndrome)
- To describe the typical imaging features and basic clinical features of intralobar pulmonary sequestration and cystic adenomatous malformation
- To describe the typical imaging features and basic clinical features of bronchial atresia on a chest radiograph and chest CT, and to list the most common lobes of the lungs in which it occurs

## Core of knowledge

- To confidently identify the following structures on postero-anterior (PA) and lateral chest radiographs:

  - Right upper, middle and lower lobes; left upper and lower lobes; and lingual
  - Fissures – major, minor and azygos
  - Airway – trachea, main bronchi, posterior wall of the intermediate bronchus and lobar bronchi
  - Heart – position of the atria, ventricles, left atrial appendage and the location of the four cardiac valves
  - Pulmonary arteries – main, right, left and interlobar d

- Aorta – ascending, arch and descending aorta
- Arteries – brachiocephalic (innominate), carotid and subclavian arteries
- Veins – superior and inferior vena cava, azygos, left superior intercostal ("aortic knuckle"), and left brachiocephalic (innominate) veins
- Components of the thoracic skeleton
- Mediastinal stripes and interfaces
- Aortopulmonary window
- Both hemidiaphragms

- To have an in-depth understanding of the significance of the following chest radiography signs:
  - Silhouette sign – loss of the contour of the heart or diaphragm indicating an adjacent abnormality (e.g. atelectasis of the right middle lobe obscures the right-hand side of the heart's border)
  - Air bronchogram – indicates airless alveoli and, therefore, a parenchymal process as distinguished from a pleural or mediastinal process
  - Air crescent sign – indicates solid material in a lung cavity, often due to a fungus ball, or crescentic cavitation in invasive fungal infection
  - Cervicothoracic sign – a mediastinal opacity that projects above the clavicles, situated posterior to the plane of the trachea, while an opacity projecting at or below the clavicles is situated anteriorly
  - Tapered margins – a lesion in the chest wall, mediastinum or pleura may have smooth tapered borders and obtuse angles with the chest wall or mediastinum, while parenchymal lesions usually form acute angles
  - Gloved finger sign – indicates bronchial impaction, e.g. in allergic bronchopulmonary aspergillosis, or other chronic obstructive processes
  - Golden sign – indicates lobar collapse with a central mass, often due to an obstructing bronchogenic carcinoma in an adult
  - Deep sulcus sign on a supine radiograph – indicates pneumothorax
  - To describe monitoring and support devices ("tubes and lines") and to confidently identify them on imaging studies
- To describe the imaging features and the preferred placement of the following devices and lines and to list the complications associated with the mal-positioning of each of the following:
  - Endotracheal tube
  - Central venous catheter
  - Swan–Ganz catheter
  - Nasogastric tube
  - Chest tube/drain

- Intra-aortic balloon pump
- Pacemaker and pacemaker leads
- Implantable cardiac defibrillator
- Left ventricular assistant device
- Atrial septal defect closure device ("clamshell device")
- Pericardial drain
- Extracorporeal life support cannulae
- Intra-oesophageal manometer, temperature probe or pH probe
- Tracheal or bronchial stent

• To describe the typical chest radiography appearances of pleural effusion on erect, supine and lateral decubitus chest radiographs, and to list four causes of a large unilateral pleural effusion

• To describe the imaging features of pleural-based masses with bone destruction or infiltration of the chest wall on a radiograph or chest CT, and to list four likely causes

• To describe the imaging features of a unilateral elevation of one hemidiaphragm on chest radiographs and to list five causes (e.g. subdiaphragmatic abscess, diaphragm rupture and phrenic nerve involvement with lung cancer, post-cardiac surgery, eventration)

• To describe the imaging features and clinical features of tension pneumothorax

• To describe the normal dimensions of the thoracic aorta

• To have an in-depth understanding of the Stanford A and B classification of aortic dissection and the implications of the classification for medical versus surgicaln management

• To comprehend the features on radiographs and CT and the differential diagnosis of diffuse interstitial and alveolar lung disease, airways and obstructive lung disease

• To differentiate solitary and multiple pulmonary nodules, benign and malignant neoplasms, hyperlucencies and their potential aetiology and evaluation

• To differentiate thoracic diseases in immunocompromised patients and congenital lung disease • To analyze and explain disorders of the pulmonary vascular system and great vessels

• To understand the diagnostic role of radiographs, radionuclides, CT and MRI in the diagnostic evaluation of disorders of the pulmonary vascular system and great vessels

• To differentiate abnormalities of the chest wall, mediastinum and pleura

**SKILLS:**

• To plan and to supervise the proper acquisition of radiographs, chest radiographs, ventilation/perfusion imaging, thoracic CT, high-resolution chest CT, and the CT pulmonary angiography (CTPA)

• To perform proper positioning of chest radiographs and of chest CT examinations for adults, newborns, infants and children

• To plan and to protocol a CT examination of the chest and to adapt it to the individual situation

• To plan and to protocol an MRI examination of the chest and to adapt it to the individual situation

• To perform proper common post-processing tasks for thoracic imaging studies, including multi-planar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (MinIP), and vessel analysis tools

• To perform ultrasonographic examinations in the diagnosis

• To perform aspirations of pleural fluid under image-guidance

**COMPETENCES AND ATTITUDES**

• To ustify diagnostic imaging examinations and/or interventional procedures of the chest • To choose the best-suited method for evaluating disorders of the chest

• To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and interventional procedures of the chest

• To choose optimal imaging parameters for radiographic, ultrasonographic, CT and MRI examinations of the chest

• To design imaging protocols for CT examinations of the thorax, including the appropriate application of intravenous contrast, spatial and temporal resolution, inspiration/expiration and reconstruction/reformatting techniques

• To apply techniques to reduce exposure doses for radiographic and CT examinations of the chest

• To supervise and teach technical staff to ensure that appropriate images are obtained

• To interpret and report radiographs, chest radiographs, ventilation/perfusion imaging, thoracic CT, highresolution chest CT and CT pulmonary angiography (CTPA) with respect to common diseases

• To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the chest

• To identify urgent and/or unexpected findings in imaging examinations of the chest and to communicate these timely and properly

• To communicate with patients and their relatives in order to explain their imaging findings of the chest

• To choose optimal biopsy routes and techniques

• To participate in and to perform under supervision at multi-disciplinary conferences and tumour boards for diseases of the chest

## RDL 715 Course Title: Gastrointestinal and Abdominal Radiology
## Course Unit 19Units

COURSE CONTENTS IN GASTROINTESTINAL AND ABDOMINAL RADIOLOGY

| S/No | Course Title | Delivery Method | Assessment Method | Credit unit |
|---|---|---|---|---|
| 1 | Anatomy of the gastrointestinal tract and normal variations. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 3units |
| 2 | The imaging of the diseases of salivary gland, pharynx and esophagus and techniques of investing these organs | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 3 | Imaging of the diseases of stomach and duodenum including technique of investigating them. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 4 | Imaging of the small bowel and peritoneal cavity diseases with the technique of investigating them. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 5 | Radiology of the diseases of the large bowel with techniques of investigation | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 6 | Imaging and the diseases of the biliary tract and technique of investigation. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 7 | Imaging and the diseases of the liver and spleen tract and technique of investigation. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 8 | The Radiology of the pancreatic diseases and the techniques of investigation. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 9 | The Radiology of the diseases adrenal glands and the techniques of investigation. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |

KNOWLEDGE

Introduction to imaging and Anatomy of the gastrointestinal tract and normal variations.

To describe the normal anatomy of the abdomen and the main variants including the internal viscera, abdominal organs, omentum, mesentery and peritoneum on conventional radiology, CT, ultrasound and MRI

• To understand the mean exposure doses of abdominal radiographs and of abdominal CT examinations

• To understand techniques to reduce exposure doses of abdominal radiographs and of abdominal CT examinations

Imaging of the diseases of salivary gland, pharynx and esophagus and techniques

• To describe the clinical presentation and natural history of the most common and/or severe diseases of the salivary gland, Pharynx and oesophagus and the principles of their treatment

• To understand normal post-procedure imaging related to previous treatment such as surgery or interventional radiology

• To understand imaging features of trauma and acute conditions, including perforation, haemorrhage, inflammation, infection, obstruction, ischaemia and infarction of salivary gland, pharynx and oesophagus on radiographs, ultrasound and CT

• To describe the imaging features and basic clinical features of salivary gland, pharynx and oesophagus tumours, diverticulitis, inflammatory diseases, colon ischaemia and radiation-induced oesophagitis.

**Imagings of the stomach, duodenum, small and large bowel**

To describe the clinical presentation and natural history of the most common and/or severe diseases of the abdomen, and the principles of their treatment

• To understand normal post-procedure imaging related to previous treatment such as surgery or interventional radiology

• To understand imaging features of abdominal trauma and acute conditions, including perforation, haemorrhage, inflammation, infection, obstruction, ischaemia and infarction on radiographs, ultrasound and CT

• To describe the imaging features and basic clinical features of colon tumours, diverticulitis, inflammatory diseases, colon ischaemia and radiation-induced colitis

• To describe the imaging features and basic clinical features of megacolon, colonic diverticulosis, specific and non-specific colitis, colonic fistula, carcinoma, polyps and postoperative stenosis on an enema

• To describe the imaging features of colonic diverticulosis, diverticulitis, tumour stenosis, ileocolic intussusception, colonic fistula, parabolic abscess, epiploic appendagitis, intra-peritoneal fluid collection, colonic pneumatosis and pneumoperitoneum on CT

• To differentiate imaging features of primary and secondary tumours of the solid abdominal organs and gastrointestinal tract

• To identify imaging features in regard to the stage and extent of tumours, including features that indicate non-resectability

• To understand both the technique and the role of associated examinations like endoscopy, endoscopic ultrasound and nuclear medicine (including SPECT, PET and hybrid imaging)

• To understand radiological manifestations of inflammatory bowel diseases, malabsorption syndromes and infection.

• To describe the basic principles and standards of post-therapy imaging evaluation (tumour, inflammation)

• To understand the main indications and techniques of interventional radiology as applied to abdominal diseases

• To describe the typical imaging features of a small bowel series and to recognize the various segments of the small bowel and normal findings

**Liver and Biliary tract Imaging**

• To differentiate the aetiology and imaging signs of chronic liver diseases, including portal hypertension

• To differentiate the major vascular abdominal lesions including arterial diseases, arterial, portal or hepatic venous obstruction and to understand their consequences

• To understand the principles and the main applications of quantification and functional imaging in abdominal diseases, such as quantification of liver fat, iron or fibrosis, tumour perfusion and bowel inflammation

• To describe the rationale and basic principles of diffusion-weighted imaging in abdominal diseases

**SKILLS**

To recognize proper positioning of abdominal radiographs for adults, newborns, infants and children

• To plan a CT examination of the abdomen and to adapt it to the individual clinical condition in regard to intravenous contrast medium or intraluminal contrast medium application, and contrast phase, with a dose as low as reasonably achievable

• To plan an MRI examination of the upper abdomen and to adapt it to the individual clinical indication in regard to the potential use of intravenous contrast medium, intraluminal contrast medium, contrast medium phase (e.g. arterial phase or delayed imaging), magnetic resonance cholangiopancreatography (MRCP), and quantification of liver fat/iron

• To plan an MRI examination of the rectum and anal canal and to adapt it to the individual clinical indication

• To plan an MRI examinations of the small bowel and to assist in performing the proper preparation

• To perform contrast medium examinations of the pharynx, oesophagus, stomach, and the small and large bowel

• To perform trans-abdominal ultrasound examinations of the gastrointestinal system, abdominal viscera and their vessels, including Doppler sonography

• To observe contrast-enhanced ultrasonographic studies of the abdominal viscera

• To observe angiography and vascular and non-vascular-interventional techniques in gastrointestinal disease

• To observe the performance of CT colonography

• To perform common post-processing tasks for abdominal imaging studies, including multi-planar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (MinIP), and vessel analysis tools

**Competences and Attitudes**

To justify diagnostic imaging examinations and/or interventional procedures of the abdomen and/or gastrointestinal system

To choose the best method for evaluating disorders of the abdomen and/or gastrointestinal system

To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and interventional procedures of the abdomen and/or gastrointestinal system

To choose optimal imaging parameters for radiographic, ultrasonographic, CT and MRI examinations of the abdomen and/or gastrointestinal system

To apply techniques to reduce exposure doses for radiographic and CT examinations of the abdomen

To design imaging protocols for CT examinations of the abdomen and gastrointestinal system, including the appropriate application of intravenous and/or intraluminal contrast, spatial and temporal resolution, and inspiration/expiration/breath hold techniques

To design imaging protocols for MRI examinations of the upper abdomen and gastrointestinal system, including the appropriate application of intravenous and/or intraluminal contrast, spatial and temporal resolution, and inspiration/expiration/breath hold techniques

To supervise and teach technical staff to ensure that appropriate images are obtained

To confidently report abdominal radiographs and to propose other imaging techniques in cases of acute abdomen

## Course Code716 Course Titles: Gynecological & Obstetrics Radiology I

## Course Unit 20Units

| S/No | Course Title | Delivery Method | Assessment Method | Credit unit |
|---|---|---|---|---|
| 1 | Anatomy and physiology of female reproductive organs with emphasis on normal variations | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 2 | Imaging modalities for investigating female reproductive organs | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 3 | Differential diagnosis obstetrics and gyneacological disorders | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 4 | Imaging of benign and malignant diseases of the uterus, 5endometrium and cervix including the fallopian tubes. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 5 | Imaging of systemic foetal anomalies | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 6 | Imaging of benign and malignant diseases of the ovaries | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 7 | Imaging of infertility patients. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 8 | Obstetric ultrasound including techni-ques, equipment and indications | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |

| | | | | |
|---|---|---|---|---|
| 9 | Normal Ultrasound assessment of fetal age 1st, 2nd and 3rd trimesters | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 10 | Abnormal Ultrasound assessment of fetus in 1st, 2nd and 3rd trimesters | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |

KNOWLEDGE

- To describe the normal anatomy of the female reproductive organs
- To understand the physiological changes affecting normal imaging anatomy of the female reproductive organs throughout the lifespan
- To understand the physiological changes of the female reproductive organs during pregnancy
- To understand the mean exposure doses of radiographs, hysterosalpingography and CT examinations of the female reproductive organs
- To understand techniques to reduce exposure doses of radiographs and CT examinations of the female reproductive organs
- To describe the clinical presentation and natural history of the most common and/or severe diseases of the female reproductive organs
- To understand normal post-procedure imaging of the female reproductive organs related to previous treatment such as surgery or interventional radiology
- To differentiate imaging features of tumours of the female reproductive organs
- To identify imaging features in regard to the stage and extent of tumours of the female reproductive organs, including features that indicate non-resectability
- To understand the imaging features of common disorders associated with pregnancy and delivery
- To understand the main indications and techniques of interventional radiology as applied to the female reproductive organs

**SKILLS**

- To perform a transabdominal and, where possible, transvaginal ultrasound in common gynaecological disorders
- To plan a CT examination in patients with common gynaecological disorders and to adapt it to the individual situation with a dose as low as reasonably achievable
- To plan an MRI examination of the female reproductive organs and to adapt it to the individual situation, also in regard to the potential use of intravenous contrast
- To perform imaging examinations for infertility work-up
- To perform proper common post-processing tasks for imaging studies of the female reproductive organs

**COMPETENCES AND ATTITUDES**

- To justify diagnostic imaging examinations and/or interventional procedures of the female reproductive organs
- To choose the best-suited method for evaluating disorders of the female reproductive organs
- To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and interventional procedures female reproductive system
- To choose optimal imaging parameters for radiographic, ultrasonographic, CT and MRI examinations of the female reproductive organs
- To apply techniques to reduce exposure doses for radiographic and CT examinations of the female reproductive organs
- To choose the optimally suited imaging modality for pregnant patients
- To design imaging protocols for CT examinations of the female reproductive organs and for staging in patients with tumours of the female reproductive organs
- To design imaging protocols for MRI examinations of the female reproductive organs including appropriate application of intravenous contrast and spatial and temporal resolution
- To supervise and teach technical staff to ensure that appropriate images of the female reproductive organs are obtained
- To interpret and report radiographs, CT and MRI examinations of patients with disorders of the female reproductive system
- To report oncological studies in patients with tumours of the female reproductive system according to FIGO stage
- To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the female reproductive system
- To identify urgent and/or unexpected findings in imaging examinations of the female reproductive system and to communicate these timely and properly
- To communicate with patients and their relatives in order to explain their imaging findings in disorders of the female reproductive system
- To participate in and to perform under supervision at multi-disciplinary conferences and tumor boards for diseases of the female reproductive system

**Course Code: RDL 717 Title: Clinical Rotation I Course Units – 10Units**

**See Appendix II**

## Course Code: RDL 721 Title: Head and Neck Radiology I Course Units – 11Units

| S/No | Course Content | Delivery Method | Assessment Method | Credit unit |
|---|---|---|---|---|
| 1 | Radiological Anatomy of the Head and Neck and normal variations | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 2 | Imaging Modalities for investigating Diseases of the head and neck | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 3 | Imaging of diseases of the oral cavity, salivary gland, pharynx and larynx | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 4 | Imaging of diseases of thyroid and para thyroid glands | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 5 | Radiology of teeth, temporo-mandibular joint and jaw diseases | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 6 | Imaging for diseases of the paranasal sinuses | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 7 | Ultrasound of the eye and orbit | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 8 | Imaging of the orbital diseases. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 9 | Radiology of diseases of petrous and temporal bone | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 10 | Imaging of the diseases affecting the skull. | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |

KNOWLEDGE

To describe the normal anatomy of the head and neck, including paranasal sinuses, the oral cavity,

pharynx and larynx, the inner ear, salivary glands, thyroid and parathyroid glands, thoracic inlet,

orbit, teeth and the temporomandibular joint

To recall common congenital lesions of the head and neck, including paranasal sinuses, the oral cavity, pharynx and larynx, the inner ear, orbit, teeth and the temporomandibular joint

To understand common manifestations of diseases of the eye and orbit including trauma, foreign bodies, inflammation and tumours

To understand common imaging manifestations of maxillo-facial trauma and tumours and disorders of the teeth

To understand common imaging manifestations of lesions and abnormal function of the temporomandibular joint

To understand common imaging manifestations of disorders of the thyroid, parathyroid and salivary glands

To be aware of the role of radionuclide imaging in disorders of the thyroid and parathyroid glands

To be aware of the role of radionuclide imaging in the functional evaluation of endocrine abnormalities

To understand common imaging manifestations of trauma, inflammation, infection and tumours of the paranasal sinuses, oral cavity, larynx and pharynx

To understand the role of ultrasound- and CT-guided puncture of salivary glands, lymph nodes and the thyroid gland.

**SKILLS**

To perform fluoroscopic examinations of the head and neck region, including barium swallows

and sialography

To perform ultrasound examinations of the neck, including thyroid, parathyroid lymph nodes

and salivary glands

To plan a CT examination in patients with common disorders of the head and neck region and to

adapt it to the individual situation with a dose as low as reasonably achievable

To plan an MRI examination of the head and neck region and to adapt it to the individual

situation.

To perform proper common post-processing tasks for imaging studies of the head and neck

region including multi-planar reformations (MPR) and maximum intensity projections (MIP)

To observe image-guided interventional techniques of the head and neck region, e.g. fine needle

aspiration biopsy of the thyroid gland

**COMPETENCES AND ATTITUDES**

To justify diagnostic imaging examinations and/or interventional procedures of the head and neck

To choose the best-suited method for evaluating disorders of the head and neck

To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and/or interventional procedures of the head and neck

To choose optimal imaging parameters for radiographic, ultrasonographic, CT and MRI examinations of the head and neck

To apply techniques to reduce exposure doses for radiographic and CT examinations of the head and neck

To supervise and design imaging protocols for CT examinations of the head and neck, including

staging examinations in tumours of the head and neck region and to adapt the examination depending on the imaging findings

To supervise pre-defined imaging protocols for MRI examinations of the head and neck and to design MRI protocols for common indications

To supervise and teach technical staff to ensure that appropriate images of the head and neck region are obtained

To recognize suboptimal image quality and its causes

To interpret and report radiographs, ultrasonographic examinations, CT studies and MRI examinations for common diseases of the head and neck region

To report oncological studies of the head and neck region according to international standards (TNM) applicable to the specific situation

To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the head and neck region

To identify urgent and/or unexpected findings in imaging examinations of the head and neck region and to communicate these timely and properly

To communicate with patients in order to explain the imaging findings in the head and neck

To attend and to conduct under supervision multi-disciplinary conferences and tumor boards for diseases of the head and neck region

**Course Title: RDL 722 Course Title: Muskuloskeletal System I**
**Course Units – 17Units**

| S/No | Course Title | Delivery Method | Assessment Method | Credit unit |
|---|---|---|---|---|
| 1 | Radiological Anatomy of Normal Musculoskeletal system | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 2 | Imaging modalities of musculoskeletal system | Lectures, Tutorials, Seminars, Clinicals/practical, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 3 | Imaging of Congenital skeletal anomalies including skeletal dysplasia's and chromosomal disorders | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 4 | Imaging of Periosteal reactions including bone and joints and sarcoid diseases | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 5 | Imaging of Avascular necrosis, Osteochondritis and miscellaneous bone lesions | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 6 | Imaging of diseases of the joints | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 7 | Radiology of Tumor and tumor like conditions of bone | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 8 | Radiology of disorders of the lymphoreticular system and other haemopoitic disorders | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1units |
| 9 | Imaging of metabolic and endo-crine disorders affecting bones | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 10 | Imaging of regional skeletal trauma | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 11 | Radiology of regional soft tissue of the skeletal system | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |

**KNOWLEDGE**

To describe the normal anatomy of the musculoskeletal system

To be familiar with normal skeletal variants that mimic disease

To describe common congenital dysplasias of the musculoskeletal system

To appreciate the value of different imaging techniques in musculoskeletal disorders

To understand common imaging presentations of trauma involving the skeleton and soft tissue

To understand the imaging presentation of degenerative disorders of the musculoskeletal system and to appreciate their clinical relevance

To understand the imaging manifestations of musculoskeletal infection and inflammation

To understand the imaging manifestations of metabolic diseases, including osteoporosis

To describe the typical radiographic features of common bone tumours

**SKILLS**

To perform ultrasound examinations of the musculoskeletal system for common musculoskeletal disorders

To plan a CT examination in patients with common disorders of the musculoskeletal system and to adapt it to the individual situation with a dose as low as reasonably achievable

To plan an MRI examination of the musculoskeletal system and to adapt it to the individual situation

To perform proper common post-processing tasks for imaging studies of the muskuloskeletal system including multi-planar reformations (MPR) and maximum intensity projections (MIP)

To perform image-guided application of intraarticular contrast media for MR arthrography or CT arthrography under supervision

**COMPETENCES AND ATTITUDES**

To justify diagnostic imaging examinations of the musculoskeletal system

To choose the best-suited method for evaluating disorders of the musculoskeletal system

To communicate with the patient in order to obtain informed consent prior to diagnostic imaging of the musculoskeletal system

To choose optimal imaging parameters for radiographic, ultrasonographic, CT and MRI examinations of the musculoskeletal system

To apply techniques to reduce exposure doses for radiographic and CT examinations of the musculoskeletal system

To design imaging protocols for CT examinations of the musculoskeletal system

To design imaging protocols for MRI examinations of the musculoskeletal system

To supervise and teach technical staff to ensure that appropriate images of the musculoskeletal system are obtained

To interpret and report radiographs, ultrasonographic examinations, CT studies and MRI examinations of the musculoskeletal system

To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the head and neck region

To identify urgent and/or unexpected findings in imaging examinations of the musculoskeletal system and to communicate these timely and properly

To communicate with patients and their relatives in order to explain their imaging findings of the musculoskeletal system

To participate in and to perform under supervision at multi-disciplinary conferences for diseases of the musculoskeletal system

**Course Code: RDL 723 Course Title : EMERGENCY RADIOLOGY I**

**Course Units – 11Units**

INTRODUCTION

The aim of this curriculum in Emergency Radiology (ER) is to ensure that the trainee develops core knowledge, skills, competences and attitudes mainly in imaging and when appropriate, in interventional handling of the various traumatic and non-traumatic emergencies. ER understands itself as a circumstance, condition and somehow disease based subspecialty, which has relevant overlap with organ based as well as with modality based knowledge, skills, competences and attitudes and is mainly embedded in a multidisciplinary context. As a consequence the curriculum will sometimes refer to transferable content from other subspecialty curricula but on the other hand will also equip the trainee for working as a specialist in any branch of radiology. A special focus lies on emergency topics with potentially life threatening conditions and those where fast and precise radiological input may have particular and immediate high impact on best possible outcome and on preparing the trainee as fast as possible to act appropriate and accordingly during night shifts. It also aims to form the basis for further ER Level III subspecialty training.

| S/No | Course Title | Delivery Method | Assessment Method | Credit unit |
|---|---|---|---|---|
| 1 | Normal Radiological Anatomy of all structures of the Body including topographic relationships and cross-sectional appearance | Lectures, Tutorials, Seminars Clinicals/ practicals, Self-directed learning. Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 2 | The various radiological modalities and techniques employed in ER including their respective strengths, weaknesses, opportunities and threats regarding ER Guidelines and corresponding institutional SOPs/algorithms, hygiene regulations, regarding emergency cases.<br>Potential risks and benefits of modality dependent contrast media including effects of oral, rectal or vaginal filling | Lectures, Tutorials, Seminars Clinicals/ practicals, Self-directed learning. Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 3 units |
| 3 | The epidemiological data regarding emergencies. Potentially critical legal aspects | Lectures, Tutorials, Seminars Clinicals/ practicals, Self-directed learning. Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 4 | The common mechanisms of injury including acting forces and their distribution in/ over human bodies | Lectures, Tutorials, Seminars Clinicals/ practicals, Self-directed learning. Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 5 | Typical appearance of pericardial effusion, pleural effusion, pneumothorax and free abdominal fluids in enhanced Focused | Lectures, Tutorials, Seminars Clinicals/ practicals, Self- | MCQ, SAQ, OSCE, MCQ, | 1unit |

| | | | | |
|---|---|---|---|---|
| | Assessment with Sonography for Trauma (eFAST) | directed learning. Assignments, Conferences | SAQ, ESSAY LOG BOOK | |
| 6 | Image optimization and workflow chain of digital imaging, image processing, reading, reporting and the distributing report/images in ER | Lectures, Tutorials, Seminars Clinicals/ practicals, Self-directed learning. Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 7 | The relevant modality dependent imaging findings of iatrogenic installations regarding tube, drainage or catheter positions | Lectures, Tutorials, Seminars Clinicals/ practicals, Self-directed learning. Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 8 | Theory, indications and contraindications for image-guided interventional procedures in emergency settings | Lectures, Tutorials, Seminars Clinicals/ practicals, Self-directed learning. Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1units |

**KNOWLEDGE**

- To describe epidemiological data regarding emergencies
- To understand the common mechanisms of injury including acting forces and their distribution in/ over human bodies
- To understand principles and basic application of estimating emergency severity such as the Injury severity score (ISS) for trauma cases and pain rating scales with regard to the region of pain in non-traumatic cases
- To describe potentially critical legal aspects
- To describe hygiene regulations
- To describe guidelines and corresponding institutional SOPs/algorithms regarding emergency cases
- To describe relevant normal anatomy of the brain, spine, musculoskeletal system, lung, heart, mediastinum, diaphragm, abdominal organs and spaces, genito-urinary tract, venous and arterial system including topographic relationships and cross-sectional appearance
- To describe corresponding common normal variants and abnormalities
- To describe the various radiological modalities and techniques employed in ER including their respective strengths, weaknesses, opportunities and threats regarding ER
- To describe factors and effects of radiation dose as well as techniques for dose reduction
- To describe criteria for good, reasonable/acceptable, poor and insufficient image quality
- To describe the workflow chain of digital imaging, image processing, reading, reporting and the distributing report/images in ER
- To describe the potential risks and benefits of modality dependent contrast media including effects of oral, rectal or vaginal filling

• To describe the various phases of intravenous contrast media application (plain, arterial, portal, delayed, hepatobiliary, urographic) and their respective values according to the clinical problem

• To identify the typical appearance of pericardial effusion, pleural effusion, pneumothorax and free abdominal fluids in enhanced Focused Assessment with Sonography for Trauma (eFAST)

• To describe respective imaging algorithms for various emergency cases

• To describe the relevant pathophysiology, clinical presentation and modality dependent imaging findings of factures, hypovolemic shock, pneumothorax, pulmonary edema, pericardial tamponade, obstructive and paralytic ileus, hollow organ perforation or anastomotic insufficiency, organ laceration or rupture (heart, liver, spleen, kidney, pancreas), ischemia, embolism, thrombosis, arterial dissection or rupture, urinary calculi, acute cholestasis, acute neurological deficits, severe inflammatory conditions (such as meningitis, acute osteomyelitis, abscesses, severe pneumonia, cholecystitis, appendicitis, …), ovarian and testicular torsion

• As far as not covered by content above: To describe additional knowledge content of other subspeciality curricula in cases where patients may often present initially to those experts such as musculoskeletal, pediatric, neurological, gynecological /obstetrical and male genitourinary emergencies

• To describe the relevant modality dependent imaging findings of iatrogenic installations regarding tube, drainage or catheter positions

• To describe radiological standard procedures in polytrauma cases, CT under resuscitation and mass casualty incidents

• To describe theory, indications and contraindications for image-guided interventional procedures in emergency settings

**SKILLS**

• To assess current guidelines provided by national and international ER and other relevant subspecialty bodies

• To use PACS for interpretation of imaging studies

• To use particular more time effective technical equipment such as dedicated CT workstations for initial interpretation of CT studies

• To properly perform or supervise patient positioning and protocol choice including the application of techniques to reduce dose exposure when appropriate

• To perform eFAST under supervision

• To perform abdominal sonography of emergency cases under supervision

• To perform femoral artery and venous puncture techniques under supervision

• To perform image guided drainage of fluid collections under supervision
• To assist in percutaneous transhepatic drainage of the biliary tract
• To assist in other interventional emergency procedures under imaging guidance, particularly in bleeding control
• To identify modality and body region dependent common imaging findings in emergency cases such as fracture patterns, luxations, cartilage injury, ileus signs, free air and fluids, bleedings, infarctions, embolism
• To classify modality dependent imaging findings to be potentially acute life-threatening, in principal but not immediately life-threatening, severe but not life-threatening or other
• To interpret the relevant modality dependent imaging findings of iatrogenic placement regarding tube, drainage or catheter location
• To assist in image interpretation or therapy of >1500 emergency cases (>500 CR, >100 eFAST, >200 US, >500 CT including >25 polytrauma cases and >25 Triple-rule-outs, >50 MRI, >10 embolisations, >10 PTD, >30 drainage of fluid collections). These cases have to be distributed proportionally over the body regions and the more common pathologies

**COMPETENCES AND ATTITUDES**

• To accordingly obtain and interpret relevant clinical information
• To differentiate high-risk from low-risk patients before imaging
• To differentiate and prioritise findings with respect to their urgency after imaging
• To be able to 'screen' as fast as possible for life-threatening findings (e.g. for CT: <10 min after scan start) using an optimised infrastructure and selective image reading in case of high-risk patients
• To understand the respective advantages and disadvantages of different imaging options in emergency cases
• To choose the probably best-suited particular imaging modality and protocol parameters and, if necessary, to proper put imaging techniques into a most appropriate diagnostic pathway considering advances and limitations of the different modalities, diagnostic accuracy and speed, amount of radiation
exposure and ethically motivated corresponding individual risk/benefit-analysis with respect to case severity, time-to diagnose/therapy, patient age and sex
• To communicate as fast as possible and effectively with involved clinicians and supervisory staff
• To participate at multi-disciplinary therapy, morbidity and mortality conferences
• To participate in QA, QM

• To communicate with patients and their relatives with respect to breaking bad news and consent in a multidisciplinary context

• To demonstrate a responsible work ethic

• To appreciate own limitations and to identify when it is appropriate to add further imaging and/or obtain assistance in image interpretation

## Interventional Radiology

It is important for radiology trainees to develop a thorough knowledge of the performance and an understanding of common interventional procedures, irrespective of whether they specialise in interventional radiology

### Course Code RDL 724 Course Title: Interventional Radiology
### Course Unit – 9Units

| S/No | Course Title | Delivery Method | Assessment Method | Credit unit |
|---|---|---|---|---|
| 1 | Normal anatomy of the arterial and venous system and its relevance to interventional radiology | Lectures, Tutorials, Seminars, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 2 | Typical endovascular approaches to common disorders in interventional radiology | Lectures, Tutorials, Seminars, Clinicals/ practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 3 | Typical approaches for image-guided placement of drainages | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 4 | The risks involved in common interventional techniques | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 5 | The use, dosage and administration of local anaesthetics | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 6 | The pharmacology, administration and patient supervision in relation to intravenous administration of sedation | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 7 | The standard procedure in emergency situations, including resuscitation techniques | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 8 | Typical catheterisation techniques and the principles of selective catheterisation and embolisation | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 9 | The indications for nephrostomy drainage, abscess drainage and pleural drainage | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |

**KNOWLEDGE**

• To describe the normal anatomy of the arterial and venous system and its relevance to interventional radiology

• To describe typical endovascular approaches to common disorders in interventional radiology

• To describe typical approaches for image-guided placement of drainages

• To understand the risk involved in common interventional techniques

• To understand the use, dosage and administration of local anaesthetics

• To understand the pharmacology, administration and patient supervision in relation to intravenous administration of sedation

• To describe the standard procedure in emergency situations, including resuscitation techniques

• To describe typical catheterisation techniques and the principles of selective catheterisation and embolisation

• To understand the indications for nephrostomy drainage, abscess drainage and pleural drainage

**SKILLS**

• To perform basic catheterisation techniques under supervision

• To perform peripheral arteriography under supervision

• To perform image-guided placement of abscess drainages

• To perform image-guided nephrostomy of dilated renal collecting systems

• To perform emergency procedures in life-threatening disorders, including cardio-pulmonary resuscitation

**COMPETENCES AND ATTITUDES**

• To justify indications for interventional radiological procedures

• To choose the best-suited approach for an interventional procedure

• To communicate with the patient in order to obtain informed consent prior to an interventional procedures

• To choose optimal imaging parameters for image-guided interventional procedures

• To apply techniques to reduce exposure doses for interventional procedures, both for the patient and for the radiologist and staff

• To safely apply local anaesthetics for pain management in patients undergoing interventional radiological procedures

• To appreciate own limitations and to identify when it is appropriate to obtain assistance in

interventional procedures

• To manage and coordinate emergency situations arising from and/or during interventional procedures • To communicate with patients and their relatives in order to explain the outcome of the interventional procedure

• To participate in and to perform under supervision at multi-disciplinary conferences for patients with potential indications for interventional procedures

## NEURORADIOLOGY

### Course Code RDL 725 Course Title: NEURORADIOLOGY

### Course Unit – 15Units

| S/No | Course Title | Delivery Method | Assessment Method | Credit unit |
|---|---|---|---|---|
| 1 | Normal anatomy and normal variants of the brain, skull, skull base, spine and spinal cord peripheral nervous system | Lectures, Tutorials, Seminars, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY, LOG BOOK | 3units |
| 2 | Normal anatomy of the craniocervical and spinal arterial and venous system and its relevance to interventional neuroradiology | Lectures, Tutorials, Seminars, Clinicals/ practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY, LOG BOOK | 2units |
| 3 | Typical approaches for image-guided placement of drainages | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY, LOG BOOK | 1unit |
| 4 | The risks involved in common interventional techniques | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY, LOG BOOK | 1unit |
| 5 | The use, dosage and administration of local anaesthetics | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY, LOG BOOK | 1unit |
| 6 | The pharmacology, administration and patient supervision in relation to intravenous administration of sedation | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY, LOG BOOK | 1unit |
| 7 | The standard procedure in emergency situations, including resuscitation techniques | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY, LOG BOOK | 1unit |
| 8 | Typical catheterisation techniques and the principles of selective catheterisation and embolisation | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY, LOG BOOK | 1unit |
| 9 | The indications for nephrostomy drainage, abscess drainage and pleural drainage | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY, LOG BOOK | 1unit |

## KNOWLEDGE

• To describe normal anatomy and normal variants of the brain, skull, skull base, spine and spinal cord peripheral nervous system

• To describe the normal anatomy of the craniocervical and spinal arterial and venous system and its relevance to interventional neuroradiology

• To describe typical endovascular and percutaneous approaches to common disorders in interventional neuroradiology (brain, skull, skull base and spine/spinal cord)

• To recall common congenital lesions of the brain, skull, skull base, spine, spinal cord and peripheral nervous system

• To understand the rationale for selecting certain imaging techniques, and the use of contrast administration, in diagnosing diseases of the central and peripheral nervous system

• To understand imaging features of stroke, haemorrhage and other common vascular lesions of the brain and spinal cord and to differentiate these from other disorders

• To understand imaging features of traumatic brain injury and spinal trauma and to comprehend their neurological sequelae

• To understand imaging features and differential diagnoses of white matter disease, inflammation and degeneration

• To understand imaging features of benign and malignant tumours of the skull, skull base, brain, spine, spinal cord and cranial and peripheral nerves

• To appreciate the role of nuclear medicine, including PET/PET-CT, in the diagnostic evaluation of disorders involving the central nervous system, skull, skull base, and spine

## SKILLS

• To perform ultrasonographic examinations of the carotid arteries, including Doppler-sonographic studies

• To observe ultrasonographic and Doppler-sonographic studies of intracranial vessels

• To perform basic vascular catheterisation and percutaneous techniques under supervision

• To observe diagnostic and interventional supraaortic digital subtraction angiographies

• To observe diagnostic and interventional spinal digital subtraction angiographies

• To observe image-guided puncture of the spine with and without contrast media application (myelography, diagnostic lumbar puncture)

• To plan CT examinations in patients with common disorders of the brain, skull, skull base, and spine and to adapt them to the individual situation with a dose as low as reasonably achievable,

including the decision for or against contrast administration

• To plan MRI examinations in patients with common disorders of the brain, skull, skull base, and spine and to adapt them to the individual situation, including the decision for or against contrast administration

• To perform proper common post-processing tasks for imaging studies of the brain spine/spinal cord and nerve roots, including multi-planar reformations (MPR), maximum intensity projections (MIP) and vessel analysis tools.

**COMPETENCES AND ATTITUDES**

• To justify diagnostic imaging examinations and/or interventional procedures of the brain, skull and spine

• To choose the best-suited method for evaluating disorders of brain, skull and spine

• To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and/or interventional procedures of the brain, skull and spine

• To choose optimal imaging parameters for radiographic, ultrasonographic / Doppler-sonographic, CT and MRI examinations of the brain, skull and spine

• To apply techniques to reduce exposure doses for radiographic and CT examinations of the brain, skull and spine

• To design imaging protocols for CT examinations of the brain, skull and spine

• To design imaging protocols for MRI examinations of the brain, skull and spine

• To supervise and teach technical staff to ensure that appropriate images of the brain, skull and spineare obtained

• To interpret and report radiographs, ultrasonographic / Doppler-sonographic examinations, CT studies and MRI examinations of the brain, skull and spine

• To report oncological studies of the brain, skull and spine

• To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the brain, skull and spine

• To identify urgent and/or unexpected findings in imaging examinations of the brain and spine and to communicate these timely and properly

• To communicate with patients and their relatives in order to explain their imaging findings of the brain, skull and spine

• To participate in and to perform under supervision at multi-disciplinary conferences, neurovascular boards and tumour boards for diseases of the brain, skull and spine

**UROGENITAL RADIOLOGY**

**COURSE CODE RDL 726 COURSE TITLE: UROGENITAL RADIOLOGY**

**COURSE UNIT – 16UNITS**

| S/No | Course Title | Delivery Method | Assessment Method | Credit unit |
|---|---|---|---|---|
| 1 | Normal anatomy and normal variants of the kidneys, ureters, bladder and urethra | Lectures, Tutorials, Seminars, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ,ESSAY LOG BOOK | 3units |
| 2 | Normal anatomy and normal variants of the retroperitoneum and the male and female pelvis | Lectures, Tutorials, Seminars, Clinicals/ practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAYLOG BOOK | 3units |
| 3 | Typical imaging features of renal parenchymal diseases, including infection and renovascular disease | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAYLOG BOOK | 1unit |
| 4 | Typical imaging features and with the appropriate imaging investigation algorithm of calculus disease | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assign-ments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ,ESSAY LOG BOOK | 1unit |
| 5 | The imaging features of urinary tract obstruction and reflux | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY, LOG BOOK | 1unit |
| 6 | Imaging features and to differentiate tumours of the kidney and urinary tract | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 7 | The typical imaging features of renal transplants | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 8 | Tmaging features and differential diagnoses of pathologies of the prostate, seminal vesicles and testes/scrotum | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 9 | Management of urogenital emergencies | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAYLOG BOOK | 1unit |

**KNOWLEDGE**

- To describe normal anatomy and normal variants of the kidneys, ureters, bladder and urethra
- To describe normal anatomy and normal variants of the retroperitoneum and the male and female pelvis
- To understand the principles of renal function
- To be familiar with typical imaging features of renal parenchymal diseases, including infection and renovascular disease
- To be familiar with typical imaging features and with the appropriate imaging investigation algorithm of calculus disease
- To understand the imaging features of urinary tract obstruction and reflux
- To understand imaging features and to differentiate tumours of the kidney and urinary tract
- To understand the typical imaging features of renal transplants
- To understand imaging features and differential diagnoses of pathologies of the prostate, seminal vesicles and testes/scrotum
- To be familiar with urogenital emergencies including management

**SKILLS**

- To perform transabdominal ultrasound examinations of the urinary tract and testes
- To plan CT examinations in patients with common disorders of the urogenital system and to adapt the examination protocol to the individual situation with a dose as low as reasonably achievable, including the decision for or against contrast administration
- To perform proper post-processing tasks for imaging studies of the urogenital system, including multi-planar reformations (MPR) and maximum intensity projections (MIP)
- To perform ascending urethrograms and micturating cysto-urethrograms under supervision

COMPETENCES AND ATTITUDES

- To justify diagnostic imaging examinations of the urogenital system
- To choose the best-suited method for evaluating disorders of the urogenital system
- To communicate with the patient in order to obtain informed consent prior to diagnostic imaging of the urogenital system
- To choose optimal imaging parameters for radiographic, ultrasonographic / Doppler-sonographic, CT and MRI examinations of the urogenital system
- To apply techniques to reduce exposure doses for radiographic and CT examinations of the urogenital system
- To design imaging protocols for CT examinations of the urogenital system
- To design imaging protocols for MRI examinations of the urogenital system
- To supervise and teach technical staff to ensure that appropriate images of the urogenital system are obtained
- To interpret and report radiographs, ultrasonographic / Doppler-sonographic examinations, CT studies and MRI examinations of the urogenital system
- To report oncological studies of the urogenital system according to international standards (RECIST, WHO) applicable to the specific situation
- To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the urogenital system
- To identify urgent and/or unexpected findings in imaging examinations of the urogenital system and to communicate these timely and properly
- To communicate with patients and their relatives in order to explain their imaging findings of the urogenital system
- To participate in and to perform under supervision at multi-disciplinary conferences and tumour boards for diseases of the urogenital system

**Course Code: RDL 727 Title: Clinical Rotation Year II Course Units – 10Units**

**See Appendix II**

**PAEDIATRIC RADIOLOGY**

**Course Code RDL 731 Course Title: PAEDIATRIC RADIOLOGY Course Unit – 16Units**

| S/No | Course Title | Delivery Method | Assessment Method | Credit unit |
|---|---|---|---|---|
| 1 | Normal paediatric anatomy and normal variants, with particular relevance to normal maturation and growth | Lectures, Tutorials, Seminars, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 3units |
| 2 | Imaging features of common disease entities specific to the paediatric age group | Lectures, Tutorials, Seminars, Clinicals/ practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |
| 3 | Familiarization with principles of establishing a child-friendly environment | Lectures, Tutorials, Seminars, /practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2unit |
| 4 | In-depth understanding of the relative values of and indications for ultrasound, CT and MRI in children | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2unit |
| 5 | Know the increased vulnerability of children to ionizing radiation and have an in-depth understanding of the ALARA principle and the special requirements for radiation safety and contrast material dosage in relation to body mass for the paediatric population | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAYLOG BOOK | 3unit |
| 6 | Imaging features of disorders of the abdomen, intestines, blunt trauma, gastro-oesophageal reflux, malrotatioins, Hirshprung's disease, anal imperforation, skeletal disorders | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |
| 7 | features of common disorders of the skeletal system in the paediatric population including fractures (accidental and non-accidental), bone dysplasia, tumours, osteomyelitis, joint effusion, Legg–Calvé–Perthes disease and slipped capital femoral epiphysis | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1unit |

| | | | | |
|---|---|---|---|---|
| 8 | Congenital disorders of the different body regions and their respective relevance for the child´s further development | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2units |

**KNOWLEDGE**

|• To describe normal paediatric anatomy and normal variants, with particular relevance to normal maturation and growth

• To understand imaging features of common disease entities specific to the paediatric age group

• To be familiar with principles of establishing a child-friendly environment

• To have an in-depth understanding of the relative values of and indications for ultrasound, CT and MRI in children

• To understand the increased vulnerability of children to ionizing radiation

• To have an in-depth understanding of the ALARA principle and the special requirements for radiation safety and contrast material dosage in relation to body mass for the paediatric population

• To recall common congenital disorders of the different body regions and their respective relevance for the child´s further development

• To be familiar with the imaging features of common disorders of the brain and spine in neonates, infants and children, including traumatic brain injury (accidental and non-acccidental), congenital disorders of the brain and spine, hypoxic injury to the brain, brain hemorrhage and brain tumours

• To be familiar with the imaging features of common disorders of the chest in the pediatric population including bronchiolitis, pneumonia, pleural effusion, pneumothorax, foreign body aspiration, mediastinal masses, thymus and variants, malformations of the airways and oesophageal atresia

• To be familiar with the imaging features of common disorders of the abdomen including intestinal obstruction, necrotising enterocolitis, blunt trauma, pneumoperitoneum and abdominal masses

• To be familiar with the imaging presentation of various grades of vesico-ureteral reflux and urethral anomalies

• To be familiar with the imaging features of gastro-oesophageal reflux, malrotation, Hirschprung’s disease, and anal imperforation

• To be familiar with imaging features of common disorders of the skeletal system in the paediatric population including fractures (accidental and non-accidental), bone dysplasia, tumours, osteomyelitis, joint effusion, Legg–Calvé–Perthes disease and slipped capital femoral epiphysis

**SKILLS**

• To perform ultrasound examinations of the head in hydrocephalus, subependymal and intraventricular haemorrhage, periventricular leukomalacia and tumours in newborns and infants under supervision

• To perform ultrasound examinations of the chest for evaluating pleural effusion, chest consolidation and normal thymus in newborns, infants and children under supervision

• To perform ultrasound examinations of the abdomen for hypertrophic pyloric stenosis, acute intestinal intussusception, acute appendicitis, intestinal obstruction and volvulus, inguinal hernia, in newborns, infants and children under supervision

• To perform ultrasound examinations of the abdomen for abdominal and pelvic masses, uretero-hydronephrosis, urolithiasis and nephrocalcinosis and cystic disease of the kidney in newborns, infants and children under supervision

• To perform ultrasound examinations of the pelvis for acute pelvic pain in female infants, children and adolescents under supervision

• To perform ultrasound examinations of the scrotum for acute scrotal pain, scrotal masses in male infants, children and adolescents under supervision

• To perform ultrasound examinations of the hip in congenital hip dysplasia and transient synovitis in newborns, infants and children under supervision

• To perform routine fluoroscopic contrast medium studies of the gastrointestinal system and urinary tract including voiding cysturethrography in newborns, infants and children under supervision

• To plan and to supervise the proper acquisition of radiographs, CT, and MRI in newborns, infants and children

• To perform proper positioning of radiographs in newborns, infants and children

• To plan and to protocol CT examinations in newborns, infants and children and to adapt it to the individual situation with special consideration of radiation protection in the paediatric population

• To plan and to protocol MRI examinations in newborns, infants and children and to adapt it to the individual situation

• To perform proper common post-processing tasks for paediatric imaging studies, including multi-planar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (MinIP), and vessel analysis tools

• To observe interventional techniques in paediatric radiology, e.g. management of intussusception

**COMPETENCES AND ATTITUDES**

• To choose the best-suited method for evaluating common disorders in the paediatric population

• To communicate with the parents / caretakers in order to obtain informed consent prior to diagnostic imaging in neonates, infants and children

• To choose optimal imaging parameters for radiographic, ultrasonographic / Doppler-sonographic, CT and MRI examinations of neonates, infants and children

• To apply techniques to reduce exposure doses for radiographic and CT examinations of neonates, infants and children

• To design optimized imaging protocols for CT examinations of neonates, infants and children

• To design optimized imaging protocols for MRI examinations of neonates, infants and children

• To supervise and teach technical staff to ensure that appropriate images of neonates, infants and children are obtained

• To interpret and report radiographs, ultrasound examinations, CT studies and MRI examinations of neonates, infants and children in regard to common disorders in this age group

• To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of neonates, infants and children

• To identify urgent and/or unexpected findings in imaging examinations of the neonates, infants and children and to communicate these timely and properly

• To communicate with parents / caregivers in order to explain the imaging findings of their children

• To communicate with children and adolescents in an age-appropriate matter in order to explain diagnostic or interventional procedure or imaging findings

• To participate in and to perform under supervision at multi-disciplinary paediatric conferences and paediatric tumour boards

**Course Code: 732 Course Title: CLINICAL AND RESEARCH ETHICS**

**Course Unit – 12units**

Introduction: Morals and behaviors that are acceptable in a Society, in Medical profession or in Research. *Ethics* or moral philosophy is a branch of philosophy that involves systematizing, defending, and recommending concepts of right and wrong conduct. ... *Ethics* seeks to resolve questions of human morality by *defining* concepts such as good and evil, right and wrong, virtue and vice, justice and crime

This will be communicated to then Resident by Didactic Lectures, Small group learning, Seminars, Role plays, registering with CITI – Collaborative Institutional Training Initiative – Programme. for Research Ethics purposes. and completing their entire course with Certification for Research purposes

**Knowledge:**

- History of Bioethics
- Ethics in Medical Practice
- Good Clinical Practice
- Ethics and Good Clinical Practice in Paediatrics
- Ethics and Good Clinical Practice in Adults
- Reproductive Ethics and Start of life
- Aging and end of life issues
- Responsible conduct of Research
- Plagiarism
- Justice and Healthcare
- Institutional Review Board – Administration and function.
- Gender and Bioethics

12. **Skill**
    Be honest with patients and all members of the health care team
13. Demonstrate honor and integrity: avoid conflicts of interest when accepting gifts from patients or vendors
14. Interact with others without discriminating on the basis of religious, ethnic, sexual or educational differences and without employing sexual or other types of harassment
15. Demonstrate positive work habits, including punctuality and professional decorum and appearance
16. Demonstrate an understanding of broad principles of biomedical ethics
17. Demonstrate principles of confidentiality with all information transmitted during a patient encounter
18. Demonstrate knowledge of regulatory issues pertaining to the use of human subjects in research

**Course Code: RDL 733. Title: Nuclear Medicine as Basic Training Course Units – 14Units**

It is recommended that a three-month period of training in nuclear medicine should be a component of the radiology curriculum during the first three years in order to gain a familiarity with this specialty. To acquire the basic knowledge of nuclear medicine and hybrid imaging techniques and to understand the role of these techniques within the diagnostic imaging algorithms should be an educational priority. This recommended three-months training period by no means implies a full training in nuclear medicine.

**KNOWLEDGE**

• To describe basic principles of physics including the basic atomic structure, principles of radioactivity and basic of radioactive decay

• To be familiar with basic principles of the production of radionuclides, manufacturing, desirable characteristics and physiological clearance of radiopharmaceuticals and PET-tracers

• To explain the principles of biological and effective half-life

• To understand the principles of quantification of PET studies including standardized uptake values (SUV)

• To describe the basic physical principles of nuclear medicine imaging technology, including gamma cameras, single photon emission computed tomography (SPECT), and positron emission tomography (PET)

• To understand the basic physical principles of hybrid imaging, including PET-CT, SPECT-CT, and MR-PET

• To be familiar with imaging performance parameters, including uniformity of response, system sensitivity, spatial resolution, spatial linearity, count rate performance, and image quality

• To understand safety aspects in nuclear medicine and hybrid imaging, including patient dosimetry, staff dosimetry, contamination, monitoring, choice of equipment, quality control and safety/risk management

**SKILLS**

• To perform radiopharmaceutical administration under supervision for the following isotope imaging studies: bone, renal, ventilation / perfusion (V/Q), thyroid, parathyroid, white cell, cardiac

• To observe nuclear imaging studies with gamma cameras, single photon emission computed

tomography (SPECT), and with positron emission tomography (PET), preferably with hybrid imaging technique

**COMPETENCES AND ATTITUDES**

• To apply the appropriateness criteria and indications for nuclear medicine and hybrid imaging procedures under guidance of nuclear medicine specialists

• To assist referring physicians in selecting the best-suited nuclear medicine or hybrid imaging examination for common indications

• To communicate with the patient in order to inform them about the procedures and obtain informed consent prior to nuclear medicine or hybrid imaging studies

• To choose optimal imaging protocols for nuclear medicine and hybrid imaging examinations under supervision

• To apply techniques to reduce exposure doses for nuclear medicine and hybrid imaging studies under supervision

• To interpret and report common nuclear medicine and hybrid imaging studies under supervision

• To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting nuclear medicine and hybrid imaging examinations

• To identify urgent and/or unexpected findings in nuclear medicine and hybrid imaging examinations and to communicate these timely and properly

• To communicate with patients and their relatives in order to explain their imaging findings of nuclear medicine studies under supervision

• To participate in multidisciplinary clinical reviews and tumour boards under supervision

**Course Code: RDL 734. Title: RADIATION PROTECTION, EDUCATION AND TRAINING**

**Course Units – 14Units**

- KNOWLEDGE

• To list the sources and properties of ionising radiation

• To list and explain mechanisms of interaction between ionising radiation and matter/tissues

• To list and explain mechanisms of radioactive decay

• To explain the phenomena of X-ray interaction with matter and the consequences for image generation, image quality and radiation exposure

• To list and explain definitions, quantities and units of kerma, absorbed energy dose (Gy), organ and effective doses (Sv), as well as exposure rate and dose rate

• To understand the mechanism of X-ray production

• To explain the function of filters and diaphragms

• To explain the role of screens (in analogue radiography) and grids and their effect on image quality and exposure

• To describe radiation effects on cells and DNA

• To describe cellular mechanisms of radiation response, repair and cell survival • To describe radiation effects upon tissues and organs

• To explain differences in radiation response between healthy tissue and tumours as basis for radiation treatment

• To describe types and magnitudes of radiation risk from radiation exposure in medicine

• To describe the basic principles of radiation protection, as outlined by the ICRP (International Commission on Radiological Protection)

• To specify types and magnitudes of radiation exposure from natural and artificial sources To describe concepts of dose determination and dose measurement for patients, occupationally exposed personnel and the public

• To explain the nature of radiation exposure and the relevant dose limits for the worker, including organ doses and dose limits for pregnant workers, comforters, careers, and the general public

• To define As Low As Reasonably Achievable (ALARA) and its applicability to diagnostic radiology settings

• To explain the factors influencing image quality and dose in diagnostic radiology

• To describe the methods and tools for dose management in diagnostic radiology: radiography, fluoroscopy, CT, mammography, and those for paediatric patients

• To explain the basic concepts of patient dose measurement and calculation for the different modalities in diagnostic radiology

• To describe the key considerations relevant to radiation protection when designing a diagnostic radiology department

• To list diagnostic procedures performed outside the radiology department with relevant radiation protection considerations

- To list expected doses (reference person) for frequent diagnostic radiology procedures

• To explain quantitative risk and dose assessment for workers and the general public in diagnostic radiology

• To define Quality Assurance (QA) in radiology, QA management and responsibilities, outline a QA and radiation protection programme for diagnostic radiology

• To list the key components of image quality and their relation to patient exposure

• To specify the relevant regulatory framework (ordinances, directives, etc.) governing the medical use of ionising radiation in the respective country and the EU

- To specify the relevant regulatory framework governing the practice of diagnostic radiology in the respective country and in the EU
- To understand the effects of poor-quality images

**SKILLS**

- To apply radiation physics to optimally select the best imaging modality
- To apply radiation physics to optimise the protocols, using minimal exposure to reach the image quality level needed for the task
- To use the laws of physics to minimise scatter and optimise contrast
- To use the correct terms to characterise exposure in daily radiograph fluoroscope and CT examinations and define organ risk, and estimate the genetic and cancer risk
- To use the technical features of the specific equipment and take advantage of all quality-improving and dose-reducing capabilities while recognising the limits of the machine
- To communicate the radiation risk to the patient at an understandable level, whenever there is a significant deterministic or stochastic risk, or when the patient has a question
- To communicate with the referrer regarding justification, and, if necessary, to suggest a different test
- To apply the three levels of justification in daily practise, with respect to existing guidelines, but also to individual cases (e.g. polymorbidity)
- To optimise imaging protocols by using standard operating procedures (SOPs) and by adapting these to the specific patient's size
- To use specific paediatric protocols, by taking into consideration the physics of small size, but also the elevated risk, vulnerability and specific pathology of each age group
- To choose the best compromise between risk-benefit-ratio, image quality and radiation exposure on a case-by-case basis
- To supervise the use of personal protective equipment
- To apply and advise on the use of radiation protection measures in diagnostic radiology (radiography, fluoroscopy-intervention, CT, mammography and paediatric patients)
- To stay within guidance/reference levels in daily practice
- To set up size-specific protocols for high-dose procedures
- To estimate organ doses and effective doses for diagnostic radiology examinations, based on measurable exposure parameters (KAP, DLP)
- To apply standards of acceptable image quality
- To perform retake analyses

**COMPETENCES AND ATTITUDES**

• To continuously check image quality in order to recognise and correct technical defects |
• To demand the best in image quality, technical innovation and exposure reduction for the lowest cost
• To coordinate the commissioning of new equipment with the other members of the core team (radiographer, medical physicist)
• To develop an organisational policy to keep doses to the personnel as low as reasonably achievable (ALARA)
• To avoid unnecessary radiation exposure during pregnancy (warning signs, questionnaire) by optimising the technique (size and positioning of the x-ray field, gonad shielding, tube-to-skin distance, correct beam filtration, minimising and recording the fluoroscopy time, excluding non-essential projections, avoiding repeat radiographs)
• To choose the best equipment for the patient spectrum based on the resources available
• To take responsibility for choosing the best imaging modalities for the individual patient (radiography, CT, alternatives such as ultrasound or MRI) by taking into consideration the risk of the disease, patient, age and size, the dose level of the procedure, and exposure of different critical organs
• To consult both the patient and staff on pregnancy related concerns in radiation protection
• To take responsibility for patient dose management in different imaging modalities
• To advise patients on the radiation-related risks and benefits of a planned procedure
• To take responsibility for the justification of radiation exposure for every individual patient, with special consideration for pregnant patients
• To take responsibility for choosing and performing the diagnostic procedure with the lowest dose for a given referrer's request
• To take responsibility for optimising the radiographic technique/protocol used for a given diagnostic procedure based on patient-specific information
• To take responsibility for applying the optimal size-adapted and problem-adapted individual protocol for high-dose procedures (CT, fluoroscopy-intervention)
• To supervise quality control procedures on all equipment related to patient exposure
• To take responsibility for the establishment of formal systems of work (Standard Operating Procedures) for radiation protection
• To take responsibility for organizational issues and implementation of responsibilities and local rules in regard to radiation protection
• To take responsibility for compliance with regulatory requirements concerning occupational and public radiation exposures
• To take responsibility for compliance with ALARA principles concerning occupational and public radiation exposures
• To take responsibility for conforming with patient protection regulations (including diagnostic reference levels, where applicable)

**COURSE CODE: RDL 735. TITLE: COMMUNICATION AND MANAGEMENT**
**COURSE UNITS – 14UNITS**

**KNOWLEDGE**

• To be familiar with the principles of communicating bad news
• To have an in-depth understanding of the nature, structure and medicolegal aspects of radiological reporting
• To understand the importance of timely communication with referring doctors with regard to imaging reports
• To understand the important role of the radiologist in multidisciplinary meetings and tumour boards
• To know the basic principles of communication in multidisciplinary meetings, including an appreciation of the transfer of knowledge, demonstration of imaging findings, and awareness of treatment consequences
• To understand the basic didactic principles of teaching radiology
• To describe the principles of administration and management as applicable to a clinical imaging department with multidisciplinary staff and high-cost equipment • To be familiar with the procedures, legalities, critical evaluation processes and priorities required for systems purchase
• To understand the principles of teleradiology and its potential role and legal implications
• To understand the methodology and principles of the clinical audit with honesty and integrity, full agreement and confidentiality
• To understand the concept of measured performance and the comparison with target standards
• To interpret the results of audit measurements, the process of implementing change and the re-measurement of performance
• To understand the limitations of the selection of appropriate target standards
• To appreciate the concepts of consensus statements from learning bodies and the methodology for sourcing them
• To understand the concept of perceptual errors
• To be aware of the risk and consequences of missed radiographic diagnoses
• To be familiar with concepts to minimize radiological risk
• To be familiar with the concepts of uncertainty and error in radiological practice • To describe the concept of hindsight bias
• To understand the importance of the comparison with previous examinations
• To be aware of the specific liabilities relating to screening
• To have a basic understanding of health economics

**SKILLS**

• To formulate a comprehensive radiological report according to accepted standards
• To perform cost–benefit and cost–efficiency evaluations for common imaging strategies
• To perform audits of structure, process and outcome
• To teach undergraduate students or other trainees relevant radiological knowledge and skills

**COMPETENCES AND ATTITUDES**

• To relate to the patient and their families with respect, honesty and confidentiality

• To be able to explain diagnostic imaging examinations and interventional procedures to the patient and to obtain informed consent

• To be able to explain examination results to patients and/or their families when appropriate

• To properly communicate with referring clinical colleagues

• To distinguish between routine methods of communication, and the necessity for immediate reporting of emergency, life-threatening or unexpected findings

• To timely and adequately communicate urgent or unexpected findings

**Course Code: RDL 736 Title: Research and Evidence-Based Medicine Course Units – 14Units**

## RESEARCH AND EVIDENCE-BASED MEDICINE

## KNOWLEDGE

• To understand the basic elements of scientific methods and evidence-based medicine

• To have an in-depth understanding of design and data analysis for technical and diagnostic performance studies, including the influence of disease prevalence and spectrum on sensitivity, specificity, accuracy, and predictive values as well as the use of ROC analysis in radiological studies

• To understand the statistics necessary for critical assessment of published radiological primary and secondary studies (i.e. meta-analyses, cost-effective analyses)

• To describe basic statistics used in studies comparing treatments (i.e. randomized

controlled trials)

- To understand the principles and practice of clinical audit
- To have a basic understanding of didactic methods to teach radiology

**SKILLS**

- To present studies from the radiological literature in departmental meetings
- To perform basic biostatistical tests relevant to the radiological literature
- To perform a focussed literature search of the relevant radiological literature
- To perform clinical audit in a radiological department

**COMPETENCES AND ATTITUDES**

- To appraise the relevant radiological literature in a critical manner
- To plan and conduct research studies under supervision in a methodologically sound manner
- To understand the value and methods of evolving imaging technologies

**Course Code: RDL 737 Title: Clinical Rotation III & Report writing**
**Course Units – 14Units**

**See Appendix II**

# CURRICULUM FOR THE PART II IN RADIOLOGY TRAINING RADIODIAGNOSIS

## About the Part II Radiology Training Program

The Nigerian Training Curriculum for Radiology recognizes that most Nigerian radiologists should now work in teams, where individual members will have specific skills and competences. This increasing training in specific areas of interest is encouraged, while it is recognized that general competences should be maintained also by subspecialised radiologists and that general radiologists are needed as well. The Nigerian Society of Radiology emphasises that during the fourth and fifth years a developing knowledge in general radiology should continue to be nourished. Elective interest training during this period may apply to two areas of interest, while training in the other areas of radiology should continue as well. For interested trainees, options to actively perform radiological research projects should ideally be offered.

A written or electronic log book of activity during senior residency Training should be maintained. This should provide a formal validated record of competencies achieved and examinations performed and should form an integral part of regular assessments of satisfactory training.

Senior residency Training by no means substitutes subspecialty Training.

The following fields of radiology are outlined in the Part 2 section of the Nigerian Training.

**There are three areas of focus in the Part II training, which include General Radiology, Subspecialty and Research and Management.**

Advanced General Radiology is an in depth continuum of the Part 1 curriculum.

**COURSE DURATION - 3 years**.

**SUMMARY OF CREDIT UNITS IN RADIOLOGY PART II TRAINING**

| Serial No: | Course code | COURSE TITLES | CREDIT UNITS |
|---|---|---|---|
| | | **Clinical Radiology 2 (Part II Program)** | |
| 1 | RDL 814 | Chest Radiology | 20 |
| 2 | RDL 813 | Cardiovascualar Radiology | 14 |
| 3 | RDL 822 | Musculoskeletal Radiology | 16 |
| 4 | RDL 815 | Gastrointestinal and abdominal Radiology | 20 |
| 5 | RDL 816 | Obstetric and Gynaeological Radiology | 16 |
| 6 | RDL 826 | Urogenital | 12 |
| 7 | RDL 821 | Head and Neck Radiology | 16 |
| 9 | RDL 831 | Paediatric Radiology | 16 |
| 10 | RDL 824 | Interventional radiology | 14 |
| 11 | RDL 812 | Breast imaging | 10 |

| | | | |
|---|---|---|---|
| 12 | RDL 825 | Neuro Radiology | 18 |
| 11 | RDL 823 | Emergency Radiology | 18 |
| 14 | RDL 832 | Oncology imaging | 12 |
| | | ***Subtotal*** | ***202*** |
| | | **MD Programme** | |
| 14 | RDL 912 | Breast Radiology | 2 |
| 15 | RDL 913 | Cardiac Radiology | 2 |
| 16 | RDL 914 | Chest Radiology | 2 |
| 17 | RDL 915 | Gastrointestinal & Abdominal Radiology | 2 |
| 18 | RDL 921 | Head & Neck Radiology | 2 |
| 19 | RDL 924 | Interventional Radiology | 2 |
| 20 | RDL 922 | Musculoskeletal | 2 |
| 21 | RDL 925 | Neuroradiology | 2 |
| 22 | RDL 931 | Paediatric Radiology | 2 |
| 23 | RDL926 | Urogenital Radiology | 2 |
| 24 | RDL938 | Forensic & Medicolegal Radiology | 2 |
| 25 | RDL 933 | Nuclear Medicine | 2 |
| | | **Health Research & Management** | |
| 26 | CBC 802 | Research Methodology in medicine | 2 |
| 27 | CBC 803 | Health Resources Management | 2 |
| 28 | RDL 939 | Seminars | 6 |
| 28 | RDL 940 | Dissertation | 12 |
| | | **Subtotal** | 22 |

**TOTAL CREDIT UNIT = Sub-total for Clinical Radiology 2 plus Sub-total for Health Research & Management plus the Credit Unit for the Subspecialty**

**For instance for a Resident who is specializing in Paediatric Radiology the total credit unit is 160 (for clinical radiology 2) + 34 (for Health Research and management) + 100 (for Paediatric radiology subspecialty) = 294**

# COURSE NAME – CLINICAL RADIOLOGY 2

## A. COURSE CODE: RDL 814 COURSE TITLE CHEST RADIOLOGY 2

**Course Units (20 UNITS)**

| | COURSE TITLE | DELIVERY MODE | ASSESSMENT METHOD | COURSE UNITS |
|---|---|---|---|---|
| 1 | **SOLITARY AND MULTIPLE PULMONARY NODULES** | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2 |
| 2 | **RADIOLOGY OF BENIGN AND MALIGNANT LUNG TUMOURS** | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2 |
| 3 | **RADIOLOGY OF INFLAMMATORY, INFECTIOUS LUNG DISEASES** | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2 |
| 4 | **AIRWAYS, OBSTRUCTIVE & INTERSTITIAL LUNG DISEASE** | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2 |
| 5 | **THORACIC DISEASE IN IMMUNOCOMPETENT, IMMUNOCOMPROMISED AND POSTTRANSPLANT PATIENTS** | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2 |
| 6 | **CONGENITAL ANOMALIES AND PULMONARY VASCULAR DISEASE** | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2 |
| 7 | **AIRWAYS AND OBSTRUCTIVE LUNG DISEASE** | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY | 2 |

| | | | | |
|---|---|---|---|---|
| | | Assignments, Conferences | LOG BOOK | |
| 8 | **INTERSTITIAL LUNG DISEASE** | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1 |
| 9 | **PLEURA AND THE DIAPHRAGM** | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 2 |
| 10 | **MEDIASTINAL AND HILAR DISEASE** | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1 |
| 11. | **THORACIC AORTA AND THE GREAT VESSELS** | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1 |
| 12. | **CHEST TRAUMA AND POST-OPERATIVE CHEST»** | Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences | MCQ, SAQ, OSCE, MCQ, SAQ, ESSAY LOG BOOK | 1 |
| | **SUBTOTAL** | | | **20** |

**CHEST RADIOLOGY (20 UNITS) COURSE CONTENT**

**SOLITARY AND MULTIPLE PULMONARY NODULES**

- Imaging differential investigation of solitary pulmonary nodules and a pulmonary masses
- Advanced imaging of solitary and multiple pulmonary nodules
- Strategies for managing a solitary pulmonary nodule detected incidentally
- Imaging features of benignity of a solitary, cavitary and multiple pulmonary nodule
- Imaging features of benignity of a solitary, cavitary and multiple pulmonary nodule
- Differential diagnosis of solitary benign pulmonary nodules
- Differential diagnosis of solitary malignant pulmonary nodules
- Differential diagnosis of multiple benign pulmonary nodules
- Differential diagnosis of multiple malignant pulmonary nodules
- Complications of percutaneous lung biopsy and their frequency
- Percutaneous lung biopsies for solitary and multiple pulmonary nodes

- Chest tube placement as a treatment for pneumothorax related to percutaneous lung biopsies

**RADIOLOGY OF BENIGN AND MALIGNANT LUNG TUMOURS**

- Radiology of bronchogenic carcinoma, and the differentials of malignant lung diseases.
- Aetiologies of mediastinal shift on a post-pneumonectomy chest
- Imaging appearance of acute and chronic radiation injury in the thorax (lung, pleura, pericardium).
- Detailed roles of CT and MRI in lung cancer staging.
- Role of positron emission tomography (PET) and integrated PET-CT in lung cancer staging.
- Manifestations and the role of imaging in thoracic lymphoma »
- Discussion on most common extrathoracic metastatic sites for lung cancer

**RADIOLOGY OF INFLAMMATORY, INFECTIOUS LUNG DISEASES**

- Pulmonary consolidation and pneumonias
- Adult (acute) respiratory distress syndrome »
- Tuberculosis and differential diagnoses
- Fungal pulmonary diseases and differential diagnoses
- Cavitary lung diseases
- Emphysema »
- Destroyed lung syndrome, giant bullectomy or lung volume reduction surgery »
- Imaging causes and patterns of segmental and lobar consolidation »
- Imaging features and differential diagnosis of atelectasis
- Differentiation of various types of pleural effusion causing atelectasis.
- Imaging features of bronchiectasis on chest radiographs and chest CT.

**AIRWAYS, OBSTRUCTIVE & INTERSTITIAL LUNG DISEASE**

- Imaging signs (direct and indirect) of small airways disease
- Typical imaging patterns and basic clinical features of cystic fibrosis
- Causes and imaging features of tracheal and bronchial stenoses
- Clinical and imaging features of pulmonary emphysema
- Unilateral hyperlucent lung and its differential diagnosis of Chest Radiograph and CT
- Radiological pathological correlation of pulmonary lobule in relation to HRCT
- Aetiopathogenesis and pathophysiology of the following imaging patterns:
    - Lung consolidation - Ground glass opacity, linear and reticular pattern
    - Honeycombing nodular pattern
    - Bronchiolar opacities (“tree-in-bud”)
    - Air trapping
    - Cysts and cyst-like conditions
    - Mosaic attenuation pattern »
    - Crazy-paving pattern

## THORACIC DISEASE IN IMMUNOCOMPETENT, IMMUNOCOMPROMISED AND POSTTRANSPLANT PATIENTS

- Radiological manifestations of pulmonary mycobacterial infections
- Pulmonary aspergillosis, and related conditions
- Pulmonary manifestation of lung tumous in immunocompromised patient.
- Infections and tumours in patients with AIDS
- Imaging features and clinical manifestations of Pneumocystis jiroveci pneumonia.
- Causes and aetiopathogenesis of hilar and mediastinal adenopathy in patients with AIDS.
- Differential diagnoses for widespread consolidation in an immunocompromised host.
- Clinical and imaging features of post-transplant lymphoproliferative disorders.
- Clinical and imaging features of graft-versus-host disease
- Invasive aspergillosis in an immunosuppressed patient and the halo sign

## CONGENITAL ANOMALIES AND PULMONARY VASCULAR DISEASE

- Aetiopathogenesis and imaging manifestations of pulmonary artery hypertension
- Role of imaging (CTPA, MRI/MRA, Doppler and venous studies in the evaluation of suspected venous thromboembolic disease.
- Causes, imaging features and differential diagnosis of enlarged hilar lymph nodes.
- Clinical and features of acute and chronic lobar and segmental pulmonary emboli on plain film, CT, CT angiography and MRI.
- Aetiopathogenesis and imaging feature of vascular redistribution seen in raised pulmonary venous pressure.
- Imaging features of congenital vascular anomalies of the chest
- Imaging features of intralobar pulmonary sequestration and cystic adenomatoid malformation
- Imaging features of bronchial atresia and other congenital diseases of the pulmonary system

## AIRWAYS AND OBSTRUCTIVE LUNG DISEASE

- Clinical and imaging features of bronchiectasis and their causes
- Aetiopathogenesis, clinical and imaging features of bronchial asthma
- Aetiopathogenesis, clinical and imaging features of chronic bronchitis
- Imaging features of tracheal abnormalities
- Imaging features of other chronic obstructive pulmonary disease .
- Pulmonary asthma and different forms of bronchitis
- Advanced aetiopathogenesis emphysema and Bronchiectasis

## INTERSTITIAL LUNG DISEASE

- Imaging patterns of interstitial lung disease including lung consolidation, ground glass opacities, nodular patterns, reticular patterns, cystic patterns and widespread septal lines.
- Advanced imaging patterns of interstitial lung disease according to zonal predominance.
- Imaging features and causes of cysts and cyst-like pattern of lung diseases
- Imaging features and causes of airspace consolidation
- Imaging features and causes of tree-in-bud pattern of lung disease

- Imaging features and causes of honeycomb lung
- Imaging features and reticular pattern of lung diseases

**PLEURA AND THE DIAPHRAGM**

- Imaging assessment and appearance of pleural effusion on ultrasound »
- Imaging features and basic clinical features of malignant mesothelioma.
- Congenital and acquired abnormalities of the diaphragm
- Asbestos-related pleural disease", "asbestosis", and their imaging findings.
- Imaging features and basic clinical features of progressive massive fibrosis and conglomerate masses secondary to silicosis or coal worker's pneumoconiosis.
- Imaging features and basic clinical features of other pneumoconiosis
- Imaging features of pleural thickening and pleural calcifications
- Empyema thoracis

**MEDIASTINAL AND HILAR DISEASE**

- Anterior mediastinal masses and their imaging manifestation
- Middle mediastinal masses and their imaging manifestation
- Posterior mediastinal masses and their imaging manifestation
- Sarcoidosis and differential diagnosis
- Causes of bilateral hilar lymph node enlargement »
- Differential diagnosis of "egg-shell" calcified lymph nodes in the chest »
- Thymomas, Thymic masses and their imaging
- To list and describe the most common causes of a mass arising in the thymus »
- Malignant germ cell tumour of the mediastinum »
- Mechanisms and imaging signs of pneumomediastinum »
- To describe the imaging appearances of normal vessels or vascular abnormalities that may mimic a solid mass »
- Mediastinal and hilar lymphadenopathy on chest radiographs, chest CT and chest MRI »
- Imaging signs of a benign cystic teratoma »
- Imaging signs of an intrathoracic thyroid mass »
- Bronchogenic pericardial, thymic or oesophageal duplication cyst

**THORACIC AORTA AND THE GREAT VESSELS »**

- Right aortic arch with mirror image branching versus an aberrant subclavian artery »
- Detailed imaging study (CT, MRI/MRA and trans-oesophageal echocardiography) in the evaluation of the thoracic aorta »
- "Aneurysm" and "pseudoaneurysm" of the aorta »
- Aortic dissection, aortic intramural haematoma, penetrating atherosclerotic ulcer
- Imaging features of aberrant subclavian artery
- Imaging features of arteritis of the aorta

**CHEST TRAUMA AND POST-OPERATIVE CHEST»**

- Causes of abnormal lung opacity following chest trauma

- Pneumomediastinum following trauma »
- Aetiology and causes of widened mediastinum following chest trauma
- Imaging signs of direct and direct signs of aortic injury on contrast-enhanced chest CT »
- Imaging features of chronic traumatic pseudoaneurysm on chest radiographs, chest CT or chest MRI »
- Diaphragmatic rupture and abnormalities following chest trauma
- Imaging features of a pneumothorax and pneumomediastinum following trauma
- Imaging features and causes of cavitary lesions following trauma on chest radiographs or chest CT
- Distinction between pulmonary contusion, laceration and aspiration
- Postoperative findings and complications of the following procedures on chest radiographs, chest CT and chest MRI:

- Wedge resection mastectomy and lobectomy,
- Pneumonectomy,
- Coronary artery bypass graft surgery,
- Cardiac valve replacement,
- Aortic graft and Aortic stent,
- Transhiatal oesophagectomy,
- Lung transplant,
- Heart transplant,
- Lung volume reduction surgery

**EXPECTED SKILL TO BE ACQUIRED**

- To prepare a patient for chest CT including indication, venous access and beta-blocking »
- To enable choice of optimal acquisition parameters for chest CT »
- To choose optimal post-processing tools for chest CT »
- To manage procedural complications in the diagnosis and treatment of chest disease »
- To design and optimize CT protocols and to adapt these protocols to evaluate each of the following, taking into account the patient's age: - Thoracic aorta and great vessels, - Superior vena cava and brachiocephalic vein stenosis or obstruction, - Pulmonary embolism, - Diffuse lung disease, - Tracheobronchial tree, - Bronchiectasis, - Small airway disease, - Lung cancer staging, - Oesophageal cancer staging , - Superior sulcus tumour, - Pulmonary metastases, - Pulmonary nodule on a radiograph, - Shortness of breath , - Haemoptysis »
- To confidently perform a radiological staging of bronchogenic cancer »
- To perform the following imaging-guided transthoracic interventions under appropriate supervision, to understand the indications and contraindications, and to manage the complications: Paracentesis and drainage of pleural effusions, - Percutaneous lung biopsy, - Paracentesis of mediastinal and pericardial fluid collections, - Drainage of refractory lung abscess »
- To apply inspiratory and expiratory imaging depending on the clinical indication »

**COMPETENCES AND ATTITUES**

- To confidently justify diagnostic imaging examinations (including CT and MRI) and/or interventional procedures of the chest

- To confidently choose the best-suited method for evaluating disorders of the chest
- To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and interventional procedures of the chest
- To choose optimal imaging protocols for radiographic, ultrasonographic, CT and MRI examinations of the chest
- To create and apply protocols and standard operating procedures to reduce exposure doses for radiological examinations of the chest
- To confidently supervise and teach technical staff to ensure that appropriate images are obtained for all radiological methods pertaining to chest imaging
- To confidently judge the quality of the imaging examinations in chest imaging and to devise strategies to improve image quality
- To confidently interpret and report chest CT for common clinical indications
- To interpret and report chest CT under supervision for rare clinical indications
- Making a specific diagnosis of interstitial lung disease (ILD) when HRCT appearances are characteristic
- To confidently interpret and report chest MRI for common clinical indications
- To interpret and report chest MRI under suprvision for rare clinical indications
- To confidently report radiographic examinations of the chest for common and rare diseases
- To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the chest
- To confidently identify urgent and/or unexpected findings in imaging examinations of the chest and to communicate these timely and properly
- To communicate with patients and their relatives in order to explain their imaging findings of the chest
- To communicate with referring clinicians to discuss radiological findings of the chest
- To perform at multi-disciplinary conferences and tumour boards for diseases of the chest

**CARDIAC AND VASCULAR RADIOLOGY 2 (14 UNITS)**

| COURSE CODE | | COURSE TITLE | COURSE UNIT |
|---|---|---|---|
| RDL | 813 | Congenital heart disease | 2 |
| | | Advanced image acquisition and positioning | 2 |
| | | Disease of the coronary arteries and major vessels | 3 |
| | | Disease of the myocardium, peri- and endocardium, heart valves | 3 |
| | | Post-procedural cardiac and radiology | 2 |
| | | Peripheral Vascular diseases | 2 |
| | | **SUBTOTAL** | 14 |

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**COURSE CONTENT CARDIC AND VASCULAR DISEASES (15 UNITS)**

**CONGENITAL HEART DISEASES**

- Basic embryological principles of the cardiovascular system
- Imaging features and clinical features of congenital heart disease in neonates
- Imaging features and clinical features of congenital heart disease in adolescence
- Imaging features and clinical features of congenital heart disease in adults
- Imaging features of congenital vascular anomalies of the cardiovascular system

**ADVANCED IMAGE ACQUISITION AND POSTPROCESSING**

- Detailed knowledge of the indications, contraindications and potential hazards (especially radiation hazards) of procedures and techniques relevant to cardiovascular disease
- The role of alternative cardiac assessment tools, including SPECT, stress test, echocardiography
- Principles uses and limitations of nuclear cardiac imaging
- Principles uses and limitations of intravascular imaging in cardiovascular disorders
- Principles uses and limitations of cardiac stress testing including exercise stress testing, stress testing in cardiac imaging.
- Relative costs of the various imaging examinations in cardiac imaging
- Principles of cardiac CT acquisition including the principles of multi-detector-CT
- Principles of ECG gating for cardiac CT and MRI
- Contrast bolus timing as it pertains to cardiac CT and MRI
- Axial multi-planar reconstructions (MPR), maximum intensity projection (MIP) and volume rendering principles as they apply to cardiac CT and MRI
- principles and techniques of coronary calcification scoring (calcium scoring)
- limitations of coronary calcification scoring and the epidemiological implications

## DISEASE OF THE CORONARY ARTERIES AND MAJORS VESSELS

- Imaging features and basic clinical features of coronary artery disease, including acute coronary syndromes, myocardial ischaemia, myocardial infarction, post myocardial infarction syndromes, ventricular aneurysms, common and unusual causes of coronary artery disease including various forms of arteritis, hibernating/stunned myocardium»
- Imaging presentations of acquired atherosclerosis, including coronary calcification on coronary CTA »
- Aetiopathogenesis understanding of acquired cardiovascular disease
- manifestations of cardiovascular disease, including trauma, as demonstrated by conventional radiography, CT, MRI, angiography, radionuclide investigations and ultrasound »
- differential diagnosis relevant to clinical presentation and imaging features of cardiovascular disease »
- Imaging features and basic clinical features of diseases of the major vessels, including thoracic aneurysm, acute and chronic aortic dissection (including classification), Marfan's syndrome, and Takayasu disease

## DISEASES OF MYOCARDIUM, PERI- AND ENDOCARDIUM, HEART VALVES

- Imaging features and basic clinical features of cardiac tumours including intracardiac tumours (myxommas, haemangiomas, sarcomas), primary cardiac tumors (myxomas, haemangiomas, sarcomas), secondary/ metastatic cardiac tumours
- Imaging features and basic clinical features of cardiomyopathy
- Imaging features and basic clinical features of diabetic and renal heart disease
- Sudden-death syndromes in young men and otherAge- and gender-related cardiac syndromes
- Imaging features and clinical correlates of valvular heart disease (rheumatic or postrheumatic valve disease, stenosis and incompetence of cardiac valves, endocarditis, sub- and supravalvular disease, subvalvular apparatus disease)
- Imaging features and basic clinical features of pericardial disease
- Imaging features and basic clinical features of athlete's heart
- Principles and practice of screening techniques and risk factors in cardiac disease

## POST-PROCEDURAL CARDIAC AND VASCULAR RADIOLOGY

- Pathophysiology, differential diagnosis and treatment of pseudoaneurysm formation following invasive cardiac procedures
- The role of the various treatments available for both congenital and acquired cardiac disease, including coronary artery disease
- Typical imaging features and basic clinical features after by-pass grafts, valve replacement, aortic replacements, ventricular surgery, pericardiectomy
- Imaging features and basic clinical features of pericardial disease including acute and chronic pericarditis and malignant cardiac disease

**PERIPHERAL VASCULAR DISEASES**

- Basic pathological and pathophysiological understanding of congenital and acquired vascular disease
- Manifestations of vascular disease, including trauma, as demonstrated by conventional radiography, CT, MRI, angiography, radionuclide investigations and ultrasound »
- Differential diagnosis relevant to clinical presentation and imaging features of vascular disease »
- Imaging features and basic clinical features of diseases of the vessels, including thoracic aneurysm, stenosis, atherosclerosis, varicosities, acute and chronic aortic dissection (including classification), Marfan's syndrome, and Takayasu disease, diabetic diseases of the vessels.
- Imaging features and basic clinical features of diseases of the peripheral blood vessels, arteries, capillaries and veins including the great veins

## EXPECTED SKILLS TO BE ACQUIRED

- How to  prepare a patient for cardiac CT including indication, venous access and beta-blocking »
- Ability to choose optimal acquisition parameters for cardiac CT.
- To choose optimal post-processing tools for cardiac CT.
- To prepare a patient for cardiac MRI including indication, venous access and medication (e.g. stress testing).
- To choose optimal acquisition parameters for cardiac MRI.
- How to choose optimal post-processing tools for cardiac MRI.
- How to apply ECG gating for cardiac CT and MRI.
- To perform an optimal contrast bolus timing for cardiac CT and MRI
- To perform coronary calcification scoring;
- To manage procedural complications in the diagnosis and treatment of cardiac disease
- To manage patients undergoing stress testing for cardiac imaging
- To confidently perform ultrasound examinations of arteries and veins
- To independently perform post-processing tasks for cardiac and vascular imaging studies, including multi-planar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (MinIP), volume rendering tools (VRT) and vessel analysis tools
- To confidently perform femoral artery and venous puncture techniques
- To confidently treat femoral artery pseudoaneurysm

## COMPETENCES AND ATTITUDES

- To confidently justify diagnostic imaging examinations (including CT and MRI) and/or interventional procedures of the cardiac and vascular systems
- To confidently choose the best-suited method for evaluating disorders of the cardiac and vascular systems
- To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and interventional procedures of the cardiac, vascular and lymphatic systems
- To choose optimal imaging protocols for radiographic, ultrasonographic, CT and MRI examinations of the cardiac and vascular systems
- To create and apply protocols and standard operating procedures to reduce exposure doses for radiological examinations of the cardiac and vascular systems
- To confidently supervise and teach technical staff to ensure that appropriate images are obtained for all radiological methods pertaining to cardiac and vascular imaging
- To confidently judge the quality of the imaging examinations in cardiac imaging and to devise strategies to improve image quality
- To confidently interpret and report cardiac CT for common clinical indications
- To interpret and report cardiac CT under supervision for rare clinical indications
- To confidently interpret and report cardiac MRI for common clinical indications
- To interpret and report cardiac MRI under supervision for rare clinical indications
- To confidently report radiographic examinations of the cardiac and vascular systems for common and rare diseases

- To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the cardiac and vascular systems
- To confidently identify urgent and/or unexpected findings in imaging examinations of the cardiac and vascular systems and to communicate these timely and properly
- To communicate with patients and their relatives in order to explain their imaging findings of the cardiac and vascular systems
- To communicate with referring clinicians to discuss radiological findings of the cardiac and vascular systems
- To perform at multi-disciplinary conferences and tumour boards for diseases of the cardiac and vascular systems

## B. MUSCULOSKELETAL DISEASE (16 UNITS)

| S/No | Course Code RDL 822 | COURSE TITLE | CREDIT UNIT |
|---|---|---|---|
| 1. | | Trauma – acute and chronic | 3 |
| | | Infections | 2 |
| 2. | | Tumours and tumour-like lesions | 2 |
| 3. | | Haematological disorders | 2 |
| 4. | | Metabolic, endocrine and toxic disorders | 2 |
| 5. | | Joints | 2 |
| 6. | | Congenital, developmental and paediatric | 2 |
| 7. | | Miscellaneous | 1 |
| | | **SUBTOTAL** | 16 |

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**LECTURE TOPICS IN MUSCULOSKELETAL SYSTEM (20 UNITS)**

**TRAUMA – ACUTE AND CHRONIC**

- Imaging features and basic clinical features of fractures and dislocations in the adult skeleton
- Imaging features and basic clinical features of fractures and dislocations in the immature skeleton
- Articular fractures and dislocations including chondral and osteochondral lesions and osteochondritis dissecans
- Advanced imaging of delayed union, non-union, avascular necrosis, reflex sympathetic dystrophy / complex regional pain syndrome, and myositis ossificans
- Stress fractures, fatigue and insufficiency fractures
- Imaging features and basic clinical features of avulsion fractures
- Imaging features, imaging strategies and basic clinical features of pathological, and non accidental injury
- Advanced imaging of upper limb fractures and dislocations
- Pelvic fractures and including associated soft tissue injuries
- Advanced imaging of lower limb fractures and dislocations
- To describe the typical imaging features and basic clinical features of fractures and dislocations of lower limb including hip fractures and dislocations, femoral fractures, tibial and fibular fractures (including the ankle joint), hindfoot fractures, tarso-metatarsal fractures and dislocations and forefoot fractures and dislocations
- To describe the typical imaging features and basic clinical features of soft tissue injuries of the shoulder, including rotator cuff injuries, glenoid labrum injuries and biceps tendon injuries

- Bone and soft tissue injuries of the knee, including meniscal injury, cruciate ligament injury, and collateral ligament injury
- Bone and soft tissue injuries of the ankle including injuries of the principal tendons and ligament

**INFECTIONS**

- Acute, subacute and chronic osteomyelitis bones and spine
- Post-traumatic and postoperative osteomyelitis
- Tuberculosis infections of the musculoskeletal system
- Pyogenic and fungal spondylitis
- Clinical and imaging features of leprosy, brucellosis and other rare infections)
- Clinical and imaging features of parasites worldwide (e.g. echinococcus)
  - Clinical and imaging features of HIV-associated infections

**TUMOURS AND TUMOUR-LIKE LESIONS**

- Osteoid osteoma, osteoblastoma and osteosarcoma.
- Osteochondroma, enchondroma, chondroblastoma, chondromyxoid fibroma, and chondrosarcoma (central and peripheral)
- Fibrous cortical defects,non-ossifying fibroma, fibrous dysplasia, fibrosarcoma and malignant fibrous histiocytoma
- Giant cell tumour, Langerhans cell histiocytosis, malignant round cell tumours (Ewing's sarcoma.
- Simple bone cysts and aneurismal bone cysts
- Imaging features, principles of tumour characterisation and staging of metastases
- Imaging recognitions of "don't touch" lesions
- Chordoma, adamantinoma, lipoma, liposarcom
- To understand and describe the typical imaging features, principles of tumour characterisation and staging of adamantinoma
- To understand and describe the typical imaging features, principles of tumour characterisation and staging of tumours of fat origin, including lipoma and liposarcoma
- Neurofibroma and schwannoma
- Haemangioma and soft tissue sarcomas

**HAEMATOLOGICAL DISORDERS**

- Imaging features and clinical features of haemoglobinopathies including sickle cell disease and thalassaemia and other haemoglobinopathies
- Imaging features and basic clinical features of myelofibrosis and myeloscleoris
- Lymphoma and leukaemia), myeloma and plasmocytoma

**METABOLIC, ENDOCRINE AND TOXIC DISORDERS**

- Imaging and clinical features of rickets and osteomalacia
- Imaging and clinical features of primary and secondary hyperparathyroidism (including chronic renal failure)

- Aetiopathogenesis and imaging and clinical features of osteoporosis (including basic concepts of bone mineral density measurements), and fluorosis

**JOINTS**

- Detailed imaging and clinical features of degenerative disease of the spine, disc and facet joints
- Detailed imaging and clinical features of degenerative disease of the peripheral joints
- Detailed imaging and clinical features of inflammatory joint disease, including rheumatoid arthritis, juvenile rheumatoid arthritis, ankylosing spondylitis, psoriatic arthritis, enteropathic arthropathies, and infective arthritis (pyogenic and tuberculous)
- Detailed imaging and clinical features of crystal arthropathies, including pyrophosphate arthropathy, hydroxyapatite deposition disease, and gout
- Detailed imaging and clinical features of masses of the joints, including, ganglion, synovial chondromatosis, and pigmented villonodular synovitis
- Detailed imaging and clinical features of neuroarthropathy, including diabetic foot, Charcot's joints, Pseudo-Charcot joint (steroid-induced)
    - Clinical and imaging features of complications of prosthetic joint replacement (hip and knee

**CONGENITAL, DEVELOPMENTAL AND PAEDIATRIC**

- Imaging and clinical features of congenital disorders of the spine, including scoliosis (congenital and idiopathic), and dysraphism
- Imaging and clinical features of congenital disorders of the shoulder, including Sprengel's deformity
- Imaging and clinical features of congenital disorders of the hand and wrist, including Madelung deformity (idiopathic and other causes)
- Imaging and clinical features of congenital disorders of the hip, including developmental dysplasia, irritable hip, Perthes disease, slipped upper femoral epiphysis
- Imaging and clinical features of femoroacetabular impingement
- Imaging and clinical features of congenital disorders of the ankle and foot
- Imaging and clinical features of congenital tarsal coalition
- Imaging and clinical features of bone dysplasias
- Imaging and clinical features of congenital disorders of multiple epiphyseal dysplasia
- To describe the imaging features and basic clinical features of congenital disorders of achondroplasia
- Imaging and clinical features of congenital disorders of osteogenesis imperfecta
- Imaging and clinical features of congenital disorders of the sclerosing disorders of the bone, including osteopetrosis, melorheostosis and osteopoikilosis
- Imaging and clinical features of tumour-like lesions in the paediatric age group, including diaphyseal aclasis and Ollier's disease

**MISCELLANEOUS**

- Clinical and imaging features of Paget's disease
- Clinical and imaging features of sarcoidosis
- Clinical and imaging features of hypertrophic osteoarthropathy

- Clinical and imaging features of transient or regional migratory osteoporosis
- Clinical and imaging features of osteonecrosis
- Clinical and imaging features and relevance of various types of soft tissue calcification/ossification

**EXPECTED SKILLS TO BE ACQUIRED**

- To choose the most appropriate imaging examination according to the clinical problem in musculoskeletal imaging
- To choose the most suitable contrast material and its optimal use according to the imaging technique and the clinical problem in musculoskeletal imaging
- To perform dynamic functional studies of the spine and joints
- To perform a correct positioning for radiography of the spine and of the extremities including special views
- To perform ultrasound of the musculoskeletal system
- To perform image-guided biopsies in the musculoskeletal system in easy cases
- To observe and/or perform under supervision image-guided biopsies in the musculoskeletal system in more complex cases
- To confidently plan a CT examination of the musculoskeletal system and to tailor it to the individual situation, with a dose as low as reasonably achievable
- To confidently plan an MRI examination of the musculoskeletal system and to tailor it to the individual situation in regard to the potential use of intravenous contrast medium and spatial resolution
- To perform contrast media applications in various joints, including the hip, shoulder and wrist for MR arthrography or CT arthrography
- To observe and/or to perform under supervision discography, facet joint injections and vertebroplasty
- To observe and/or to perform under supervision image-guided bone biopsy and drainage of the musculoskeletal system
- To confidently perform proper post-processing tasks of musculoskeletal imaging studies, including multi-planar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (MinIP), and fusion images

**COMPETENCES AND ATTITUDES**

- To confidently justify diagnostic imaging examinations and/or interventional procedures of the musculoskeletal system
- To confidently choose the best-suited method for evaluating disorders of the musculoskeletal system
- To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and interventional procedures of the musculoskeletal system
- To confidently choose optimal imaging parameters for radiographic, ultrasonographic, CT and MRI examinations of the musculoskeletal system
- To confidently apply techniques to reduce exposure doses for radiographic and CT examinations of the musculoskeletal system

- To confidently design imaging protocols and standard operating procedures for CT examinations of the musculoskeletal system, including the appropriate application of intravenous contrast, positioning, spatial and temporal resolution
- To confidently design imaging protocols and standard operating procedures for MRI examinations of the musculoskeletal system, positioning, including the appropriate application of intravenous contrast, spatial and temporal resolution
- To supervise and teach technical staff to ensure that appropriate images of the musculoskeletal system are obtained
- To confidently judge the quality of imaging examinations in musculoskeletal imaging and to devise strategies to improve image quality
- To confidently interpret and report radiographs, ultrasonographic examinations, osteodensitometric studies, CT studies and MRI examinations of the musculoskeletal system
- To report oncological studies of the musculoskeletal system according to international standards (RECIST, WHO) applicable to the specific situation
- To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the musculoskeletal system
- To confidently identify urgent and/or unexpected findings in imaging examinations of the musculoskeletal system and to communicate these timely and properly
- To communicate with patients and their relatives in order to explain their imaging findings of the musculoskeletal system
- To perform at multi-disciplinary conferences and tumour boards for diseases of the musculoskeletal system

## C. GASTROINTESTINAL AND ABDOMINAL RADIOLOGY 2 (20 UNITS)

| S/No | Course Code RDL 815 | COURSE TITLE | CREDIT UNIT |
|---|---|---|---|
| 1 | | Imaging techniques-General requirements | 2 |
| 2 | | Oesophagus | 2 |
| 3 | | Stomach and duodenum | 2 |
| 4 | | Small bowel | 2 |
| 5 | | Colon and rectum | 2 |
| 6 | | Peritoneum and abdominal wall | 1 |
| 7 | | Abdominal vessels | 2 |

| | | |
|---|---|---|
| 8 | Liver | 2 |
| 9 | Biliary tract | 2 |
| 10 | Pancreas | 2 |
| 11 | Spleen | 1 |
| | **SUBTOTAL** | **20** |

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**LECTURE TOPICS IN GASTROINTESTINAL AND ABDOMINAL RADIOLOGY**

**KNOWLEDGE**

**IMAGING TECHNIQUES – GENERAL REQUIREMENTS**

- Advanced indications and contraindications for the various imaging examinations in abdominal imaging
- Details of costs-benefits of the various imaging examinations in abdominal imaging
- Detailed radiation burden and risks of different investigations in abdominal imaging
- Advanced contrast studies and enema techniques
- Detailed knowledge of contrast-enhanced ultrasound study of the liver and other abdominal organs
- Techniques for quantification of diseases using ultrasound, CT and MRI, and their clinical role and limitations.
- Detailed knowledge of endosonography techniques
- Detailed knowledge of techniques for CT colonography, CT/MR enterography and CT/MR enteroclysis
- Role for post-processing images in view of obtaining reformatting, MIP, MinIP, vessel analysis, 3D analysis
- Endoluminal reconstructions, fusion images, as well as acquisition and postprocessing of functional studies
- Detailed technique of PET-CT, (FDG, choline) in abdominal tumours, and liver metastases of extra-abdominal origin
- Basic technique for ablation of liver tumours using ultrasound and/or CT guidance
- Detailed knowledge of technique of trans-jugular liver biopsy
- Principle and results of transarterial chemoembolisation
- Principles of and Detailed knowledge of therapeutic embolisation techniques used in abdominal imaging

**OESOPHAGUS**

- Imaging features of benign and malignant tumors of the oesophagus
- Inflammatory oesophageal lesion fistulae, oesophagitis, benign and malignant strictures, infections and infestations

- Oesophageal hernias; sliding and para-oesophageal hiatus hernia, oesophageal varices
- Barrett's oesophagus and the clinical manifestations of this disease »
- Clinical and imaging appearances of common motility disorders »
- Role of PET or PET-CT in the staging of oesophageal cancer »
- Post-surgical appearances on imaging examinations
- Oesophageal cancer and imaging criteria for non-resectability and lymph node involvement »
- Endoscopic ultrasound in the staging of oesophageal cancer and the technique of endoscopic ultrasound-guided biopsy.

**STOMACH AND DUODENUM**

- Imaging suspected perforation of the stomach and postoperative follow-up
- Endoscopic ultrasound and PET or PET-CT in the staging of gastric cancer
- Imaging protocol (CT, MRI, US) for gastric cancer staging »
- Imaging pre- and post-surgical treatment of obesity and complications
- Surgical procedures for the treatment of obesity
- Imaging and clinical features of benign gastric tumours
- Imaging and clinical features of malignant gastric tumours
- Imaging and clinical features of infiltrative disorders (gastric ulcers, linitis plastica, gastric ulcers)
- Positional abnormalities of the stomach including gastric volvulus and gastric hernia
- Duplication cysts and other cystic conditions of the upper gastrointestinal tract on CT
- Advanced imaging of gastroduodenal disease on ultrasound
- Imaging peptic ulcer disease and other inflammatory conditions of the duodenum
- Abnormalities of the duodenum, annular pancreas, submucosal tumours and papillary tumours

**SMALL BOWEL**

- Imaging examination and features of various causes and forms of small bowel obstruction
- Inflammatory small bowel diverticulosis, infections and infiltrative disease of small bowel
- Small bowel ischaemia, haematoma, fistula, perforation and post-operative follow up imaging
- Imaging and clinical features of small bowel lymphoma, carcinoid tumour
- MRI and CT techniques of enterography and enteroclysis
- Detailed description of capsule endoscopy, virtual endoscopy, CT and MRI examination
- Small bowel adenocarcinoma, polyposis, stromal tumour, carcinoid tumour
- Crohn's disease, ulcerative colitis, Whipple's disease, amyloidosis, radiation-induced injury, malrotation, Meckel's diverticulum, coeliac disease, diverticulosis and systemic sclerosis
- Detailed understanding of principles of the interpretation of CT/MRI examination of the small bowel

**COLON AND RECTUM**

- Advanced and detailed imaging technique for study of the colon
- Clinical and imaging features of diverticulitis, inflammatory disease, and uncommon disease of the colon
- Clinical and imaging features of benign and malignant disease of the colon including lymphoma
- Clinical and imaging features of large bowel obstruction

- Clinical and imaging features of acute appendicitis
- Clinical and imaging features of large colorectal carcinoma
- Ct colonography in colorectal cancer screening, diagnosis and staging
- Clinical and imaging features of locally recurrent or metastatic colorectal cancer
- Clinical and imaging features of haemorrhoids, rectal fissures, sphincter tera and perianal sepsis
- Crohn's disease, ulcerative colitis and other infective colitis
- clinical and imaging features and differential diagnosis of colonic polyps

**PERITONEUM AND ABDOMINAL WALL**

- Clinical and imaging features of peritoneal disease (nodules, thickening, fluid collection)
- Clinical and imaging features of abdominal wall hernias (inguinal, femoral, umbilical, Spighelian, parastomal, postoperative) on CT and on ultrasound
- Clinical and imaging features of hernial strangulation
- Clinical and imaging features of mesenteric cysts and tumour
- Clinical and imaging features of the following peritoneal diseases: peritonitis, peritoneal carcinomatosis, peritoneal tuberculosis, mesenteric lymphoma, mesenteric and greater omental infarction

**VESSELS**

- Advanced Doppler ultrasound abdominal vessels, stenosis or occlusion
- Advanced Doppler ultrasound of flow in the portal and hepatic veins
- Roles of angiography and CTA, MRA and radionuclide imaging in acute gastrointestinal haemorrhage
- To describe the angiographic and CT appearances of acute haemorrhage and to describe the advantages and limitations of the techniques
- Clinical and imaging features of small bowel ischaemia/infarction on CT
- Clinical and imaging features of of occlusion, stenosis and aneurysms of the mesenteric arteries

**LIVER**

- Clinical and imaging features of vascular diseases of the liver, including Budd–Chiari Syndrome, Osler–Weber disease, portal thrombosis, peliosis and sinusoidal obstruction syndrome
- Clinical and imaging features of cystic disease of the liver and the biliary system
- Clinical and imaging features of liver adenomas and haemangiomas
- Clinical and imaging features and image quantification of homogeneous and heterogeneous liver steatosis

- Clinical and imaging features of hepatocellular carcinoma (HCC), the major techniques and the indications for treatment (surgical resection, chemo- or radioembolisation, percutaneous ablation, liver transplantation, oral targeted therapy)
- Clinical and imaging features of liver metastases
- Clinical and imaging features of peripheral cholangiocarcinoma
- Aetiopathogenesis, image quantification and imaging features of common morphological changes associated with liver cirrhosis, including lobar atrophy or hypertrophy, regeneration nodules, fibrosis
- Clinical and imaging features and quantification of liver iron overload, Wilson disease and related disorders
- Advances percutaneous image-guided liver, current application of diffusion-weighted imaging of the liver and radionucide chemembolization

**BILIARY TRACT**

- Imaging features and sensitivity and specificity parameters of imaging methods for the detection of gall bladder, acute cholecystitis and common bile duct stones
- Clinical and imaging features of cholecystitis and unusual features of cholecystitis such as gangrenous, emphysematous and acalculous cholecystitis on various imaging modalities
- clinical and imaging features of gallbladder cancer their imaging staging
- Clinical and imaging features of adenomyomatosis on ultrasound, CT and MRI
- Cholangiocarcinoma of the liver hilum (Klatskin's tumour), staging, and options for resectability.
- clinical and imaging features of ampullary carcinoma on various advance imaging modalities
- Aetiopathogenesis and imaging features of sclerosing cholangitis and other inflammatory disease of the biliary tract

**PANCREAS**

- Natural history of chronic pancreatitis and to list the common causes
- Imaging features of pancreatic calcifications on plain films, ultrasound and CT
- Anatomical variants of the pancreatic duct (e.g. annular pancreas) and the imaging methods used to diagnose it
- Indications and rationale for functional examinations of the pancreas (e.g. MRCP following secretin stimulation)
- Role and value of clinico-biological (Ranson score, APACHE II) and CT (Balthazar's CT severity score) methods for the grading of acute pancreatitis
- Imaging features of extra-pancreatic fluid collections and phlegmons in the case of acute pancreatitis
- Imaging features of pancreatic adenocarcinoma on ultrasound, CT, MRI and endoscopic ultrasound
- Tumour staging for pancreatic adenocarcinoma including criteria for unresectability
- Imaging features of cystic tumours of the pancreas, mainly serous and mucinous cystadenoma, intraductal mucinous tumours and rare cystic tumours
- Imaging features, tumour characterisation and the indication for follow-up imaging for IPMN
- Various complications of different types of major techniques for pancreatic surgery

- Imaging features of a pancreatic pseudocyst, advantages and limitations of different treatments (follow-up, interventional procedure, percutaneous or endoscopic surgery)

**SPLEEN**

- Clinical and imaging features of lymphoproliferative disorders and their staging
- clinical and imaging features of splenic traumas and focal splenic abnormalities,
- Clinical and imaging features of splenic infection and benign and malignant masses
- Clinical and imaging features splenic calcifications and splenic enlargement

**EXPECTED SKILLS TO BE ACQUIRED**

- To choose the most appropriate imaging examination according to the clinical problem in abdominal imaging
- To choose the most suitable contrast material and its optimal use according to the imaging technique and the clinical problem
- To perform video-fluoroscopy of the swallowing mechanism
- To perform contrast studies of the upper gastrointestinal tract with the most appropriate contrast material
- To perform both single and double contrast studies as well as motility assessments of the gastrointestinal tract
- To perform small bowel follow-through and enteroclysis, including catheter placement beyond the ligament of Treitz, appreciating the importance and degree of filling and distension of small bowel loops
- To perform a double contrast barium enema, a motility assessment and a single contrast enema
- To catheterise a stoma for colon opacification and to perform pouchograms and loopograms
- To confidently plan a CT examination of the abdomen and to tailor it to the individual situation in regard to intravenous contrast medium, rate of injection, dose and delay of the contrast medium and to a potential intraluminal contrast medium application, with a dose as low as reasonably achievable
- To confidently plan an MRI examination of the upper abdomen and to tailor it to the individual situation in regard to the potential use of intravenous contrast medium, rate of injection, dose and delay of the contrast medium, potential intraluminal contrast medium, magnetic resonance cholangiopancreatography (MRCP), and quantification of liver fat/iron
- To confidently plan an MRI examination of the small bowel, rectum and anal canal and to adapt it to the individual situation, including the application of endoluminal contrast
- To apply techniques for quantification of diseases using ultrasound, CT and MRI, based on an in-depth understanding of their clinical role and limitations. »
- To perform MRI and CT enterography and enteroclysis
- To perform ultrasound examinations of the liver, gall bladder, biliary tree, pancreas and spleen
- To perform duplex Doppler examinations of the abdominal vessels; recognising the normal findings of the duplex Doppler study of the hepatic artery, superior mesenteric artery, portal vein and hepatic veins
- To perform ultrasound examinations of the gastrointestinal tract and to identify the various portions (stomach, duodenum, small bowel, appendix and colon)

- To perform ultrasound examinations of the abdomen in patients with suspected inflammatory bowel disease »
- To perform contrast-enhanced ultrasound examinations of the liver under supervision
- To perform liver biopsies under ultrasound or CT guidance under supervision
- To perform biopsies of abdominal tumours with an easy access route under ultrasound or CT guidance
- To drain abdominal abscesses with an easy access route under ultrasound or CT guidance
- To assist and/or perform under supervision image-guided interventions in colon cancer, e.g. colonic stent placement in the case of colonic obstruction
- To assist and/or perform under supervision percutaneous gastrostomy under image guidance
- To assist and/or perform under supervision percutaneous cholecystostomy
- To assist and/or perform under supervision percutaneous biliary interventions
- To assist and/or perform under supervision radiologically guided stenting of the biliary system and gastrointestinal system, using polytetrafluoroethylene and expandable metal stents
- To assist and/or perform under supervision the ablation of liver tumours using ultrasound and/or CT guidance
- To assist and/or perform under supervision trans-jugular liver biopsies
- To assist and/or perform under supervision balloon angioplasty and stenting of the mesenteric arteries for the treatment of stenosis and aneurysms
- To perform under supervision transarterial chemoembolisation and simple embolization for acute abdominal bleeding control
- To assist radio-embolisation procedures
- To perform percutaneous image-guided liver biopsy
- To perform CT colonography
- To perform basic and advanced post-processing tasks for abdominal imaging studies, including maximum intensity projections (MIP), minimum intensity projections (MinIP), volume rendering, vessel analysis tools, endoluminal reconstructions, and fusion images

**COMPETENCES & ATTITUDES**

- To confidently justify diagnostic imaging examinations and/or interventional procedures of the abdomen and/or gastrointestinal system
- To confidently choose the best method for evaluating disorders of the abdomen and/or gastrointestinal system
- To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and interventional procedures of the abdomen and/or gastrointestinal system
- To confidently choose optimal imaging parameters for radiographic, ultrasonographic, CT and MRI examinations of the abdomen and/or gastrointestinal system
- To confidently apply techniques to reduce exposure doses for radiographic and CT examinations of the abdomen
- To confidently design imaging protocols and standard operating procedures for CT examinations of the abdomen and gastrointestinal system, including the appropriate application of intravenous and/or intraluminal contrast, spatial and temporal resolution, and inspiration/expiration/breathhold techniques
- To confidently design imaging protocols and standard operating procedures for MRI examinations of the upper abdomen and gastrointestinal system, including the appropriate

application of intravenous and or intraluminal contrast, spatial and temporal resolution, and inspiration/expiration/breathhold techniques

- To supervise and teach technical staff to ensure that appropriate images are obtained
- To confidently judge the quality of the imaging examinations in abdominal imaging and to devise strategies to improve image quality »To confidently report abdominal radiographs in cases of acute abdomen
- To confidently interpret and report abdominal radiographs, ultrasonographic examinations, abdominal CT studies and MRI examinations of the upper abdomen, small bowel, rectum and anal canal
- To report oncological studies of the abdomen according to international standards (RECIST, WHO) applicable to the specific situation
- To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the abdomen and gastrointestinal system
- To confidently identify urgent and/or unexpected findings in imaging examinations of the abdomen and gastrointestinal system and to communicate these timely and properly
- To communicate with patients and their relatives in order to explain their imaging findings of the abdomen and gastrointestinal system »To perform at multi-disciplinary conferences and tumour boards for diseases of the abdomen and gastrointestinal system

## D. OBSTETRICS AND GYNAECOLOGICAL RADIOLOGY (16 UNITS)

| S/No | Course Code RDL 816 | COURSE TITLE | CREDIT UNIT |
|---|---|---|---|
| 1 | | Uterus and its condition | 5 |
| 2 | | Congenital anomalies | 3 |
| 3 | | Pregnancy | 5 |
| 4 | | Ovaries / adnexe / infertility/pelvic floor | 3 |
| | | **SUBTOTAL** | **16** |

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**LECTURE TOPICS IN OBSTETRICS AND GYANAECOLOGY**

**CONGENITAL ANOMALIES**

- Detailed study of congenital malformations of the uterus
- Detailed study of congenital malformations of the Fallopian tubes
- Detailed study of congenital malformations of the Vagina
- Study of congenital malformations of the genitourinary system
- Detailed study of congenital malformations of intersexuality
- Detailed study of congenital malformations ambiguous genitalia
- Imaging-guided treatments of congenital malformation of genitourinary system

**UTERUS AND ITS CONDITIONS**

- Advanced imaging of transvaginal sonography and hysterosonography and MRI HSG
- Clinical and imaging features benign tumours of the myometrium (uterine fibroids and polyps)
- Clinical and imaging features of malignant tumours of the myometrium
- Clinical and imaging features of the endometrium, their tumours and other abnormalities
- Clinical and imaging features of adenomyosis uteri
- Advances in clinical and imaging features of inflammatory disease of the cervix
- Clinical and imaging features and imaging staging of cervical cancer
- Clinical and imaging features of functional disorders of the cervix
- Clinical and imaging features of endometriosis and adenomyois
- Image-guided therapeutic approaches to uterine leiomyomas
- Imaging features of the uterus after different types of gynaecological surgeries
- Imaging features of the uterus after different types of image-guided therapies
- HSG and fallopian tube catheterization using Conventional Radiography and MRI

**PREGNANCY**

- Clinical and imaging features of uterine disorders associated with pregnancy
- Clinical and imaging features of uterine disorders during delivery

- Transabdominal and/or transvaginal ultrasound in gynaecological disorders
- MRI /or transvaginal ultrasound in gynaecological disorders
- Clinical and imaging features of uterine disorders in the post-partum period
- Image-guided therapeutic approaches in severe post-partum bleeding
- Clinical features and imaging strategies in pregnant patients with symptoms of an acute abdomen
- Principles of MR pelvimetry and important pelvimetric measurements
- Foetal MR imaging technology and MR appearances of stages of embryonic and fetal development

**OVARIES / ADNEXAE / INFERTILITY/PELVIC FLOOR**

- Detailed imaging features and clinical features of ovarian cysts
- Clinical and imaging features of benign solid ovarian tumours
- Clinical and imaging features of malignant ovarian tumours
- Clinical and imaging features of of functional disorders of the ovaries
- Clinical and imaging features of inflammatory disorders of the tubes
- Clinical and imaging features of tumours of the tubes
- Advanced imaging work-up and features of infertility
- Clinical and imaging features of ovarian torsion and other acute ovarian condition
- Changes and disorders of the ovaries associated with pregnancy and the post-partum period
- Clinical and imaging features of ovaries after different types of gynaecological surgeries
- Imaging features of the ovaries after different types of image-guided therapies
- Advanced imaging techniques for detailed visualization of the female pelvic floor
- Clinical and imaging features of descensus uteri and pelvic prolapsed
- Female urinary incontinence and vesicovaginal and uterovaginal fistulas

**EXPECTED SKILLS TO BE ACQUIRED**

- To choose the most appropriate imaging examination according to the clinical problem in gynaecological and obstetric radiology
- To choose the most suitable contrast material and its optimal use according to the imaging technique, the clinical problem and the age in gynaecological and obstetric radiology
- To confidently perform a transabdominal and/or transvaginal ultrasound in gynaecological disorders
- To confidently perform a transabdominal and/or transvaginal ultrasound in pregnant patients
- To perform hysterosalpingography
- To confidently plan a CT examination in gynaecological and obstetric radiology and to tailor it to the individual situation with a dose as low as reasonably achievable
- To confidently plan an MRI examination in gynaecological and obstetric radiology and to tailor it to the individual situation of the patient in regard to the potential use of intravenous contrast medium and spatial resolution
- To perform a pelvimetric MR examination in the pregnant patient
- To observe and/or perform under supervision image-guided biopsies, e.g. of kidney masses
- To observe and/or perform under supervision image-guided drainage procedures in the urogenital tract

- To observe and/or perform under supervision percutaneous nephrostomy
- To confidently perform proper post-processing tasks of examinations in paediatric urogenital radiology, including multi-planar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (MinIP), and fusion images

**COMPETENCES & ATTITUDES**

- To justify diagnostic imaging examinations and/or interventional procedures of the female reproductive organs
- To choose the best-suited method for evaluating disorders of the female reproductive organs
- To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and interventional procedures of the female reproductive organs
- To choose optimal imaging parameters for radiographic, ultrasonographic, CT and MRI examinations of the female reproductive organs
- To apply techniques to reduce exposure doses for radiographic and CT examinations of the female reproductive organs
- To choose the optimally suited imaging modality for pregnant patients
- To design imaging protocols for CT examinations of the female reproductive organs and for staging in patients with tumours of the female reproductive organs
- To design imaging protocols for MRI examinations of the female reproductive organs including the appropriate application of intravenous and/or intraluminal contrast and spatial and temporal resolution
- To supervise and teach technical staff to ensure that appropriate images of the female reproductive organs are obtained
- To interpret and report radiographs, CT and MRI examinations of patients with disorders of the female reproductive system
- To report oncological studies in patients with tumours of the female reproductive system according to international standards (FIGO, RECIST, WHO) applicable to the specific situation
- To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the female reproductive system
- To confidently identify urgent and/or unexpected findings in imaging examinations of the female reproductive system and to communicate these timely and properly
- To emphatically communicate with patients and their relatives in order to explain imaging findings in disorders of the female reproductive system
- To perform at multi-disciplinary conferences and tumour boards for diseases of the female reproductive system

**UROGENITAL RADIOLOGY (12 UNITS)**

| S/No | Course Code RDL 826 | COURSE TITLE | COURSE UNITS |
|---|---|---|---|
| 1 | | Anatomic variants and congenital abnormalities | 2 |
| 2 | | Renal physiology and kinetics of contrast agents | 2 |
| 3 | | Adrenal glands conditions | 2 |
| 4 | | Kidney and uretereral conditions | 3 |
| 5 | | Bladder and urethra | 2 |
| 6 | | Male reproductive system | 1 |
| | | **SUBTOTAL** | **12** |

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

## LECTURE TOPICS IN UROGENITAL RADIOLOGY

### ANATOMIC VARIANTS AND CONGENITAL ABNORMALITIES

- Triple obliquity of the kidney and criteria of normality of the pyelocaliceal system on CT urography
- Normal variants, including junctional parenchymal defect, column of Bertin's hypertrophy, foetal lobulation, or lipomatosis of the sinus, and to accurately differentiate these variants from disease
- Description of anatomy of the bladder wall using US, CT and MRI
- Imaging features of prostatic zonal anatomy with ultrasound, CT and MRI
- Ultrasound and MRI anatomy of scrotal structures (testicular and extratesticular)
- Doppler anatomy and features of renal, testicular and extratesticular vessel.
- Study of main renal malformations, such as ectopia, duplicatioins or fusions
- Congenital malformations of the ureter, bladder and urethra
- Congenital malformations of the prostate, seminal vesicles, vas, and the testes
- Congenital malformations of IVC, renal and testicular/ovarian vessels
- Congenital physiological malformations of the urogenital system

### RENAL PHYSIOLOGY AND KINETICS OF CONTRAST AGENTS

- The physiology of micturition and imaging findings in normal micturating urogenital tract
- Physiology of renal excretion of contrast agents
- Enhancement curves within renal compartments after intravascular injection of contrast agents
- Potential nephrotoxicity of contrast media, risk factors of contrast induced nephrotoxicity
- Methods to reduce the risk of contrast nephrotoxicity
- Details of nephrogenic systemic fibrosis (NSF) including the definition of NSF.
- Clinical features and the risk factors and appropriate use of Gadolinium-based contrast media in patients at risk
- Principle of renal contrast excretion and phases of renal contrast excretion

### ADRENAL GLANDS PATHOLOGIES

- Imaging and clinical features of adrenal insufficiency
- Imaging features and basic clinical features of benign solid tumours of the adrenal glands
- Imaging features and basic clinical features of adrenal cysts
- Imaging features and basic clinical features of malignant tumours of the adrenal gland in the adult and in the paediatric population
- Imaging, management and principles of differential diagnosis of incidentally discovered lesions of the adrenal glands
- Imaging features and basic clinical features of adrenal trauma

- Imaging features and basic clinical features of adrenal gland haemorrhage
- Imaging features and basic clinical features of adrenal hyperplasia
- Imaging features and basic clinical features of adrenal gland infections and infestations

**KIDNEY AND URETERAL PATHOLOGIES**

- Imaging features of vascular disorders of the kidney
- Imaging features and basic clinical features of medical nephropathies
- Imaging features and basic clinical features of infections of the kidney and/or urinary tract
- Imaging features of cystic diseases of the kidney
- Imaging features and basic clinical features of tumours of the kidney
- Imaging features and basic clinical features of renal tuberculosis
- Imaging features and basic clinical features other renal infections and infestations
- Imaging features and basic clinical features of renal artery steonis, anaeurysm
- Imaging features and basic clinical features renal vessel thrombosis
- Imaging features and basic clinical features of renal infarctions
- Imaging features of calculi of the urinary tract
- Imaging features and basic clinical features of urinary obstruction
- Imaging features and basic clinical features of tumours of the ureter
- Imaging features after renal transplantation
- Imaging features and basic clinical features of trauma to the kidneys and/or ureters
- Principles of CT urography including the main indications, choice of technique, choice of contrast agent and dose

**BLADDER AND URETHRA**

- Imaging features and basic clinical features of inflammatory disorders of the bladder
- Imaging features and basic clinical features of tumours of the bladder
- Imaging features of urinary diversion
- Imaging features and basic clinical features of urinary outflow obstructions
- Imaging features and basic clinical features of incontinence and functional disorders of the bladder
- Imaging features and basic clinical features of vesicovaginal fistula and related fistula
- Imaging features and basic clinical features of strictures of the urethra
- Imaging features and basic clinical features of urethral diverticula
- Imaging features and basic clinical features of trauma to the bladder and urethra
- Principles of plain film, ultrasound, CT and MRI cystourethrography including the main indications, choice of technique, choice of contrast agent, dose, film timing and indications
- Conventional, CT and MRI cavernography
- Imaging features bladder diverticula, ectopic cystocoel and simple cystocoles
- Imaging features and basic clinical features schistosomiasis and other infections and infestation

**MALE REPRODUCTIVE SYSTEM**

- Imaging features and basic clinical features of inflammatory disorders of the prostate
- Imaging features and basic clinical features of benign prostatic hyperplasia
- Imaging features and basic clinical features of tumoural pathology of the prostate

- Imaging features of prostate tumour recurrence and metastasis to the protate
- Imaging features and basic clinical features of inflammatory disorders of the prostate
- Imaging features of cystic disease of the prostate, urethra and bladder
- Imaging features and basic clinical features of inflammatory disorders of the testes
- Imaging features and basic clinical features of tumoural pathology of the testes
- Imaging features and basic clinical features of testicular torsion
- Imaging features and basic clinical features of Peyronie's disease
- Imaging manifestations of impotence and interventional techniques
- Imaging features and basic clinical features of priapism
- Imaging features and basic clinical features of tumoural pathology of the penis
- Imaging features and basic clinical features of traumatic lesions of the penis

**EXPECTED SKILLS TO BE ACQUIRED**

- To choose and/or guide the choice of the most appropriate imaging examination according in urogenital radiology related to the clinical problem and the patient's history, including any previous radiological examinations
- To choose the most suitable contrast material and its optimal dose and use according to the imaging technique, the clinical problem, and relevant patient related criteria in urogenital radiology
- To identify patients at risk of contrast nephrotoxicity
- To take measures to reduce the risk of contrast nephrotoxicity
- To take measures to reduce the risk of contrast media nephrotoxicity
- To identify patients at risk to develop NSF
- To confidently perform ultrasound examinations of the kidneys, urinary tract, and of the male reproductive system
- To perform Doppler spectrum analysis on intrarenal vessels (for resistive/pulsatility index measurement) and on the entire course of the proximal renal arteries for velocity calculation
- To confidently perform cystourethrography
- To confidently plan a CT examination in urogenital radiology and to tailor it to the individual situation with a dose as low as reasonably achievable
- To confidently perform state-of-the-art CT urography
- To confidently plan an MRI examination in urogenital radiology and to tailor it to the individual patient in regard to spatial resolution and the potential use of intravenous contrast medium
- To observe and/or perform under supervision image-guided biopsies, e.g. renal parenchymal biopsies, biopsies of kidney masses, and biopsies of retroperitoneal masses
- To observe and/or perform under supervision image-guided drainage procedures related to the urogenital tract
- To observe and/or perform under supervision percutaneous nephrostomy
- To confidently perform proper post-processing tasks of examinations in urogenital radiology, including multiplanar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (MinIP), and fusion images for diagnostic purposes and for imaging-guided interventional procedures and therapies

**COMPETENCES AND ATTITUDES**

- To confidently justify diagnostic imaging examinations in urogenital radiology

- To confidently choose or guide the best-suited method for evaluating disorders in urogenital radiology
- To communicate with the patient in order to obtain informed consent prior to diagnostic imaging studies and interventional procedures in urogenital radiology
- To confidently choose optimal imaging parameters for radiographic, ultrasonographic, CT and MR examinations in urogenital radiology
- To confidently apply techniques to reduce radiation exposure doses for radiographic and CT examinations in urogenital radiology
- To confidently design imaging protocols and standard operating procedures for CT examinations in urogenital radiology, including the appropriate application of intravenous contrast, positioning, spatial and temporal resolution, with a special focus on dose reduction
- To confidently design imaging protocols and standard operating procedures for MR examinations in urogenital radiology, including the appropriate application of intravenous contrast, and of spatial and temporal resolution
- To supervise and teach technical staff to ensure that appropriate images of the urogenital system are obtained, adjusted to the clinical problem
- To confidently judge the quality of imaging examinations in urogenital radiology and to provide strategies to improve image quality
- To confidently interpret and report radiographs, ultrasonographic examinations, CT studies and MRI examinations in urogenital radiology
- To report oncological studies in urogenital radiology according to international standards (RECIST, WHO) applicable to the specific situation
- To appreciate one's own limitations and to identify when it is appropriate to obtain an additional opinion (-s) in performing, interpreting and reporting images of the urogenital system
- To confidently identify urgent and/or unexpected findings in imaging examinations of the urogenital system and to communicate these findings timely and properly with the referring physician or his replacer responsible for patient care
- To empathically communicate with patients and their families in order to explain their imaging findings of the urogenital system, whenever appropriate
- To actively contribute at multi-disciplinary meetings and tumour boards for diseases of the urogenital system

## E. HEAD AND NECK RADIOLOGY (16 UNITS)

| S/No | Course Code RDL 821 | COURSE TITLE | CREDIT UNIT |
|---|---|---|---|
| 1 | | Temporal bone | 2 |
| 2 | | Facial skeleton, skull base and cranial nerves | 2 |
| 3 | | Orbit and visual pathways | 2 |
| 4 | | Nose, nasopharynx and paranasal sinuses | 2 |
| 5 | | Masticator space, parotid space and carotid space | 2 |

| | | |
|---|---|---|
| 6 | Lymph nodes of the head and neck region | 1 |
| 7 | Oral cavity, oropharynx and retropharyngeal | 2 |
| 8 | Hypopharynx and larynx | 1 |
| 9 | Thyroid and parathyroid glands and visceral lesions | 1 |
| 10 | Congenital and transspatial lesions | 1 |
| | **SUB TOTAL** | **16** |

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**LECTURE TOPIC IN HEAD AND NECK RADIOLOGY**

**TEMPORAL BONE**

- Clinical and imaging features of congenital disorders leading to deafness (e.g. Cochlear aplasia/hypoplasia, mondini malformation, large endolymphatic sac anomaly (lesa) / large vestibular aqueduct syndrome (lvas)
- Clinical and imaging features of secondary deafness including otosclerosis, Menière's disease, and temporal bone inflammatory disease
- Clinical and imaging features of cholesteatoma and cerebellopontine angle tumours
- Clinical hand-on imaging evaluation of temporal bone, structures and its diseases
- Clinical and imaging features of facial nerve palsy and imaging facial nerve and its different components
- Clinical and imaging features of temporal bone tumours
- Clinical and imaging features and differentiate different pathologies of the middle ear
- Clinical and imaging features of different types of cochlea implants and their respective mri compatibility / non-compatibility (including specific precautions)
- Aetiopathogenesis of clinical and imaging features of vascular tinnitus and to describe their respective imaging features

**FACIAL SKELETON, SKULL BASE AND CRANIAL NERVES**

- Clinical and imaging features of neoplasms of the clivus including meningioma, macroadenoma and clivus chordoma
- Clinical and imaging features of of tumours of the jugular foramen, including glomus tumour or paraganglioma, jugular bulb pseudolesion, jugular bulb diverticulum, dehiscent jugular bulb, jugular foramen schwannoma, and jugular foramen meningioma
- Clinical and imaging features of diffuse diseases of the skull base, including fibrous dysplasia, plasmocytoma, Langerhans cell histiocytosis, chondosarcoma and metastases
- Clinical and imaging features of facila bone fractures
- Clinical and imaging features of neoplasms of the mandible and maxilla
- Clinical and imaging features of features of dentigerous cysts and odontogenic keratocysts

- Clinical and imaging features of infectious and inflammatory lesions of the mandible, maxilla and skull base, including osteomyelitis
- Clinical hand-on imaging evaluation of facial skeleton, skull base and cranial nerves

**ORBIT AND VISUAL PATHWAYS**

- Clinical, imaging and imaging features of various congenital lesions of the orbit
- Clinical and imaging features of benign tumours of the orbit in children including dermoid and epidermoid cysts, cavernous haemangioma and lymphangioma,
- Clinical and imaging features of rhabdomyosarcoma and retinoblastoma
- Clinical and imaging features of orbital manifestations of neurofibromatosis type I
- Clinical and imaging features of infectious and inflammatory disorders of the orbits including optic neuritis, abscesses, sarcoidosis and idiopathic inflammatory disorders
- Clinical and imaging features of malignant tumours of the orbits including ocular melanoma, orbital lymphoma, higher grade optic / chiasmal glioma, adenoid cystic carcinoma of the lacrimal glands.
- Clinical hand-on imaging evaluation of orbits and visual pathways

**NOSE, NASOPHARYNX AND PARANASAL SINUSES**

- Clinical and imaging features of congenital lesions of the paranasal sinuses including choanal atresia and frontoethmoidal encephalocele
- Clinical and imaging features of paranasal sinuses pathology, sinonasal polyposis, sinonasal mucocele and sinonasal Wegener granulomatosis
- Clinical and imaging features inflammatory of paranasal sinuses including acute and chronic rhinosinusitis, and mucocele
- Clinical and imaging features of benign and malignant neoplasms of the nose and paranasal sinuses Clinical and imaging features nose and paranasal sinuses after surgery
- Clinical and imaging features nasopharyngeal pathologies including Thornwaldt cyst, inflammatory and infectious lesions and neoplasms
- Clinical hand-on imaging evaluation of nose, nasopharynx and paranasal sinuses

**MASTICATOR SPACE, PAROTID SPACE AND CAROTID SPACE**

- Clinical and imaging features denervation atrophy, benign muscle hypertrophy and asymmetries of the pterygoid venous plexus
- Clinical and imaging features abscess formations of the masticator space
- Clinical and imaging features benign and malignant neoplasms of the masticator space including peripheral nerve sheath tumours of the trigeminal nerve
- Clinical and imaging features parotitis, Sjogren syndrome and benign lymphoepithelial lesions in patients with HIV
- Clinical and imaging features benign and malignant neoplasms of the parotid space
- Clinical and imaging features of Warthin tumour, benign mixed tumour, adenoid cystic carcinoma, mucoepidermoid carcinoma, lymphoma, lymph node metastases and malignant tumors of the skin
- Clinical and imaging features vascular lesions of the carotid space
- Ectatic carotid arteries, carotid artery pseudoaneurysm, carotid artery dissection, and jugular venous thrombosis

- Clinical and imaging features neoplasms of the carotid space including carotid body paraganglioma, glomus vagale paraganglioma, schwannoma, and neurofibroma

**LYMPH NODES OF THE HEAD AND NECK REGION**

- Clinical, imaging and imaging features of of infectious and inflammatory disorders of the lymph nodes including reactive lymph node enlargement, suppurative lymph nodes, Kimura disease, and Castleman disease
- Clinical, imaging and imaging features of neoplastic disorders of the lymph nodes, including lymphoma (Hodgkin and Non-Hodgkin) and nodal metastases
- Clinical, imaging and imaging features of benign and malignant lymph nodes

**ORAL CAVITY, OROPHARYNX AND RETROPHARYNGEAL SPACE**

- Clinical, imaging and imaging features of dermoid and epidermoid cysts, accessory salivary tissue, lymphangioma and lingual thyroid gland
- Clinical, imaging and imaging features of infectious lesions of the oral cavity and oropharynx, including abscesses, retention cysts, sialoceles, sialadenitis and ranula
- Clinical, imaging and imaging features of benign and malignant neoplasms of the oral cavity and oropharynx
- clinical and imaging features of benign mixed tumours, squamous cell carcinoma, malignant tumours of the minor salivary glands
- Clinical, imaging and imaging features of retropharyngeal abscesses

**HYPOPHARYNX AND LARYNX**

- Clinical and imaging features of neoplasms of the hypopharynx and larynx,
- Clinical and imaging features of hypopharynx and larynx after surgery and after radiation
- Clinical and imaging features of vocal cord paralysis, laryngoceles and pharyngoceles
- Clinical and imaging features of laryngeal trauma
- Clinical and imaging features functional abnormalities of the larynx and hypopharynx during impaired swallowing including primary and secondary aspiration and dysfunction of the crico-pharyngeal muscle
- Advanced and PET-CT findings in head and neck tumours involving the pharynx, larynx and oral cavity

**THYROID, PARATHYROID, SALIVARY GLANDS AND VISCERAL LESIONS**

- Clinical and imaging features of thyroiditis and multinodular goiter
- Clinical and imaging features of malignant neoplasms of the thyroid and parathyroid glands
- Clinical and imaging features of cervical oesophageal carcinoma
- Clinical and imaging features of Zenker diverticulum and the typical approaches to therapy
- Important findings of Tc-99m-scintigraphy in various diseases of the thyroid gland
- Clinical and imaging features of benign and malignant neoplasms of the salivary glands
- Clinical and imaging features of sinuses
- Clinical and imaging features of benign and malignant disease of the sinuses

**CONGENITAL AND TRANSSPATIAL LESIONS**

- Clinical and imaging features of branchial cleft cysts, thyroglossal duct cysts and thymus cysts
- To describe the imaging features and basic clinical features of vascular lesions including malformations of the head and neck region
- Clinical and imaging features of neurocutaneous syndromes, including neurofibromatosis type I, in the head and neck region
- Clinical and imaging features of fibromatosis colli

**Expected skill to be acquired**

- To choose the most appropriate imaging examination according to the clinical problem in head and neck imaging
- To choose the most suitable contrast material and its optimal use according to the imaging technique and the clinical problem in head and neck imaging
- To perform dynamic functional studies including video-fluoroscopy of the swallowing mechanism
- To ascertain correct positioning for imaging studies of the skull, sinus, skull base, and facial bones including special views
- To perform ultrasound including Doppler sonography of the neck, tongue, thyroid and salivary glands
- To perform percutaneous biopsy, guided by ultrasound or CT in straightforward/technically easy cases
- To perform fine needle aspiration biopsy in easy cases
- To perform lymph node aspiration biopsies in easy cases
- To observe and/or perform under supervision percutaneous biopsy, guided by ultrasound, CT and/or MRI in more complex cases
- To observe and/or perform under supervision dacryocystography
- To observe and/or perform under supervision fine needle aspiration biopsy in more complex cases
- To observe and/or perform under supervision lymph node aspiration biopsies in more complex cases
- To perform dental radiology and interpret it in relation with the patients clinical features»
- To confidently plan a CT examination of the head and neck region and to tailor it to the individual situation in regard to intravenous contrast medium, rate of injection, dose and delay of the contrast medium, with a dose as low as reasonably achievable
- To confidently plan a CT examination of the temporal bone and to tailor it to the individual situation in regard to the potential use of intravenous contrast medium and spatial resolution
- To confidently plan an MRI examination of the head and neck region and to tailor it to the individual situation in regard to the potential use of intravenous contrast medium, rate of injection, dose and delay of the contrast medium, and spatial resolution
- To confidently plan an MRI examination of the temporal bone and to tailor it to the individual situation in regard to the potential use of intravenous contrast medium and spatial resolution
- To apply techniques for quantification of head and neck disorders using ultrasound, CT and MRI, based on an indepth understanding of their clinical role and limitations.
- To confidently perform proper post-processing tasks for head and neck imaging studies, including multi-planar reformations (MPR), maximum intensity projections (MIP), minimum

intensity projections (MinIP), vessel analysis tools, endoluminal reconstructions, 3D reconstructions including volume rendering and virtual endoscopy and multimodality fusion of images

**COMPETENCES & ATTITUDES**

- To confidently justify diagnostic imaging examinations and/or interventional procedures of the head and neck region
- To confidently choose the best-suited method for evaluating disorders of the head and neck region
- To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and interventional procedures of the head and neck region
- To confidently choose optimal imaging parameters for radiographic, ultrasonographic, CT and MRI examinations of the head and neck region
- To confidently apply techniques to reduce exposure doses for radiographic and CT examinations of the head and neck region
- To confidently design imaging protocols and standard operating procedures for CT examinations of the head and neck region, including the appropriate application of intravenous contrast, spatial and temporal resolution
- To confidently design imaging protocols and standard operating procedures for MRI examinations of the head and neck region, including the appropriate application of intravenous contrast, spatial and temporal resolution
- To supervise and teach technical staff to ensure that appropriate images of the head and neck region
- To confidently judge the quality of the imaging examinations in head and neck imaging and to devise strategies to improve image quality
- To confidently interpret and report radiographs, ultrasonographic examinations, CT studies and MRI examinations of the head and neck region
- To report oncological studies of the head and neck region according to international standards (e.g. TNM) applicable to the specific situation »
- To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the head and neck region
- To confidently identify urgent and/or unexpected findings in imaging examinations of the head and neck region and to communicate these timely and properly
- To communicate with patients and their relatives in order to explain the imaging findings of the head and neck region
- To take an active part and/or conduct multi-disciplinary conferences and tumour boards for diseases of the head and neck region

## PAEDIATRIC RADIOLOGY (16 UNITS)

| S/No | Course Code RDL 831 | COURSE TITLE | COURSE UNIT |
|---|---|---|---|
| 1 | | Principles of imaging specific to children | 1 |
| 2 | | Brain and spine | 2 |
| 3 | | Head and neck | 1 |
| 4 | | Paediatric chest | 2 |
| 5 | | Cardiovascular system | 2 |
| 6 | | Digestive tract | 2 |
| 7 | | Genito-urinary tract | 3 |
| 8 | | Musculoskeletal system | 2 |
| 9 | | Miscellaneous conditions | 1 |
| | | **SUBTOTAL** | **16** |

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.
**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

## LECTURE TOPICS IN PAEDIATRIC RADIOLOGY

### PRINCIPLES OF IMAGING SPECIFIC TO CHILDREN

- Detailed discussion of developmental anatomy during childhood
- Normal variants in childhood that may mimic disease
- To have a basic understanding of embryology as applied to paediatric diseases
- Imaging appearances of various stages of embryonic and fetal development in US and MR imaging
- Principles guiding the construction of a child-friendly environment
- ALARA principle and dose consideration and their application in paediatric patients
- Imaging guideline algorithms specific to children
- Indications and contraindications for contrast media within the paediatric population including neonates

### BRAIN AND SPINE

- Imaging features and basic clinical features of the main congenital malformations of the brain (for details, see Congenital and developmental abnormalities)
- Imaging features, causes and basic clinical features of hydrocephalus in infants, children and adolescents
- Imaging features, causes and basic clinical features of subependymal and intraventricular haemorrhage in infants
- Imaging features, causes and basic clinical features of periventricular leukomalacia
- Imaging features and basic clinical features of elevated intracranial pressure in infants, children and adolescents
- Imaging features and basic clinical features of brain tumours in infants, children and adolescents
- Imaging features and basic clinical features of head trauma in infants, children and adolescents

- Imaging features and clinical features of non-accidental trauma in infants, children and adolescents
- Imaging features and basic clinical features of intracranial infections (including antenatal infections) in infants, children and adolescents
- Imaging features, causes and basic clinical features of intracranial ischaemia / stroke in infants, children and adolescents
- Imaging features and basic clinical features of pituitary disease in infants, children and adolescents
- Imaging features and basic clinical features of spinal malformations including spina bifida aperta, spina bifida occulta, meningomyelocele, dermal sinus, split cord malformations

**HEAD AND NECK**

- Imaging features and basic clinical features of the main congenital malformations of the head and neck region including the orbit, the nose, the pharynx, the temporal bone in infants, children and adolescents (for details, see specific chapter in head and neck radiology)
- Imaging features, causes and basic clinical features of inflammatory/infectious disorders of the head and neck region in infants, children and adolescents
- Tumours of the head and neck region in infants, children and adolescents
- Imaging features and basic clinical features of traumatic lesions of the head and neck region in infants, children and adolescents
- Imaging features of thyroid diseases in infants, children and adolescents

**PAEDIATRIC CHEST**

- Radiographic imaging features of normal thymus and its variants in infants, children and adolescents
- Radiographic imaging features of congenital abnormalities of bronchus and chest (pulmonary sequestration, cystic adenomatoid malformation, lobar emphysema, bronchial atresia) in infants, children and adolescents
- Radiographic imaging features of neonatal respiratory distresses in premature babies and neonates
- Radiographic imaging features of foreign body aspiration in infants, children and adolescents
- Radiographic imaging features of bronchiolitis in infants, children and adolescents
- Radiographic imaging features of cystic fibrosis in infants, children and adolescents
- Radiographic imaging features of chest consolidation, pneumonia and complications of pneumonia in infants, children and adolescents
- Radiographic imaging features of pleural effusions in infants, children and adolescents
- Radiographic imaging features of pneumothorax in infants, children and adolescents
- Radiographic imaging features of congenital pulmonary airway malformations
- Imaging features of infiltrative diseases of the lung in infants, children and adolescents
- Imaging features of complications of metastatic diseases of the lung in infants, children and adolescents
- Imaging features of mediastinal masses (germ-cell tumour, cystic mediastinal masses, lymphadenopathies, lymphoma, neurogenic tumours) in infants, children and adolescents

- Imaging features of congenital diaphragmatic hernia, diaphragm palsy and eventration in infants, children and adolescents

**CARDIOVASCULAR SYSTEM**

- Imaging features and basic clinical features of the main congenital malformations of cardiovascular system including aortic arch abnormalities in infants, children and adolescents
- Imaging features, causes and basic clinical features of arterial hypertension in infants, children and adolescents
- Imaging features, causes and basic clinical features of inflammatory / infectious disorders of the cardiovascular system in infants, children and adolescents
- Imaging features and basic clinical features of traumatic lesions of the cardiovascular system in infants, children and adolescents
- Imaging features and basic clinical features of vascular malformations and vascular tumours in infants, children and adolescents

**DIGESTIVE TRACT**

- Clinical and radiographic imaging features of oesophageal atresia in neonates
- Clinical and radiographic imaging features of necrotizing enterocolitis in neonates
- Clinical and radiographic imaging features of pneumoperitoneum in neonates
- Imaging features and basic clinical features of ano-rectal malformations in neonates
- Clinical and radiographic imaging features of hypertrophic pyloric stenosis in neonates and infants
- Imaging features and basic clinical features of gastrointestinal obstruction in neonates
- Imaging features and basic clinical features of Hirschsprung's disease in neonates, infants, children and adolescents
- Imaging features and basic clinical features of gastro-oesophageal reflux in infants, children and adolescents
- Imaging features and basic clinical features of intestinal malrotations and volvulus in infants, children and adolescents
- Imaging features and clinical features of intestinal intussusception in infants, children and adolescents
- Imaging features and clinical features of appendicitis in infants, children and adolescents
- Imaging features and basic clinical features of peritonitis in neonates, infants, children and adolescents
- Imaging features and basic clinical features of inguinal hernia in infants, children and adolescents
- Imaging features and basic clinical features of inflammatory bowel diseases and the respective complications in infants, children and adolescents
- Imaging features and basic clinical features of blunt abdominal trauma in infants, children and adolescents
- Imaging features and basic clinical features of digestive tract foreign bodies in infants, children and adolescents
- Imaging features and basic clinical features of disorders of the hepatobiliary systemin infants, children and adolescents

- Imaging evaluation of disorders of the biliary system with US and MRCP in infants, children and adolescents
- Imaging features and basic clinical features of disorders of portal circulation in infants, children and adolescents
- Imaging features and basic clinical features of disorders of the pancreas in infants, children and adolescents
- Imaging features and basic clinical features of disorders of the spleen in infants, children and adolescents

**GENITO-URINARY TRACT**

- Major renal malformations, such as horseshoe kidney, ectopia, or fusion
- Imaging features and basic clinical features of upper and lower urinary tract malformations in infants, children and adolescents
- Imaging features and basic clinical features of urinary tract infection in infants, children and adolescents
- Imaging features of the different grades of vesico-ureteral reflux and urethral anomalies on voiding cysturethrography
- Imaging features and basic clinical features of uretero-hydronephrosis in infants, children and adolescents
- Imaging features and basic clinical features of cystic diseases of the kidneys in infants, children and adolescents
- Imaging features of urolithiasis and nephrocalcinosis in infants, children and adolescents
- Imaging features and basic clinical features of oncologic disorders of the abdomen in infants, children and adolescents, including neuroblastoma, Wilms tumours, hepatoblastoma, Burkitt's lymphoma, with differential diagnosis
- Imaging features and basic clinical features of common disorders of the adrenal glands in infants, children and adolescents
- Imaging features and basic clinical features of sexual development disorders in neonates and infants
- Imaging features and basic clinical features of pubertal development disorders in infants and adolescents
- Imaging features and basic clinical features of common gynaecological disorders (malformations, ovarian cysts and tumours) in girls
- Imaging features and basic clinical features of common disorders of the testis and scrotum in boys

**MUSCULOSKELETAL SYSTEM**

- Imaging features and basic clinical features of fractures (accidental and non-accidental) in neonates, infants, children and adolescents
- Medico-legal aspects of non-accidental injury
- Imaging features and basic clinical features of complex trauma in infants, children and adolescents
- Imaging features and basic clinical features of common bone dysplasia (achondroplasia, osteogenesis imperfecta, congenital metabolic disorders) in children and adolescents
- Imaging features and basic clinical features of rickets

- Imaging features and basic clinical features of infiltrative bone marrow diseases in infants, children and adolescents
- Imaging features and basic clinical features of haemoglobinopathies including sickle cell disease and thalassaemia
- Imaging features and basic clinical features of bone tumours in children and adolescents
- Imaging features of joint effusions in children and adolescents
- Imaging features and basic clinical features of osteomyelitis and septic arthritis in children and adolescents
- Imaging features and basic clinical features of juvenile rheumatoid arthritis in children and adolescents
- Imaging features and basic clinical features of congenital disorders of the spine, including scoliosis (congenital and idiopathic), and dysraphism in infants, children and adolescents
- Imaging features and basic clinical features of developmental dysplasia of the hip in neonates, infants, children and adolescents
- Imaging features and basic clinical features of transient synovitis in children and adolescents
- Imaging features and basic clinical features of Legg-Calvé-Perthes disease in children
- Imaging features and basic clinical features of slipped capital femoral epiphysis in children
- Imaging features and basic clinical features of congenital disorders of the ankle and foot, including congenital tarsal coalition
- Imaging features and basic clinical features of osteochondrosis, including Scheuermann's disease, in children and adolescents
- Imaging features and basic clinical features of soft-tissue tumours in children and adolescents

**MISCELLANEOUS PATHOLOGIES**

- Neuro-imaging features, extracranial manifestations, diagnostic criteria and clinical features of neurofibromatosis type I
- Neuro-imaging features, extracranial manifestations, diagnostic criteria and clinical features of neurofibromatosis type II
- Neuro-imaging features, extracranial manifestations, diagnostic criteria and clinical features of tuberous sclerosis
- Neuro-imaging features, extracranial manifestations, diagnostic criteria and clinical features of Sturge-Weber disease
- Neuro-imaging features, extracranial manifestations, diagnostic criteria and clinical features of von Hippel Lindau disease
- Imaging features of less common neurocutaneous syndromes
- Imaging features and clinical features of haematological disorders in children and adolescents
- Imaging features and basic clinical features of Langerhans cell histiocytosis

**EXPECTED SKILLS TO BE ACQUIRED**

- To perform ultrasound examinations in infants, children and adolescents and to appreciate the difference between portable and departmental ultrasound machines
- To choose the most suitable contrast material and its optimal use according to the imaging technique, the clinical problem and the age in paediatric radiology
- To observe and/or perform under supervision ultrasound of brain in the infant

- To observe and/or perform under supervision Doppler sonography of the intracranial vessels in infants, children and adolescents
- To observe and/or perform under supervision ultrasound of the hip in neonates and infants
- To observe and/or perform under supervision ultrasound of the abdomen in neonates, infants, children and adolescents
- To observe and/or perform under supervision voiding cystourethrography in infants, children and adolescents
- To observe and/or perform under supervision contrast-media studies of the gastrointestinal tract in infants, children and adolescents
- To confidently perform a treatment for intussusception
- To confidently plan a CT examination in infants, children and adolescents and to tailor it to the individual situation and age, with a dose as low as reasonably achievable
- To confidently plan an MRI examination in infants, children and adolescents and to tailor it to the individual situation and age of the patient in regard to the potential use of intravenous contrast medium and spatial resolution
- To confidently perform proper post-processing tasks of examinations in paediatric radiology, including multiplanar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (MinIP), and fusion images

**INTERVENTIONAL RADIOLOGY (14 UNITS)**

| S/No | Course Code RDL 824 | COURSE TITLE | CREDIT UNIT |
|---|---|---|---|
| 1 | | Nonvascular interventions | 2 |
| 2 | | Diagnostic angiography/venography | 2 |
| 3 | | Vascular intervention | 2 |
| 4 | | Biopsy and thermal ablation | 2 |
| 5 | | Fluid aspiration and abscess drainage | 2 |
| 6 | | Hepatobiliary intervention | 2 |
| 7 | | Genitourinary intervention | 2 |
| | | **SUBTOTAL** | 14 |

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**LECTURE TOPIC IN VASCULAR INTERVENTIONAL RADIOLOGY**
**NON-INVASIVE VASCULAR IMAGING**

- Clinical imaging relevant to acquisition parameters of CTA, MRA including contrast materials used and reconstruction techniques
- Clinical, imaging and imaging features of CTA and MRA of atherosclerotic disease, vasculitis, aneurismal disease, thrombosis, embolism and other vascular pathological conditions »
- Advanced principles of MR angiography (MRA), CTA techniques
- Advantages and disadvantages of different contrast materials used for MRA, CTA and US
- Differences between time-of-flight, phase contrast, and contrast-enhanced techniques pertaining to MRA
- To discuss the advantages and disadvantages of MRA compared with other techniques
- To have an in-depth understanding of nephrogenic systemic fibrosis (NSF
- Clinical, imaging and imaging features of MRA of atherosclerotic disease, vasculitis, aneurismal disease, thrombosis, embolism and other vascular pathological conditions
- Clinical hands-on on non-invasive imaging

**DIAGNOSTIC ANGIOGRAPHY/VENOGRAPHY**

- Advances in Seldinger technique of arterial and venous puncture
- Advances in mechanisms for guidewire, sheath and catheter insertions into the groin
- Advances in mechanisms of puncture site haemostasis, including manual compression and common closure devices
- Aternative sites of arterial puncture, such as brachial, axillary and translumbar
- Detailed knowledge of guidewires, sheaths and catheters used for common diagnostic angiographic procedures
- Advance imaging techniques of digital subtraction angiography techniques, bolus chase techniques, road mapping and pixel shift techniques
- Detailed standard arterial and venous anatomy and variations in anatomy throughout the body
- Advance imaging techniques of principles of peripheral vascular angiography
- Imaging advances and principles of mesenteric, coeliac and renal angiography
- Advanced clinical imaging and principles of abdominal and thoracic aortography
- Advanced clinical imaging and principles of carotid, vertebral and subclavian angiography
- Advanced clinical imaging and principles of venous venograph
- To describe the imaging features on diagnostic angiography of atherosclerotic disease, vasculitis, aneurismal disease, thrombosis, embolism and other vascular pathological conditions
- Detailed complication and post-procedural care regimens for standard diagnostic vascular procedures

**VASCULAR INTERVENTION**

- Advanced clinical imaging and principles of endovascular treatment of atherosclerotic diseases
- Advanced clinical procedure and principles of angioplasty balloon dynamics and the mechanism of action of angioplasty
- To describe the complications and results in different anatomical areas

- Advances in drugs and dosages used during angioplasty
- To describe the principles of intra-arterial pressure studies
- Common angioplasty procedures, such as renal, iliac and femoral angioplasties
- Advanced clinical imaging and principles arterial stenting, stenting materials and angioplasty
- To describe the basic mechanisms for stent deployment and to list the materials used for stent construction
- Peripherally inserted central catheter (PICC) lines, Hickman catheters, dialysis catheters and ports
- Detail procedure of venous access catheters, and technique of access to jugular and subclavian veins
- Details of haemodialysis shunt interventions, angioplasty and complication
- Advanced clinical imaging and principles for stenting, caval filter placement and angioplasty»
- Procedure for embolisation such as acute bleeding, tumour therapy, AVM treatment
- To describe the technique of selective angiography
- Details procedure of embolisation and specific embolisation materials and post-embolic pain and post-embolic syndrome
- Clinical hands-on on vascular intervetions
- Transjugular intrahepatic portosystemic shunt (TIPS), the technique and complications

**BIOPSY AND THERMAL ABLATION**

1. Detailed study of re-procedure coagulation tests and the correction of abnormalities
2. Advanced imaging techniques used for guiding biopsy, including CT and ultrasound
3. Detailed study of needles used for biopsy procedures, including fine gauge needles, large gauge needles and trucut biopsy
4. Detailed study of safe access routes to various lesion to be biopsied
5. To discuss complication rates associated with individual organ biopsy
6. Detailed study of description and indications and pro and cons of fine needle biopsy versus large gauge or core biopsy
7. Detailed description of post-procedural care for chest and abdominal biopsy
8. Detailed study of thermal ablation techniques in various organ systems

**FLUID ASPIRATION AND ABSCESS DRAINAGE**

- Detailed study of tubes, materials used for chest tubes, pelvic and abscess drainage catheters.
- Detailed study of imaging techniques used for guidance for fluid aspiration and abscess drainage
- Advance description of the trocar and Seldinger techniques for catheter placement
- To list situations where more than one catheter is required
- Detailed study of various approaches to abdomino-pelvic abscess drainage

**HEPATOBILIARY INTERVENTION**

- Integration of ultrasound, CT and MRCP to plan an appropriate drainage procedure »
- Procedure of trans-hepatocholangiography and other similar procedure
- Detailed study of image-guided hepatobiliary interventions
- Detailed study of materials, aftercare and complications of hepatobiliary interventions

- Clinical hands-on on hepatobiliary interventions and non-invasive imaging

**GENITOURINARY INTERVENTION**

- Image- guidance mechanisms for genitourinary interventions (various types)
- Detailed study of catheters and materials used for genitourinary interventions
- Description and hands on for genitourinary interventions (various types)
- Detailed study of the aftercares and complications and treatments of genitourinary interventions
- Vascular genitourinary interventions (various types)
- Interventions for ovary and uterus
- Clinical hands-on on hepatobiliary interventions and non-invasive imaging

**EXPECTED SKILLS TO BE ACQUIRED**

- To confidently justify indications and to have an in-depth knowledge of the contraindications for common interventional radiology procedures
- To confidently treat both minor and major allergic reactions to iodinated contrast materials
- To perform radiation safety procedures in the interventional radiology suite
- To perform corticosteroid prophylaxis, groin closure techniques, treat potential groin complications
- To perform a correct pre- and post-procedural care and medical treatment in difficult cases
- To perform duplex ultrasound, including both arterial and venous examinations
- To perform common Doppler examinations, including carotid Doppler, hepatic and renal Doppler studies and lower extremity venous duplex examinations
- To perform the Seldinger technique of arterial and venous puncture
- To perform guidewire, sheath and catheter insertions into the groin
- To perform puncture site haemostasis, including manual compression and common closure devices
- To perform arterial puncture at alternative sites, such as brachial, axillary and translumbar sites
- To use guidewires, sheaths and catheters for common diagnostic angiographic procedures »
- To perform digital subtraction angiography techniques, bolus chase techniques, road mapping and pixel shift techniques
- To perform peripheral vascular angiography, mesenteric, coeliac and renal angiography, abdominal aortography and thoracic aortography
- To perform under supervision carotid, vertebral and subclavian angiography
- To perform venography
- To perform post-procedural care regimens for standard diagnostic vascular procedures
- To perform pre-procedure coagulation tests and to correct abnormalities
- To perform common angioplasty procedures, such as renal, iliac and femoral angioplasties under supervision.
- To choose the correct drugs and dosages during angioplasty.
- To perform intra-arterial pressure studies, arterial stenting under supervision.
- To perform post-procedural care after arterial stenting.

- To observe and/or perform under supervision the placement of peripherally inserted central catheter (PICC) lines, Hickman catheters, dialysis catheters and ports.
- To observe and/or perform under supervision haemodialysis shunt interventions.
- To observe and/or perform under supervision venoplasty and stenting.
- To observe and/or perform under supervision caval filter placement.
- To observe and/or perform under supervision embolisation for indications such as acute bleeding, tumour therapy, AVM treatment.
- To perform selective angiography and effectively treat post-embolic pain and post-embolic syndrome.
- To observe and/or perform under supervision transjugular intrahepatic portosystemic shunt (TIPS).
- To perform transcutaneous, image-guided biopsy procedures, including fine gauge needle biopsies, large gauge needle biopsies and trucut biopsy.
- To plan safe access routes to various lesions to be biopsied.
- To treat common complications of biopsy, such as pneumothorax and haemorrhage.
- To perform chest drainage, fluid aspiration and abscess drainage and use underwater seal drainage systems »
- To apply fibrinolytic agents in patients with loculated or complex empyemas »
- To perform abscess drainage and administer antibiotic regimens before and after abscess drainage »
- To perform the trocar and Seldinger techniques for catheter placement
- To perform pelvic abscess drainage and transhepatocholangiography.
- To perform under supervision biliary drainage with one-stick needle systems and needle and guidewire
- To perform under supervision biliary decompression with catheters
- To perform emergency procedures in life-threatening disorders, including cardio-pulmonary resuscitation

**COMPETENCES & ATTITUDES**

- To appropriately select patients for a requested interventional procedure through a review of available history, imaging, laboratory values, and proposed or expected outcomes of the procedure
- To confidently identify features in the history or physical findings that would require pre-procedure assistance from other specialty disciplines, such as cardiology, anaesthesia, surgery or internal medicine
- To confidently identify risk factors from the patient's history, physical or laboratory examinations that indicate potential risk of bleeding, nephrotoxicity, cardiovascular problems, breathing abnormalities, or adverse drug interactions during or after the procedure
- To obtain informed consent after discussion of the procedure with the patient, including a discussion of risks, benefits and alternative therapeutic options
- To choose the best-suited approach for an interventional procedure »To choose optimal imaging parameters for image-guided interventional procedures

- To apply techniques to reduce exposure doses for interventional procedures, both for the patient and for the radiologist and staff
- To supervise and teach technical staff to ensure that appropriate support is provided for interventional procedures
- To safely apply local anaesthetics for pain management in patients undergoing interventional radiological procedures.
- To correctly manage the pre-procedure work-up, including antibiotic regimens, coagulation screening and intravenous fluid replacement for the various radiological intervention.
- To correctly manage the monitoring of the patient during the radiological intervention and to recognize abnormalities and physical signs or symptoms that need immediate attention during the procedure.
- To correctly manage the aftercare of the various type of radiological interventions, including knowledge of complications, catheter care and ward rounds.
- To manage conscious sedation and analgesia during interventional procedures.
- To reduce accidental exposure to blood and body fluids in the interventional radiology suite.
- To appreciate own limitations and to identify when it is appropriate to obtain assistance in interventional procedures.
- To effectively manage and coordinate emergency situations arising from and/or during interventional procedures.
- To communicate with patients and their relatives in order to explain the outcome of the interventional procedure.
- To perform at multi-disciplinary conferences for patients with potential indications for interventional procedures

**BREAST RADIOLOGY (10 UNITS)**

| S/No | Course Code RDL 812 | COURSE TITLE | COURSE UNIT |
|---|---|---|---|
| 1 | | Epidemiology and natural history of breast diseases | 1 |
| 2. | | Pathogenesis and imaging features of breast diseases | 1 |
| 3. | | Multidisplinary breast unit management | 2 |
| 4 | | Radiology and pathology correlation of breast disease | 1 |
| 5 | | Imaging features in post- treatment breast | 1 |
| 6 | | Imaging technologies used in breast diseases | 2 |
| 7 | | Breast disease and breast cancer screening | 2 |

**SUBTOTAL** 10

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**LECTURE TOPICS IN BREAST RADIOLOGY**

**EPIDEMIOLOGY AND NATURAL HISTORY OF BREAST DISEASES**

- Description of normal embryology, anatomy and physiology of the breast, axilla and associated structures
- Knowledge of changes due to age, lactation, hormonal status, hormone replacement therapy, surgery
- Imaging changes in breast due to breast reduction/augmentation as well as oncoplastic reconstruction), radiotherapy etc.
- Detailed epidemiological data regarding breast cancer including national, regional and worldwide
- Identification of major risk factors of breast cancer, including familial-genetic predisposition and previous thoracic radiation therapy
- Principles of risk stratification and the indications for genetic counselling
- Principles and objectives of population screening
- Masking effect of breast density determining a reduced sensitivity of mammography

**PATHOGENESIS AND IMAGING FEATURES OF BREAST DISEASES**

- Clinical management and radiological evaluation of patients presenting with a palpable breast mass.
- Clinical management and radiological evaluation of patients presenting with mastodynia, breast trauma, inflammatory findings, nipple discharge, nipple or skin retraction, nipple thickening and axillary adenopathy
- Benign diseases of the breast and of how these diseases manifest, both clinically and on imaging
- Borderline or high-risk breast lesions (those defined to imply an uncertain potential for malignancy), and of their clinical and pathological significance
- Malignant diseases of the breast, axilla and associated structures, of genetic subtypes, of histological prognostic factors and of the TNM classification
- Cytological and pathological reporting of breast diseases

- Biomolecular classification of breast cancer and to be able to understand the imaging implications of that classification

**MULTIDISPLINARY BREAST UNIT MANAGEMENT**

- To know the relative costs of the various imaging examinations utilized in the management of breast diseases
- Central role of the multidisciplinary team in planning investigations, treatment and in outcome review for breast cancer patients.
- Breast unit model for treating breast cancer and the recommendations of the authorities of American, UK and European Parliament in favor of the breast unit model for treating breast cancer
- Communication principles of breaking news and the psychosocial consequences of doing so improperly
- Planning, implementation, supervision and interpretation of all imaging techniques used in breast imaging.
- Indications, contraindications and complications of all imaging techniques used in breast imaging.
- Standardized lexicon and categories of breast imaging reporting with reference to lesion, breast, or patient (ACR BI-RADS® or other standardized classification methods).
- Standardized evaluation of the imaging-based oncologic status of breast cancer patients according to RECIST 1.1 criteria

**RADIOLOGY AND PATHOLOGY CORRELATION OF BREAST DISEASE**

- Extramammary staging of breast cancer and evaluation of distant metastases
- Radiologic-pathologic correlation of breast lesions
- Relative role of breast density as a risk factor for breast cancer
- Description of the structure and management of a national or regional screening programme
- Legal liability in breast imaging and its far reaching implications in patients' management
- Imaging work-up and main pathological conditions that can be detected in male patients, children and in pregnant and lactating women
- Imaging work-up and main pathological conditions that can be detected in adolescent females

**IMAGING FEATURES IN POST- TREATMENT BREAST**

- Principles and indications for breast-conserving surgery and sentinel node biopsy
- Indications for neoadjuvant chemotherapy and to understand the clinical and imaging evaluation of response to treatment

- Adjuvant therapy options for breast cancer and with methods for surveillance after treatment
- Radiation therapy options including methods for partial breast irradiation as well as with typical radiological findings associated with those therapies
- Radiological methods for evaluating tumour extent and searching for additional ipsilateral malignant lesions or contralateral malignant lesions, including the role of MRI
- Minimally invasive therapy options for distant metastases
- Imaging appearance of local recurrence of breast cancer

**IMAGING TECHNOLOGIES USED IN BREAST DISEASES**

- Tomosynthesis in the clinical setting and the potential of 2D mammograms reconstructed from tomosynthesis dataset
- Advantages, potential indications and limitations of new technologies, such as CAD, tomosynthesis elastography, diffusion-weighted MR imaging and MR spectroscopy,
- Contrast materials for contrast-enhanced MRI, and systems for breast lesion radiofrequency-based excision
- MR-guided focused ultrasound and other new therapeutic imaging-guided techniques/
- Radiofrequency ablation, cryoablation, electroporation etc in imaging and management of breast cancer or breast benign diseases

**BREAST DISEASE AND CANCER SCREENING**

- Identification of the risks and benefits of screening to the population and the individual, including those related to subject age, family and personal history
- Screening theory and lead time bias, length bias, survival versus mortality rates,
- Prevalence versus incidence screening,
- Definition of lead time and interval cancer rate, overdiagnosis and overtreatment
- American, UK and European guidelines for breast cancer screening and diagnosis
- The potential of tomosynthesis in the screening setting for increasing the detection rate and reducing the recall rate
- Principles and techniques used in screening audit.
- Desirable goals for positive predictive value, percentage of stage 0 (ductal carcinoma in situ) and stage I tumours, minimal carcinomas and node positivity
- Prevalent and incident cancer rates, recall rates, interval cancers, sensitivity, specificity and false-negative rate, and the importance of data collection
- Analysis of controversies regarding mammographic screening and related research

- Current debate on the estimate of over-diagnosis/overtreatment in developed countries and also under-diagnosis/under treatment in developing countries
- Legal liability in breast cancer screening and its far reaching implications in patients management

**EXPECTED SKILLS TO BE ACQUIRED**

- To take a detailed history of patients regarding disorders of the breast and relevant risk factors
- To perform physical examinations of the breast, axilla and associated structures
- To perform radiologic-pathologic correlation of breast lesions
- To supervise the imaging quality of the radiography of surgical specimens and communicate with the surgeon accordingly
- To participate in double reading of screening examination discussing cases of disagreement and getting a feedback after final decision and/or final assessment after recall
- To perform fine needle aspiration at least of cysts which require treatment aspirations
- To perform image-guided fine needle aspiration cytology (free-hand and/or image-guided) or core needle biopsy under ultrasound guidance, including sampling of breast lesions and of suspicious axillary lymph nodes
- To perform mechanical and vacuum-assisted core biopsy (free-hand and/or image-guided) under mammographic stereotactic guidance and under MRI guidance
- To perform image-guided localization or tomosynthesis
- To perform abscess management

**COMPETENCES AND ATTITUDES**

- To choose the best-suited method for evaluating disorders of the breast for a variety of clinical indications
- To justify and optimise all relevant diagnostic imaging examinations and/or interventional procedures of the breast, including minimization of x-ray exposure in mammography and choice of optimal imaging parameters for mammography, ultrasound and MRI of the breast
- To confidently judge the quality of the imaging examinations in breast imaging and to devise strategies to improve image quality
- To supervise and teach technical staff to ensure that appropriate images of the breast are obtained
- To interpret and report mammograms, including those obtained with tomosynthesis, breast ultrasound and breast MRI examinations using a standardized diagnostic categorisation system such as the ACR Breast Imaging Reporting and Data System (BI-RADS®); this competence should be acquired by means of performance/ reporting (under supervision) of at least 800

mammograms, 500 ultrasound, 50 breast MR studies and 50 interventional procedures during the two years

- To communicate with patients and their relatives in order to explain their imaging findings in disorders of the breast
- To communicate with the patient in order to obtain informed consent prior to interventional procedures of the breast
- To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the breast
- To identify urgent and/or unexpected findings in all types of imaging examinations of the breast and to communicate these timely and properly
- To appreciate and respect the roles and responsibilities of other members of the breast imaging team, e.g. clerical officers, radiographers, nurses, support staff, secretaries etc.
- To appreciate and respect the roles and responsibilities of other members of the multidisciplinary breast care team, being an integral part of the team in planning investigations, treatment and in outcome review
- To perform at multi-disciplinary conferences and tumour boards for diseases of the breast

## NEURORADIOLOGY (18 UNITS)

| S/No | Course Code | COURSE TITLE | CREDIT UNIT |
|---|---|---|---|
| | RDL 825 | | |

| | | |
|---|---|---|
| 1. | Advanced normal neuro-anatomy | 2 |
| 2. | Congenital and developmental abnormalities | 2 |
| 3. | Neurovascular conditions | 3 |
| 4. | Head trauma, neurotrauma and head injury | 2 |
| 5. | Intracranial tumours and tumour-like conditions | 3 |
| 6. | Infectious, inflammatory and neurodegenerative disorders | 2 |
| 7. | Hydrocephalus and intracranial hypertension | 1 |
| 8. | Spine and spinal cord conditions | 2 |
| 9. | Epilepsy and peripheral nervous system | 1 |
| | **SUBTOTAL** | **18** |

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**LECTURE TOPICS IN NEURORADIOLOGY**

**ADVANCED NORMAL NEURO-ANATOMY**

- Detailed normal anatomy of the brain, skull, skull base, brain, extracranial head, spine, spinal cord and peripheral nervous system
- Detailed normal imaging findings of the brain and spine on X-ray, ultrasound, CT and MRI
- Detailed normal anatomy of the skull, skull base, and spine on conventional radiography
- Detailed normal anatomy of the cortex, white matter, basal ganglia, ventricles, cisterns and cranial nerves on CT and/or MRI of the brain
- Detailed normal anatomy of the functional anatomy of the motor, sensory and visual systems
- Detailed normal anatomy of the functional anatomy of the cognition and memory
- Detailed normal anatomy of the glymphatic system
- Detailed normal anatomy of the orbit and its contents, paranasal sinuses, temporal bone, salivary glands, neck lymph nodes, larynx, pharynx, thyroid and parathyroid glands, skull, skull base, and deep spaces of the neck on CT and/or MRI of the brain
- Detailed normal anatomy of the vertebral bodies, spinal canal, intervertebral discs, dural sac, spinal cord and cauda equina on CT and/or MRI of the spine

- Detailed normal anatomy of the aortic arch, carotid and vertebral arteries, intracranial arteries and the circle of Willis, spinal and spinal cord vascularisation on X-ray angiography, CT angiography and MR angiography
- Detailed normal anatomy and normal imaging features of Virchow-Robin spaces
- Detailed normal anatomic variants of skull, skull base, brain, extracranial head, spine, and spinal cord and differentiate these from pathology

**CONGENITAL AND DEVELOPMENTAL ABNORMALITIES**

- Imaging features of malformations of the skull base and craniovertebral junction
- Anomalies of the oro-pharyngeal apparatus including branchial cleft cysts, and thyroglossal duct cysts
- Imaging features of malformations of cortical development, including focal cortical dysplasia, polymicrogyria, heterotopia (subependymal, focal subcortical, laminar), lissencephaly / pachygyria, (hemi) megalencephaly, microlissencephaly, schizencephaly
- Imaging features of agenesis and dysgenesis of the corpus callosum and of holoprosencephaly (lobar, alobar, semilobar)
- Imaging features of hindbrain and posterior fossa malformations, including the Chiari malformations, the Dandy Walker spectrum and the molar tooth malformations (including Joubert syndrome)
- Imaging features of white matter injury of the premature brain / periventricular leukodystrophy (PVL)
- Imaging features of intracranial and spinal arachnoid cysts
- Imaging features of hypoxic ischemic encephalopathy of the mature infant after severe acute asphyxia
- Imaging features of hypoxic ischemic encephalopathy of the mature infant after prolonged partial hypoxia
- Neuro-imaging features, extracranial manifestations, diagnostic criteria and clinical features of tuberous sclerosis, Sturge-Weber diseases, neurofibromatosis type I and II, and other common phakomatoses
- Common imaging features of segmental vascular syndromes
- Imaging features of inherited metabolic conditions and leukodystrophies

**NEUROVASCULAR CONDITIONS**

- Stroke subtypes and their causative mechanism in adults and paediatric patients
- Relevance of the “time is brain” approach to the imaging evaluation of patients with stroke
- Comprehensive stroke evaluation parameters for MRI and CT, including diffusion-weighted imaging, CT perfusion, MR perfusion, CT angiography and MR angiography
- CT and MR perfusion parameters relevant for stroke imaging and to describe their relevance and limitations
- Main neuroradiological interventions in patients with acute ischaemic stroke
- Diagnostic and therapeutic approach in patients with ischemic strokes of the posterior circulation / basilar artery occlusion
- Interventional approaches to intracranial and extracranial stenoses
- Imaging features, relevant clinical features and imaging algorithm in patients with venous stroke / intracranial venous thrombosis
- Imaging and clinical features in patients with subarachnoid haemorrhage (SAH)
- Standard imaging evaluation algorithm in patients with spontaneous SAH
- Major complications and describe their respective imaging features in patients with spontaneous SAH
- Intracranial collateral circulation and their relevance in ischaemic stroke
- Imaging features and relevant haemodynamic parameters in patients with vasospasm • To describe the imaging features of atherosclerotic and hypertensive small vessel diseases
- Imaging features of genetically determined small vessel diseases (CADASIL, Susac, Fabry, HERNS)
- Imaging features of cerebral amyloid angiopathy and cerebral amyloid angiopathy-related inflammation
- Imaging features of arterial vessel wall abnormalities in atherosclerotic diseases of the intracranial and extracranial vessels
- Common imaging features in patients with migraine and Headache
- Causes and imaging features of to differentiate atypical and typical intracerebral haemorrhages
- Imaging algorithms in patients with atypical and typical intracerebral haemorrhages
- Types and imaging features of different types of intracranial and extracranial vascular malformations
- Imaging features and therapeutic approaches in patients with intracranial vascular malformations
- Imaging features, differential diagnoses and relevance of developmental venous anomalies

- Imaging features, differential diagnoses and relevance of cavernous malformations
- Imaging features, differential diagnoses and relevance of capillary telangiectasias
- Imaging features of the different types of intracranial aneurysms: secular, dissecting, fusiform, giant, infectious
- Imaging features of intra/extracranial arterial dissections, posterior reversible encephalopathy syndrome and reversible cerebral vasoconstriction syndrome
- Imaging features and basic clinical features of primary and systemic central nervous system vasculitis
- Imaging features of cerebrovascular lesions related to arterial hypertension
- Standard imaging evaluation and features of brain death
- Imaging and clinical features in patients with venous occlusive disease
- Imaging features of Moyamoya syndrome and Moyamoya disease

**HEAD TRAUMA, NEUROTRAUMA AND HEAD INJURY**

- Typical imaging algorithms and features in patients with acute traumatic injury to the brain
- Typical imaging features and basic clinical features of epidural hematoma
- Typical imaging features and basic clinical features of subdural hematoma
- Typical imaging features and basic clinical features of traumatic subarachnoidal hemorrhage
- Causes and imaging algorithms and imaging features of traumatic CSF leaks
- Imaging features and basic clinical features of brain contusions
- Imaging features and basic clinical features of diffuse axonal injury
- Imaging features and warning signs for elevated intracranial pressure
- Imaging features of fractures of the skull and skull base including the temporal bone, facial bones, the paranasal sinuses and the orbit
- Imaging features and clinical features in children with non-accidental injury
- Imaging features of vascular traumatic injury of the intra- and extracranial vessels

**INTRACRANIAL TUMOURS AND TUMOUR-LIKE CONDITIONS**

- Imaging findings in intracranial and extracranial tumours
- Detailed knowledge of the WHO classification of CNS tumours including their molecular parameters
- Imaging manifestations of intracranial metastases of various primary tumours
- Imaging features and basic clinical features of diffuse astrocytic and oligodendroglial tumors

- Imaging features and basic clinical features of pilocytic astrocytomas,
- Imaging features and basic clinical features of pleomorphic xantoastrocytoma
- Imaging features, basic clinical features, location and association of subependymal giant cell astrocytomas
- Imaging features, basic clinical features, and location of neuronal and mixed neuronal-glial tumors including ganglioglioma, gangliocytoma, dysembryoplastic neuroepithelial tumour (DNET), dysplastic cerebellar gangliocytoma, desmoplastic infantile, desmoplastic infantile astrocytoma and ganglioglioma, rosetteforming glioneuronal tumor, neurocytoma and paraganglioma
- Imaging features of tumour response and recurrence
- Imaging features and basic clinical features of CNS tumours treatment-related (pseudoprogression and pseudoresponse)
- Imaging features and locations of the various forms of brain stem tumours
- Imaging features and basic clinical features of optic pathway gliomas
- Imaging features and basic clinical features of ependymal tumours and choroid plexus tumors
- Imaging features and basic clinical features of the different genetic defined medulloblastomas and other embryonal tumours such as CNS neuroblastoma and atypical teratoid and rhabdoid tumors (ATRT)
- Imaging features and basic clinical features of primary and secondary lymphoma and leukaemia of the brain and spinal cord
- Imaging features of post-transplantation lymphoproliferative disease
- Imaging features, basic clinical features and differential diagnosis of sellar and suprasellar region such as craneopharingiomas, and tuber cinereum hamartomas
- Imaging features and basic clinical features of pituitary microadenomas and macroadenomas
- Imaging features and basic clinical features of tumours of the pineal region
- Imaging features and basic clinical features of typical and atypical meningiomas, and malignant meningiomas
- Imaging features of mesenchymal, non-meningothelial tumours, such as angiosarcomas, hemangiopericytomas, chondromas, chondrosarcomas, osteomas, osteosarcomas and hemangioblastomas
- Imaging features and basic clinical features of histiocytic tumours including Langerhans cell histiocytosis, Erdheim-Chester disease, Rosai-Dorfman disease, juvenile xanthogranuloma and histiocytic sarcoma.

- Imaging features and basic clinical features of germ cell tumours such as germinomas, embryonal carcinomas and teratomas
- Imaging features and basic clinical features of cranial nerves tumours including vestibular schwannoma/“acoustic neuroma”, trigeminal schwannoma and facial nerve schwannoma
- Imaging features and basic clinical features of perineural spread of malignant tumors
- Imaging features and dissemination pathways of malignant and benign tumours of the suprahyoid neck, and paranasal sinuses, including their potential spread patterns through the skull base
- Imaging features and basic clinical features of orbital tumours
- Imaging features and basic clinical features of temporal bone tumours
- Iimaging features and basic clinical features of salivary gland tumours
- Imaging features and basic clinical features of thyroid and parathyroid tumours
- Imaging features of chordoma of the clivus and other tumours of the skull base

**INFECTIOUS, INFLAMMATORY AND NEURODEGENERATIVE DISORDERS**

- Imaging features of age-related changes of the brain or degenerative diseases
- Imaging features and clinical features of multiple sclerosis (MS) and its variants, acute disseminated encephalomyelitis (ADEM) and neuromyelitis optica spectrum disorders (NMOSD)
- Imaging appearance differentiation of demyelinating lesions from age-related changes
- Imaging features of treatment-related effects in patients with multiple sclerosis
- Imaging features and clinical features of CLIPPERS
- Imaging features and clinical features of neurosarcoidosis
- Imaging features and clinical features of IRIS (immune reconstitution inflammatory syndrome)
- Imaging features and clinical features of patients with dementia of the Alzheimer type and primary neurodegenerative diseases, such as multi-system atrophy, and fronto-temporal dementia
- Imaging features of treatment-related effects in patients with Alzheimer disease.
- Imaging features in Parkinson’s disease and in atypical Parkinson syndromes, and other movement disorders such as progressive supranuclear palsy
- Imaging features and basic clinical features of amyotrophic lateral sclerosis
- Imaging features and basic clinical features of degenerative ataxia disorders
- Imaging features and basic clinical features of Wilson disease
- Imaging features and basic clinical features of acute and chronic hepatic encephalopathy, and chronic renal failure

- Imaging features and basic clinical features of exogenous toxic (carbon monoxide poisoning, recreational drugs, ethanol abuse, organic solvents), and acquired metabolic conditions (osmotic demyelination syndrome, hyper/hypoglycemia, iron and B12/copper deficiency
- Imaging features of herpes simplex virus (HSV) infections of the brain, and understand the therapeutic concepts and urgency of HSV infections of the brain
- Imaging features of meningitis and their complications and the limitations of imaging in patients with meningitis
- Imaging features and basic clinical features of the different stages of intracranial abscess formation
- Imaging features and basic clinical features of tuberculous meningitis and intracranial tuberculomas.
- Imaging features and basic clinical features of hemophagocytic lymphohistiocytosis.

**HYDROCEPHALUS AND INTRACRANIAL HYPERTENSION**

- Basic understanding of the production, flow and resorption of CSF and problems arising form any of the processes
- Aetiopathogenesis of different types of hydrocephalus and their respective causes
- Imaging features and clinical features of normal pressure hydrocephalus
- Imaging features, causes and clinical features of non-communicating hydrocephalus.
- Imaging features, causes and clinical features of benign intracranial hypertension
- Imaging features, causes and clinical features of CSF hypotension
- Imaging features and list the major causes of aqueductal stenosis
- Methods of qualitative and quantitative imaging-based flow assessment of the CSF
- Different therapeutic approaches to hydrocephalus, including shunt placement and third ventriculostomy
- Imaging features and basic clinical features of hypophysitis
- Imaging features and basic clinical features of IgG4 related disorders
- Imaging features and basic clinical features congenital infections of the brain including toxoplasmosis, CMV, rubella and HSV
- Imaging features and basic clinical features of sarcoidosis
- Imaging features and basic clinical features of HIV infection of the brain and its complication
- Imaging features and basic clinical features of prion and fungal infections

- Imaging features and causes of therapy induced lesions to the CNS, (e.g. after radiation therapy and after chemotherapy) such as radiation-induced leukoencephalopathy, radiation induced tumours, radiation necrosis, and SMART syndrome
- Imaging features of autoimmune-mediated encephalitis

**SPINE AND SPINAL CORD CONDITIONS**

- Imaging features and basic clinical features of spinal malformations including spina bifida aperta, spina bifida occulta, meningomyelocele, dermal sinus, split cord malformations, scoliosis
- spondylolisthesis, spondylolysis and differentiation of stable and unstable fractures of the spine
- Imaging features and clinical features in spinal cord trauma, myelopathy and common causes
- Differentiation between benign and malignant vertebral compression fractures
- •Imaging features of spinal instability
- Imaging features of inflammatory condition of the spine: enthesopathies, DISH, Bechterew
- Imaging features of spinal metastases including the criteria for cord compression
- Imaging features of osteoporosis and metabolic diseases involving the spine
- Imaging features and clinical features in spinal cord ischemia
- Imaging features and clinical features of Hirayama disease
- Imaging features and clinical features of transdural spinal cord herniation • To list the most common intraspinal tumours
- Imaging features and basic clinical features of spinal cord tumours (ependymoma, astrocytoma, haemangioblastoma)
- Imaging features and basic clinical features of intradural spinal tumours (meningioma, neurinoma)
- Imaging features and basic clinical features of transverse myelitis (TM)
- Imaging features and basic clinical features of spinal manifestations of MS, acute disseminated encephalomyelitis (ADEM), and neuromyelitis optica spectrum disorders (NMOSD)
- Imaging features and basic clinical features of infectious diseases of the spine and spinal cord including discitis and spondylodiscitis
- Imaging features and basic clinical features of spinal vascular malformations
- Imaging features and basic clinical features of syrinx formation and hydromyelia

- To describe the imaging features of chordomas and other primary tumours of the spine
- To have an in-depth knowledge of the imaging features of degenerative diseases of the spine disc and facet joints
- To describe percutaneous and endovascular interventional procedures of the spine/spinal cord

**EPILEPSY AND PERIPHERAL NERVOUS SYSTEM**

- Major causes of seizures in paediatric and adult population
- Imaging evaluation algorithm in patients with seizures
- Imaging features of mesial temporal sclerosis
- Imaging features of status epilepticus
- The roles of neurofunctional imaging in the assessment of epilepsy and findings
- Imaging evaluation algorithm and features of brachial plexopathy
- Imaging evaluation algorithm and features of lumbosacral plexopathy
- Imaging evaluation algorithm in patients with entrapment neuropathies • To describe the imaging features of tumoral lesions of the peripheral nerves
- Imaging features of inflammatory lesions of the peripheral nerves, including chronic inflammatory demyelinating polyradiculoneuropathy
- To describe the imaging features of hereditary motor and sensory neuropathies

**EXPECTED SKILLS TO BE ACQUIRED**

- To choose the most appropriate imaging examination according to the clinical problem in neuroradiology
- To choose the most appropriate imaging strategy in the monitoring of CNS tumours
- To choose the most appropriate imaging strategy in the monitoring of multiple sclerosis
- To choose an appropriate interventional procedure (endovascular or percutaneous) according to the clinical problem in neuroradiology
- To choose the most suitable contrast material and its optimal use according to the imaging technique and the clinical problem in neuroradiology
- To observe and/or perform under supervision ultrasound of brain in the infant
- To observe and/or perform under supervision Doppler sonography of the intracranial vessels
- To observe and/or perform under supervision diagnostic neuroangiography
- To observe and/or perform under supervision intraarterial thombecthomy and other recanalization procedures in patients with ischaemic stroke

- To observe and/or perform under supervision neurointerventional therapy in patients with acute basilar artery occlusion
- To observe and/or perform under supervision endovascular treatment of intracranial aneurysms
- To observe and/or perform under supervision spinal angiography
- To observe and/or perform under supervision percutaneous interventional procedures of the extracranial head
- To observe and/or perform under supervision disk, vertebral and facet interventional procedures included discography and biopsy
- To observe and/or to perform under supervision discography, facet joint injections and vertebroplasty • To confidently plan a CT examination of the brain and spine and to tailor it to the individual situation, with a dose as low as reasonably achievable
- To confidently plan an MRI examination of the brain and spine and to tailor it to the individual situation in regard to the potential use of intravenous contrast medium and spatial resolution
- To plan and perform advanced CT and MRI examinations including perfusion CT and MR, diffusion tensor imaging, functional MR imaging (task-related and resting-state), and proton MR spectroscopy
- To confidently perform proper post-processing tasks of neuroradiological studies, including multi-planar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (MinIP), tractography, functional MRI and fusion images in regard to the potential use of intravenous contrast medium and spatial resolution
- To plan and perform advanced CT and MRI examinations including perfusion CT and MR, diffusion tensor imaging, functional MR imaging, and proton MR spectroscopy
- To confidently perform proper post-processing tasks of neuroradiological studies, including multi-planar reformations (MPR), maximum intensity projections (MIP), minimum intensity projections (MinIP), DTI, functional MRI and fusion images

**COMPETENCES AND ATTITUDES**

- To confidently justify diagnostic imaging examinations and/or interventional procedures of the brain, skull, skull base, spine, spinal cord, extracranial head, and peripheral nervous system
- To confidently choose the best-suited method for evaluating disorders of the brain, skull, skull base, spine, spinal cord, extracranial head, and peripheral nervous system

- To communicate with the patient in order to obtain informed consent prior to diagnostic imaging and interventional procedures of the brain, skull, skull base, spine, spinal cord, extracranial head, and peripheral nervous system
- To confidently choose optimal imaging parameters for X-ray, ultrasound, CT and MRI examinations of the brain, skull, skull base, spine, spinal cord, extracranial head, and peripheral nervous system
- To confidently apply techniques to reduce exposure doses for X-ray and CT examinations of the brain, skull, skull base, spine, and extracranial head.
- To design a time-saving imaging algorithm and to define standard operating procedures for imaging patients with stroke
- To confidently perform and interpret a comprehensive imaging evaluation in patients with acute stroke
- To confidently design imaging protocols and standard operating procedures for CT examinations of the brain, skull, skull base, extracranial head, spine, spinal cord, peripheral nervous system, including the appropriate application of intravenous contrast, positioning, spatial and temporal resolution
- To confidently design imaging protocols and standard operating procedures for MRI examinations of the brain and spine, including the appropriate application of intravenous contrast, spatial and temporal resolution
- To supervise and teach technical staff to ensure that appropriate images of the brain, skull, skull base, spine, spinal cord, extracranial head, and peripheral nervous system are obtained
- To confidently judge the quality of imaging examinations in neuroradiology and to devise strategies to improve image quality
- To confidently interpret and report X-ray, ultrasound, CT and MRI examinations of the brain, skull, skull base, spine, spinal cord, extracranial head, and peripheral nervous system
- To confidently use structured reporting in common clinical situations (eg. stroke, multiple sclerosis, brain tumours, dementia…)
- To confidently use visual scales to report global and regional brain atrophy
- To confidently use visual scales to report white matter abnormalities
- To report oncological studies according to international standards applicable to the specific situation

- To appreciate own limitations and to identify when it is appropriate to obtain assistance in interpreting and reporting images of the brain, skull, skull base, extracranial head, spine, spinal cord, and peripheral nervous system
- To confidently identify urgent and/or relevant unexpected findings in imaging examinations of the brain, skull, skull base, extracranial head, spine, spinal cord, and peripheral nervous system, and to communicate these timely and properly
- To communicate with patients and their relatives in order to explain their imaging findings of the brain, skull, skull base, spine, spinal cord, extracranial head, and peripheral nervous system
- To participate in and/or conduct multi-disciplinary conferences, vascular boards, and tumour boards for diseases of the brain, skull, skull base, extracranial head, spine, spinal cord, peripheral nervous system

**EMERGENCY RADIOLOGY (18 UNITS)**

| S/No | Course Code RDL 823 | COURSE TITLE | COURSE UNIT |
|---|---|---|---|
| 1 | | General emergency radiology | 2 |
| 2 | | Anatomy relevant to emergency radiology | 1 |
| 3 | | Central nervous system and brain | 2 |
| 4 | | Face, skull, head and neck | 1 |
| 5 | | Spine and vertebral column | 1 |
| 6 | | Chest and cardiovascular system | 2 |
| 7 | | Abdomen and gastrointestinal tract | 2 |
| 8 | | Obstetrics and gynaecology | 2 |
| 9 | | Male genitourinary system | 1 |
| 10 | | Male and female pelvis | 1 |
| 11 | | Extremities (including shoulder and hip) | 1 |
| 12 | | Paediatric, interventional, musculoskeletal and others | 2 |
| | | **SUBTOTAL** | **18** |

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**LECTURE TOPICS IN EMERGENCY RADIOLOGY**

**GENERAL EMERGENCY RADIOLOGY**

- Epidemiological data regarding emergency pathologies
- Common mechanisms of injury including acting forces and their distribution in/over human bodies

- Principles and basic application of estimating emergency severity such as the Injury Severity Score (ISS) for trauma cases and pain rating scales with regard to the region of pain and clinical appearance in non-traumatic emergencies legal issues and hygiene regulations
- Basic knowledge of the guidelines and corresponding institutional Standard Operating Procedures/ algorithms regarding emergency cases
- Radiological modalities and techniques employed in ER including their respective strengths, weaknesses.
- Opportunities and threats regarding ER factors of various imaging modalities and effects of radiation dose as well as techniques for dose reduction good, reasonable/acceptable, poor and insufficient image quality
- Basic understanding of the workflow chain of digital imaging, image processing, reading, reporting and the distributing report/images in ER
- Potential risks and benefits of modality dependent contrast media including effects of oral, rectal, bladder or filling
- Imaging algorithms for low-energy and high-energy traumatic emergencies
- Imaging algorithms for various non traumatic emergency cases
- Relevant modality dependent imaging findings of tubes, drains and catheters, especially with regards to positioning
- Radiological standard procedures in polytrauma cases, those under resuscitation and mass casualties.
- Radiological standard procedures, incidents, indications and contraindications for image-guided interventional procedures in emergency settings

## ANATOMY RELEVANT TO EMERGENCY RADIOLOGY

- Detailed relevant normal anatomy of the brain, spine, musculoskeletal system, lung, heart, mediastinum, diaphragm, abdominal organs and spaces, genito-urinary tract, venous and arterial system including topographic relationships and cross-sectional appearance
- Detailed knowledge of common and uncommon normal variants, sites of anatomy most likely affected by various emergency medical conditions and distinction from acute pathology

## CENTRAL NERVOUS SYSTEM AND BRAIN

- Imaging features and basic clinical findings of skull fractures
- Intracranial haemorrhages (subdural, epidural, subarachnoidal, parenchymal)

- Parenchymal injuries (cortical contusion, diffuse axonal injury, deep gray matter injury, brainstem injury)
- Extra- and intracranial vascular injuries, Penetrating injuries, dural sinus thrombosis
- Increased intracranial pressure and herniation syndromes
- Arterial cerebral infarction (including the description of particular technical issues such as MR-DWI, MR-perfusion, MRA, CE-MR, TOF, CT-perfusion, CTA)
- Central nervous system infections (meningitis, encephalitis, abscess/cerebritis, subdural empyema, spinal epidural abscess, osteomyelitis/discitis)

**FACE, SKULL, HEAD AND NECK**

- Imaging features and basic clinical findings of Le-Fort fractures and other facial fractures
- Imaging features and basic clinical findings of orbital injuries (post bulbar emphysema and haemorrhage) and ocular injuries (rupture, laceration, lens dislocation, vitreous haemorrhage, subchoroidal haemorrhage)
- Trauma to the larynx, pharynx and upper oesophagus
- Orbital, epidural, subdural or other abscesses / empyema
- Infections of the paranasal sinuses (acute, fungal, chronic sinusitis, complications)
- Infections of the suprahyoid neck (retropharyngeal and paravertebral abscess, tonsillitis and peritonsillar abscess, odontogenic infections, submandibular and sublingual abscess, parotitis, sialoadenitis, cervical necrotising fasciitis)
- Acute infections of the infrahyoid neck (epiglottitis, lymphadenitis, jugular thrombophlebitis)
- External and internal ear infection and mastoiditis (cholesteatoma, apical petrositis)
- Orbital infections and optic neuritis

**SPINE AND VERTEBRAL COLUMN**

- Evaluation criteria of low-risk and high-risk patients and of patients with neurological deficits (such as prediction rules, Nexus, CCR)
- Imaging features and basic clinical features of spinal/plexus trauma (spinal cord contusion, spinal epidural hematoma, nerve root avulsion, plexus injuries)
- Assessment of instability of spinal fractures
- Mechanisms of injury such as hyperextension/ hyperflexion injury including the description of frequently associated injuries

- Imaging features and basic clinical features of different vertebral injuries (occipital condyle fracture, Jefferson burst fracture, atlanto-axial rotary fixation, Hangman's fracture, whiplash injury, wedge compression, burst compression, flexion tear drop fracture, bilateral facet dislocation, chance fracture, complex fracture, pathological fracture, injuries to intervertebral disks)
- Imaging features and basic clinical features of disc herniation
- Imaging features, basic clinical features and common causing pathogens of infections (osteomyelitis, discitis, spondylodiscitis, epidural abscess)

**CHEST AND CARDIOVASCULAR**

- The trainee is required to be able to describe the imaging features and basic clinical findings of:
- Imaging features and basic clinical findings of chest trauma (rib fractures, sternal and manubrial fractures, hemothorax, pneumothorax, pneumomediastinum, pulmonary contusion/ laceration/ hematoma, pneumatocele, tracheal and bronchial injury, oesophageal injury, diaphragm injury
- Imaging features and basic clinical findings of acute pulmonary infections including the various etiologies and causing pathogens as well as aspiration pneumonia
- Imaging features and basic clinical findings of airway foreign bodies
- Imaging features and basic clinical findings of severe obstructive airway disease and ARDS
- Emergencies of the heart, Heart trauma and pericardium
- Aortic emergencies (thoracic aortic trauma, supra-aortic injuries including carotid and vertebral injuries, aortic dissection, aortic aneurysms, aortitis)
- Aetiopathogenesis and imaging features and basic clinical findings of pulmonary oedema
- Imaging features and basic clinical findings of thromboembolic disease including the fat embolism syndrome
- Combination protocols in CT for concurrent ruling out of multiple life-threatening causes of chest pain

**ABDOMEN AND GASTROINTESTINAL TRACT**

- Imaging features and basic clinical findings of hemoperitoneum, intraperitoneal fluids and retroperitoneal haemorrhage
- Imaging features and basic clinical findings of intraperitoneal and retroperitoneal gas collections
- Imaging features and basic clinical findings of active arterial and venous extravasation

- Imaging features and basic clinical findings of organ injuries (liver, spleen, adrenal, kidney, pancreas, gallbladder, bowel)
- Imaging features and basic clinical findings of abdominal wall injuries
- Imaging features and basic clinical findings of aortic and major vessel trauma
- Emergencies related with the peritoneal cavity (peritonitis, abdominal abscess, insufficient bowel anastomosis, hollow organ perforation, ascites)
- Imaging features and basic clinical findings of liver and biliary tract including obstructive and non-obstructive jaundice and cholecystitis
- Imaging features and basic clinical findings of pancreatitis
- Imaging features and basic clinical findings of the urinary tract (urinary stones, infection, pyelonephritis, renal abscess, renal infarction)
- Imaging features and basic clinical findings of adrenal haemorrhage
- Non-traumatic emergencies of the gastrointestinal tract

**OBSTETRICS AND GYNECOLOGY**

- Imaging features and basic clinical findings of foeto-placental trauma
- Imaging features and basic clinical findings of ovarian torsion
- Imaging features and basic clinical findings of pelvic inflammatory disease and abscesses
- Imaging features and basic clinical findings of acute abdominal disease in pregnancy
- Imaging features and basic clinical findings of major and minor trauma in pregnancy
- Imaging features and basic clinical findings of ectopic pregnancy

**MALE GENITOURINARY**

- Imaging features and basic clinical findings of urethral and penile trauma, urethral stones and foreign bodies
- Imaging features and basic clinical findings of scrotal and testicular trauma
- Imaging features and basic clinical findings of testicular torsion of the epididymal appendix
- Imaging features and basic clinical findings of epididymitis, orchitis and testicular infarction of scrotal abscess
- Imaging features and basic clinical findings of Fournier gangrene

**MALE AND FEMALE PELVIS**

- Imaging features and basic clinical findings of pelvic ring fractures and disruptions
- Imaging features and basic clinical findings of isolated fractures without pelvic ring involvement

- Imaging features and basic clinical findings of bladder injury
- Supportive interventional procedures in bleeding control

**EXTREMITIES (INCLUDING SHOULDER AND HIP)**

- Imaging features and basic clinical findings of fractures including stress and insufficiency fractures and their classification
- Imaging features and basic clinical findings of luxations and their classification
- Imaging features and basic clinical findings of chondral and osteochondral lesions and their classification
- Imaging features and basic clinical findings of ligamental tears or ruptures and their classification
- Imaging features and basic clinical findings of menisceal and labral tears and their classification
- Imaging features and basic clinical findings of tendon and muscular injuries and their classification
- Imaging features and basic clinical findings of acute inflammatory diseases
- Imaging features and basic clinical findings of avascular necrosis
- Imaging features and basic clinical findings of acute compartment syndromes

**PAEDIATRIC, INTERVENTIONAL, MUSCULOSKELETAL AND OTHERS**

- Imaging features and basic clinical findings in the corresponding emergency sections of the respective subspecialty curricula
- Interventional procedures as provided in the corresponding emergency sections of the respective subspecialty curricula

**SKILLS EXPECTED TO BE ACQUIRED**

- To use and optimize efficiency enhancing technical equipment for initial interpretation of CT studies (e.g. dedicated CT workstation)
- • To independently perform the following, while acknowledging own limitations and indication to call in expertise of supervisor: e-FAST, abdominal sonography and contrast-enhanced sonography of emergency cases and femoral artery and venous puncture techniques
- To perform under supervision: image guided drainage of fluid collections, percutaneous transhepatic drainage of the biliary tract and other interventional emergency procedures under image guidance, particularly in bleeding control

- To confidently identify modality dependent imaging findings of misplacement of devices such as tubes, drains and catheters
- To confidently identify modality and body region dependent common imaging findings in emergency cases such as fracture patterns, ileus and small bowel obstruction, free air and fluid, bleeding, infarction, organ injury
- To confidently classify modality dependent imaging findings as acute life-threatening, in principal but not immediately life-threatening, severe but not life-threatening or self-limiting acute conditions
- To confidently classify modality dependent imaging findings according to curricular content provided by other subspecialties
- To perform image interpretation or therapy of >1500 emergency cases (>500 CR, >100 eFAST, >200 US, >500 CT including >25 polytrauma cases and cardiovascular emergencies cases, >50 MRI, >10 embolisations, >10 PTD, >30 drainage of fluid collections). These cases have to be distributed proportionally over the body regions and typical pathologies
- To interpret, report, communicate and demonstrate common and typical findings
- To interpret, report, communicate and demonstrate rare findings under supervision
- To supervise the imaging quality of emergency CT, radiographic and MRI examinations including image postprocessing
- To manage procedural complications of imaging in the emergency setting

**COMPETENCES AND ATTITUDES**

- To confidently differentiate high-risk from low-risk patients before imaging
- To confidently differentiate and prioritize findings with respect to their urgency after imaging
- To confidently 'screen' as fast as possible for life-threatening findings (e.g. for CT: <10 min after scan start) using an optimized infrastructure and selective image reading in case of high-risk patients
- To have an in-depth understanding of the respective advantages and disadvantages of different imaging options in emergency cases
- To be able to choose and to justify the best-suited imaging modality and protocol parameters and, if necessary, to put imaging techniques into the most appropriate diagnostic pathway considering advantages and limitations of the different modalities, diagnostic accuracy and speed, amount of radiation exposure and ethically motivated individual risk/benefit-analysis with respect to case severity, time-to-diagnose/therapy, patient age and sex including pregnant patients

- To be integral and active part of continuous workflow optimisation with particular respect to ethical considerations, improvement of diagnostic accuracy and shortening of the time-to-diagnose/therapy
- To chair at multi-disciplinary treatment, morbidity and mortality conferences
- To supervise, teach and train technical staff to ensure with respect to appropriate emergency workflow and imaging
- To communicate timely and properly with patients (if possible), their relatives (if needed) and the involved other medical disciplines in order to explain imaging findings of disorders and to rapidly evaluate adequate therapy with respect to best possible outcome.
- To participate in Quality Assessment and Quality Monitoring
- To appreciate own limitations and to respect the roles and responsibilities of other members of the multidisciplinary emergency team, being an integral part of the team in decision-making.

**ONCOLOGIC IMAGING (12 UNITS)**

| S/No | Course Code RDL 832 | COURSE TITLE | COURSE UNIT |
|---|---|---|---|
| 1 | | Cancer biology and treatment relevant to imaging | 1 |
| 2 | | Imaging techniques in oncologic imaging | 2 |
| 3 | | Advanced techniques and contrast agents in oncologic imaging | 1 |

| | | |
|---|---|---|
| 4 | Cancer staging using imaging and treatment planning | 2 |
| 5 | Cancer response assessment and clinical trials | 1 |
| 6 | Cancer screening and surveillance | 3 |
| 7 | Interventional oncology | 2 |
| | **SUBTOTAL** | **12** |

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**LECTURE TOPICS IN ONCOLOGIC IMAGING**

**CANCER BIOLOGY AND TREATMENT RELEVANT TO IMAGING**

- Aetiopathogenesis of oncogenesis, angiogenesis, lymphangiogenesis and metastasis including genomics and proteomics
- Principles of treatment including surgery, locoregional therapies, chemotherapy, bone marrow/stem cell transplantation, immunotherapy and radiotherapy
- Detailed biology of different tumour types, particularly the most common cancers: lung, breast, colorectal, and prostate.
- Treatment strategies of different tumour types, particularly the most common cancers: lung, breast, colorectal, and prostate
- Acute and chronic complications of oncologic treatment and their imaging features

## IMAGING TECHNIQUES IN ONCOLOGIC IMAGING

- Indications and contraindications for the various imaging examinations in oncologic imaging for staging and response assessment
- Appropriate imaging examination for oncologic imaging according to the clinical problem: ultrasound, CT, MRI, and hybrid techniques (PET-CT, PET-MRI, SPECT-CT)
- Roles, strengths, weakness and limitations of each imaging technique in oncologic imaging
- Roles of endocavitary/endoscopic US techniques for tumour characterization and staging
- Appropriate endocavitary/endoscopic US investigations
- Contrast material and its optimal use according to the imaging technique and the clinical problem in oncologic imaging
- Relative costs of the various imaging examinations in oncologic imaging
- Radiation burden and risks of different investigations in oncologic imaging
- Techniques for post-processing images used to obtain reformat images such as MIP, MinIP, vessel analysis, 3D analysis
- Techniques for post-processing images used to obtain reformat images such as endoluminal reconstructions, fusion images, and also acquisition and treatment of functional studies in oncologic imaging
- Detailed Imaging findings in US, CT, MRI, nuclear medicine and hybrid imaging techniques
- Detailed Imaging findings in PET/CT, PET/MRI, and pitfalls in diagnosis of patients with cancers
- Detailed of radiotracers used in hybrid imaging in oncology and imaging finding using them
- Indications for functional imaging techniques in oncologic imaging

## ADVANCED TECHNIQUES AND CONTRAST AGENTS IN ONCOLOGIC IMAGING

- Principles of PET-CT for oncologic imaging
- Most important PET tracers with fluorine 18, gallium 68 or carbon 11 including FDG, DOTATATE/DOTATOC, DOPA, choline, PSMA, FLT, F-MISO, acetate
- PET imaging protocols, methods of PET image analysis, data processing, possible pitfalls and limitations of these technique in oncologic imaging
- Principles of advanced MRI techniques used in oncologic imaging such as dynamic contrast-enhanced (DCE) MRI, Diffusion-weighted imaging (DWI), Spectroscopy using 1H, 31P, 13C, Targeted contrast agents and fMRI (BOLD)
- Principles of advanced CT techniques including dynamic contrast enhanced CT (perfusion CT) and Dual-energy computed tomography (DECT) in oncologic imaging

- Principles of contrast-enhanced ultrasound (CEUS) in oncologic imaging
- Imaging protocols and methods of image analysis and data processing for the different MRI, CT and US techniques in oncologic imaging

**CANCER STAGING USING IMAGING AND TREATMENT PLANNING IN ONCOLOGIC IMAGING**

- Imaging anatomy and the pathways of spread for the common cancer types
- Staging systems for common cancer types such current TNM, clinical staging classification, etc and knowledge of their limitations
- Application of imaging techniques including ultrasound, computed tomography, magnetic resonance imaging, nuclear medicine and hybrid techniques PET/CT and PET/MRI for cancer staging
- Appropriate choice of imaging techniques and/or the appropriate sequence of imaging techniques in the investigation of specific clinical problems in oncologic imaging
- Appreciation of common imaging 'false positives' and 'false negatives' in cancer staging, and the role of different imaging techniques for lesion characterisation
- National and international guidelines for staging common cancer types
- Principles of structured and criteria-based reporting in imaging oncology

*Treatment planning in oncologic imaging*

- Role of imaging in treatment planning e.g. surgery, radiotherapy
- National and international guidelines in treatment planning in oncologic imaging

**CANCER RESPONSE ASSESSMENT AND CLINICAL TRIALS**

- Principles of response assessment and an appreciation of the advantage and limitations of the different response criteria e.g. RECIST, combined size and enhancement criteria, iRECIST, PET criteria for evaluation of lymphoma
- Concept of clinical trials, including main endpoints for evaluation of treatments like response rate, disease control rate, time to progression, disease-free and progression-free survival, best overall response
- Concepts of the following: baseline examination, nadir, tumour response, tumour progression, stable disease, target lesion, non-target lesions, new lesions, pseudoprogression
- Advantages and limitations of each imaging method for response evaluation (ultrasound, CT, MRI, nuclear medicine and PET/CT, PET/MRI)

- Role of advanced techniques in response assessment: DCE-MRI, DW-MRI, MR-Spectroscopy, PET/CT, PET/MRI, Perfusion CT
- Challenges of advanced imaging biomarker development in clinical trials: generalizability, standardization, QA, QC
- Awareness of national and international guidelines in cancer response assessment and clinical trials

**CANCER SCREENING AND SURVEILLANCE**

- Principles of screening and the organisation of screening using breast, lung and colorectal cancer as core examples and to have awareness of national and international guidelines in this field
- Major advantages and drawbacks of a screening programmes
- Role for different imaging techniques in surveillance in different cancer types
- Patterns of recurrence in common cancers
- Role of imaging in assessing suspected disease recurrence, and the advantages and limitations of different techniques
- Potential of advanced techniques for surveillance: whole body MRI, PET/CT with different tracers

**INTERVENTIONAL ONCOLOGY**

- Basic principles of safe interventional technique specific to oncology and their complications of the procedures
- Interventional techniques used in oncological radiology
- Common image-guided interventional oncologic procedures including; percutaneous fine needle aspiration, biopsy or drainage and local tumour treatments
- Risks and complications of common procedures in interventional oncology
- Pharmacological actions of the agents used in analgesia and sedation and the necessary monitoring required to perform this safely
- Detailed processes and actions required in intermediate life support and management of anaphylaxis

**EXPECTED SKILLS TO BE ACQUIRED**

- Justify, protocol, conduct and supervise oncological imaging examinations to a high standard
- Confidently tailor examinations appropriately to the clinical question in oncologic imaging

- Confidently interpret all images relevant in the diagnosis, staging, assessment of response and detection of recurrent disease of the common cancers
- Develop resources to be able to diagnose, stage, assess response of unusual tumour types using all imaging modalities
- Accurately assess response to treatment according to recognised objective response criteria in oncologic imaging
- Advise on the appropriate diagnostic imaging and follow-up protocols for different tumour types
- Plan effective imaging pathways for the common cancers
- Confidently discuss the appropriate imaging strategies in oncologic imaging with clinicians within a multidisciplinary setting
- Communicate effectively with patients and professional colleagues in the interdisciplinary oncological team
- Provide clinicians with optimized images which may aid surgical management or treatment planning including the role of imaging in radiotherapy planning and treatment
- Work efficiently with US, CT and MRI-guided interventions and where appropriate, fluoroscopic imaging
- Undertake the following procedures under supervision: US-guided biopsy of masses and lymph nodes; CT-guided biopsy of masses (retroperitoneal, pelvic side-wall, thoracic and lymph nodes) and liver lesions; drainage of collections and local tumour treatments

**COMPETENCES AND ATTITUDES**

- Conduct good clinical care and practice: Be aware of the limits of personal knowledge and to know when to seek further information or help
- Maintain good medical practice: Keep the knowledge base up to date and be able to discuss current medical practice with colleagues and patients
- Maintain good doctor -patient relationship and work in partnership with patients: Be aware of different levels of patient understanding and personality types, to explain diagnostic and therapeutic radiology procedures effectively, and to exhibit a flexible approach taking into account different learning styles and expectations of patients
- Demonstrate good team working skills: Understand the value of team working (multidisciplinary teams) and to demonstrate good communication with professional colleagues

- Give assurance and improve the quality of care: Be able to describe an effective clinical governance approach and to participate in clinical governance processes e.g. clinical audit, guidelines development
- Develop teaching competencies: Understand the principles of teaching and learning, and conduct teaching sessions in a quality assured training programme and develop competence as a clinical supervisor

**HEALTH RESEARCH AND MANAGEMENT (30 UNITS)**

| S/No | COURSE TITLE | COURSE UNIT |
|---|---|---|
| 1 | Research Methodology in Medicine | 3 |
| 2 | Evidence based medicine | 2 |
| 3 | Health Resource and management | 5 |
| 4 | Dissertation (research project) | 15 |
| 5 | Book of Case Reports | 10 |
| | **SUBTOTAL** | **30** |

**DELIVERY MODE:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**ASSESSMENT METHODS:** Lectures, Tutorials, Seminars, Clinicals/practicals, Self-directed learning, Assignments, Conferences.

**LECTURE TOPICS IN RESEARCH AND MANAGEMENT**

**RESEARCH METHODOLOGY IN MEDICINE**

- Overview of role and spectrum of research; budget and sources of funding for research
- Types of health researches in each particular clinical situation and their limitations
- Role of computers in medical research including the use of illustration package such as coreldraw, pain, use of Microsoft for illustrations, etc
- The role of health informatics in medicines
- Detailed knowledge of statistical methods such as (SPSS, EPINFO, SPSS, STATA,Minitab,Statistica, Epdata, Atalas, ANOVA, etc).
- Statistical methods , test of significance and confidence intervals
- Physical and virtual library, internet-based online practicals, questionnaires and information

- Detailed and advanced statistical methods, probability distributions; Advanced Statistical methods, probability distribution, sampling and controls.
- Detailed study and description of hypothesis, hypothesis testing, errors and reporting and eligibility criteria
- Advanced definition of research problems, objectives, variables, study population,, sampling and questionnaires design
- In-dept study and description of the role and spectrum of research, and types of health research and their limitations
- Writing research proposals, (planning and protocol development), proposal presentation at local research groups, departmental, faculty, and external defense
- Writing of dissertations and defense of dissertations at various levels (research group, departmental, faculty and external defense.
- Good clinical practice, clinical governance and clinical trials
- Advanced Literature review literature search, advanced and specialised search engines;
- Cohort studies, cross sectional studies, meta-analysis, Systemic review.
- Basic principles and methods of writing good/quality papers for publications in high quality journals.

**EVIDENCE BASED MEDICINE**

- Ethical considerations in medical research, research design, work schedule, flow charts, data collection, and processing.
- To understand the basic elements of scientific methods and evidence-based medicine
- Design and data analysis for technical and diagnostic performance studies
- Influence of disease prevalence and spectrum on sensitivity, specificity, accuracy, and predictive values
- The detailed use of ROC analysis in radiological studies
- Statistics for critical assessment of published radiological primary and secondary studies (i.e. meta-analyses, cost-effective analyses)
- Basic statistics used in studies comparing different treatments (i.e. randomised controlled trials)
- Principles and practice of clinical audit
- Methods of teaching evidence-based healthcare and didactic lecture in radiology
- Principles and practice of clinical governance and good clinical practice in radiology

- Different types of radiological literature and how to write them in a critical manner
- Planning, executive and analysis of advanced research studies methodologically and in sound manner
- Study of value and methods of evolving imaging technologies and communication technology in medicine

**HEALTH RESOURCE AND MANAGEMENT**

- Principles and detailed understanding of Health care process
- Principles and practice of finance management for non-financial managers
- Principles and overview of healthcare financing in local and international level
- Principles and detailed strategies of performance management
- Principles and basic understanding sustainable development
- Methods for establishment and implementation of sustainable development in healthcare
- Principles and strategies of healthcare planning
- Advanced finance management for non-financial managers
- Detail of concept of emotional intelligence
- Principles and basic understanding of quality assurance in Health care system
- Organization and evaluation of healthcare services
- Leadership principles and practice in public and private healthcare system
- Total quality management and management for change
- Principles and basic understanding of strategic management
- Material resources management in healthcare
- Human resources management in healthcare
- Legal aspect of medical practice in a changing world
- Financial planning for physicians
- Principles and basic understanding of risk management
- Team building and team playership in Healthcare
- Problem-solving and decision-making skill
- Public -private partnership in health care financing and management
- Different scenarios of health resources management and performance of different types of healthcare systems and different countries and regions of the world

- Clinics in health resources and management by visiting health, financial and management institutions of world class both locally and abroad and getting firsthand information of international best practices.

**DISSERTATION (RESEARCH PROJECT)**

- Identification of topic and section, initial literature search and identification of practical problem the research is to address
- Selection of supervisors and approval of topic
- Seminar presentation of dissertation proposal to the department
- Methods of computation and analysis of numerical data
- Research proper and its presentation to departmental academic seminar
- Presentation of dissertation and interpretation of data. to the faculty academic board
- Purpose of clinical decision-making and research in healthcare.

**EXPECTED SKILLS TO BE ACQUIRED »**

- Ability to understand the role and spectrum of research; budget and sources of funding for research
- To know and understand the types of health researches and their limitations
- To know the role of computers in medical research (SPSS, EPINFO, ANOVA, etc), Statistical methods, test of significance and confidence intervals
- To know the use of physical and virtual library, internet-based online practical , questionnaires and information
- To have accurate understanding of the statistical methods, probability distributions; Advanced Statistical methods, probability distribution, sampling and controls.
- To have and in-depth knowledge of hypothesis, hypothesis testing, errors and reporting and eligibility criteria
- To understand the definition of research problems, objectives, variables, study population,, sampling and questionnaires design
- To know the role and spectrum of research, and types of health research and their limitations
- To have advanced knowledge of know how to write research proposals, (planning and protocol development), proposal presentation at local research groups, departmental, faculty, and external defense

- To have advanced knowledge of how to carry out quality research, write of dissertations and defense of dissertations at various levels (research group, departmental, faculty and external defense.
- To have in-depth understanding and show high practical knowledge of good clinical practice, clinical governance and clinical trials
- To have in-depth understanding and show high practical knowledge of evidence-based healthcare
- To have in-depth understanding and show high practical knowledge healthcare management and financing exhibiting international best practices.
- To have in-depth understanding and show high practical knowledge of cohort studies, cross sectional studies, meta-analysis, Systemic review.
- To have in-depth understanding and display advanced practical knowledge of Basic principles and methods of writing good/quality papers for publications in high quality journals.
- To have in-depth understanding and exhibit advanced and high practical knowledge of ethical considerations in medical research, research design, work schedule, flow charts, data collection, and processing.

**COMPETENCES & ATTITUDES »**

- Confidently justify roles and spectrum of research; budget and sources of funding for research
- Confidently choose the best-suited method for evaluating a radiology problem, types of health research in each particular clinical situation and their limitations
- Efficiently communicate with the computer in order to obtain the best possible research result using computer statistical softwares (SPSS, EPINFO, ANOVA, etc), other statistical methods, test of significance and confidence intervals
- Confidently choose and use optimal physical and virtual library, internet-based online practical, questionnaires and information in carrying out health researches
- Confidently apply detailed and advanced statistical methods, probability distributions; advanced Statistical methods, probability distribution, sampling and controls in radiology researches
- Confidently formulate good and accurate hypothesis, design hypothesis testing, errors and reporting and eligibility criteria in radiology research
- Confidently design advanced definition of research problems, objectives, variables, study population, sampling and questionnaires design

- Supervise and teach technical staff to ensure in-depth study and description of the role and spectrum of research, and types of health research and their limitations within radiology
- Confidently write quality research proposals, (planning and protocol development), proposal presentation at local research groups, departmental, faculty, and external defense
- Confidently write, interpret and report research dissertations and defense such dissertations at various levels (research group, departmental, faculty and external defense).
- Confidently practice, supervise and teach technical staff to ensure in-depth Good clinical practice, clinical governance and clinical trials
- Confidently practice, advanced and in-depth evidence-based healthcare
- Exhibit good ethical considerations in medical research, research design, work schedule, flow charts, data collection, and processing.
- Confidently exhibit team building and team player- ship in Healthcare
- Confidently practice problem-solving approach to issues and show good decision-making skills
- Have good knowledge of how to use IT to improve efficiency and quality of care
- Possess good knowledge of how to use IT for proactive communications with peers, clinicians and patients

# CURRICULUM FOR SUBSPECIALIZATION – CLINICAL RADIOLOGY 3

MD programme in Radiology refers to the year of sub-specialization when the Resident in his or her fifth year chooses one of the topics below to study in depth. The Research interest, areas of studies and areas of Teaching will be related to this chosen subject of sub-specialization. Being a more narrowed aspect of Radiology, there is more focused attention with resultant development of the Resident into a recognized authority in the area of Sub-specialization

Each resident is expected to undertake lectures in any one of the below courses in accordance with the expected area of research.

## MD PROGRAMME (-Subspecialty)

| COURSES | Course Code |
|---|---|
| Breast Radiology | RDL 912 |
| Cardiac Radiology | RDL 913 |
| Chest Radiology | RDL 914 |
| Gastrointestinal & Abdominal Radiology | RDL 915 |

| | |
|---|---|
| Head & Neck Radiology | RDL 921 |
| Interventional Radiology | RDL 924 |
| Musculoskeletal | RDL 922 |
| Neuroradiology | RDL 925 |
| Paediatric Radiology | RDL 931 |
| Urogenital Radiology | RDL 936 |
| Forensic & Medicolegal Radiology | RDL 938 |
| Nuclear Medicine | RDL 933 |
| **Health Research & Management** | |
| Research Methodology in medicine | CBC 801 |
| Health Resources Management | CBC 802 |
| Seminars | RDL 939 |
| Dissertation | RDL 940 |

**RDL 931** **Advanced Paediatric Radiology** **2 Credit Units**

## ADVANCED PRINCIPLES OF IMAGING SPECIFIC TO CHILDREN

Detailed discussion of developmental anatomy during childhood, Normal variants in childhood that may mimic disease, To have a advanced understanding of embryology as applied to paediatric diseases, Imaging appearances of various stages of embryonic and fetal development in US and MR imaging, Principles guiding the construction of a child-friendly environment, ALARA principle and dose consideration and their application in paediatric patients, Imaging guideline algorithms specific to children, Indications and contraindications for contrast media within the paediatric population including neonates

**RDL 915 ADVANCED ABDOMINAL RADIOLOGY**

## ADVANCED PRINCIPLES OF ABDOMINAL RADIOLOGY

Knowledge of indications and contraindications for the various imaging examinations in abdominal imaging; Details of costs-benefits of the various imaging examinations in abdominal imaging; Detailed radiation burden and risks of different investigations in abdominal imaging; Advanced contrast studies and enema techniques; Detailed knowledge of contrast-enhanced ultrasound study of the liver and other abdominal organs; Techniques for quantification of diseases using ultrasound, CT and MRI, and their clinical role and limitations, Detailed knowledge of endosonography techniques; Detailed knowledge of techniques for CT colonography, CT/MR enterography and CT/MR enteroclysis; Role for post-processing images in view of obtaining reformatting, MIP, MinIP, vessel analysis, 3D analysis; Endoluminal reconstructions, fusion images, as well as acquisition and postprocessing of functional studies; Detailed technique of PET-CT, (FDG, choline) in abdominal tumours, and liver metastases of extra-abdominal origin; Basic technique for ablation of liver tumours using ultrasound and/or CT guidance; Detailed knowledge of technique of trans-jugular liver biopsy; Principle and results of transarterial chemoembolization; Principles of and Detailed knowledge of therapeutic embolisation techniques used in abdominal imaging; Advanced imaging of the oesophagus, stomach and duodenum, small bowel, colon and rectum, hepatobiliary system, pancreas, peritoneum and abdominal wall, and the spleen.

**RDL 921 Advanced Head & Neck Radiology 2 Credit Units**

## ADVANCED PRINCIPLES OF IMAGING SPECIFIC TO HEAD AND NECK RADIOLOGY

Detailed discussion of temporal bone, facial skeleton, skull base and cranial nerves, orbit and visual pathways, nose, nasopharynx and paranasal sinuses, masticator space, parotid space and carotid space, lymph nodes of the head and neck region, oral cavity, oropharynx and retropharyngeal space, hypopharynx and larynx, thyroid, parathyroid, salivary glands and visceral lesions, congenital and transspatial lesions, including clinical imaging features of congenital abnormalities and pathologies including normal variants.

**RDL 922 ADVANCED MUSCULOSKELETAL RADIOLOGY**

## ADVANCED PRINCIPLES OF IMAGING SPECIFIC TO MUSCULOSKELETAL RADIOLOGY

Advanced knowledge articular fractures and dislocations including chondral and osteochondral lesions and osteochondritis dissecans; Advanced imaging of delayed union, non-union, avascular necrosis, reflex sympathetic dystrophy / complex regional pain syndrome, and myositis ossificans; Stress fractures, fatigue and insufficiency fractures; Imaging and clinical features of avulsion fractures; Imaging features, imaging strategies and clinical features of pathological, and non accidental injury; Advanced imaging of upper limb fractures and dislocations; Pelvic fractures and including associated soft tissue injuries; Advanced imaging of lower limb fractures and dislocations; To describe the typical imaging and clinical features of fractures and dislocations of lower limb including hip fractures and dislocations, femoral fractures, tibial and fibular fractures (including the ankle joint), hindfoot fractures, tarso-metatarsal fractures and dislocations and forefoot fractures and dislocations; To describe the typical imaging and clinical features of soft tissue injuries of the shoulder, including rotator cuff injuries, glenoid labrum injuries and biceps tendon injuries; Bone and soft tissue injuries of the knee, including meniscal injury, cruciate ligament injury, and collateral ligament injury; Bone and soft tissue injuries of the ankle including injuries of the principal tendons and ligament; Advanced imaging of bone infections, tumour and tumour-like bone conditions, haematological bone disorders, metabolic bone disorders, endocrine bone disorders, toxic bone disorders, joint disorders, congenital bone anomalies, developmental bone disorders and the miscellaneous bony lesions.

**RDL 914** **Advanced Chest Radiology** **2 Credit Units**

## ADVANCED PRINCIPLES OF IMAGING SPECIFIC TO CHEST RADIOLOGY

Detailed discussion of solitary and multiple pulmonary nodules, radiology of benign and malignant lung tumours, radiology of inflammatory, infectious lung diseases, airways, obstructive & interstitial lung disease, thoracic disease in immunocompetent, immunocompromised and posttransplant patients**,** congenital anomalies and pulmonary vascular disease, airways and obstructive lung disease, interstitial lung disease, pleura and the diaphragm, mediastinal and hilar disease, thoracic aorta and the great vessels, chest trauma and post-operative chest including clinical imaging features of congenital abnormalities and pathologies including normal variants.

**RDL 924** **ADVANCED INTERVENTIONAL RADIOLOGY**

## ADVANCED PRINCIPLES OF INTERVENTIONAL RADIOLOGY

Clinical imaging relevant to acquisition parameters of CTA, MRA including contrast materials used and reconstruction techniques; Clinical, imaging and imaging features of CTA and MRA of atherosclerotic disease, vasculitis, aneurysmal disease, thrombosis, embolism and other vascular pathological conditions; Advanced principles of MR angiography (MRA), CTA techniques; Advantages and disadvantages of different contrast materials used for MRA, CTA and US; Differences between time-of-flight, phase contrast, and contrast-enhanced techniques pertaining to MRA; To discuss the advantages and disadvantages of MRA compared with other techniques; To have an in-depth understanding of nephrogenic systemic fibrosis (NSF); Clinical hands-on on non-invasive imaging; Advanced diagnostic angiography and venography; Advanced vascular intervention and hands-on skill acquisition; Biopsy and thermal ablation; Non-vascular interventional biopsies and fluid drainages; Advanced hepatobiliary and genitourinary interventions.

| | | | | |
|---|---|---|---|---|
| **RDL** | **939** | **SEMINARS** | **=** | **6 CREDIT UNITS** |
| **RDL** | **940** | **THESIS/DISSERTATION** | **=** | **12 CREDIT UNITS** |

# NATIONAL POSTGRADUATE COLLEGE OF NIGERIA

# FACULTY OF RADIOLOGY RESIDENCY LOG BOOK

LOG BOOK FOR PART 1

| TRAINEE'S NAME |
| --- |
| |

RESIDENT'S DATA

| | |
|---|---|
| | |
| (SURNAME) | (OTHER NAMES) |
| | |
| (ADDRESS) | |
| | |
| (TRAINING CENTRE) | |
| | |
| (CONSULTANT IN CHARGE OF TRAINING) | |
| | |
| | |
| (DATE TRAINING COMMENCED) | (EXAM PART) |
| | |
| (RESIDENTS SIGNATURE) | (DATE) |
| | |
| *I certify that the trainee has been personally involved in the radiological management of the cases listed in this log book.* | |
| | |
| SIGNED (CONSULTANT-IN-CHARGE) | (DATE) |

## CASES FOR DOCUMENTATION IN LOG BOOK

| S/N | PART | NO | DETAILS |
|---|---|---|---|
| **SECTION A. PLAIN RADIOGRAPY - 200 (Reports under Supervision)** | | | |
| **1.** | **CHEST** | **70** | **Normal, congenital, Infections/inflammation, trauma, masses- benign/malignant, airway disease, interstitial disease, pleural disease** |
| **2.** | **SPINE** | **50** | **Normal, degenerative disease, congenital, Infections/inflammation, trauma, masses- benign/malignant** |
| **3.** | **JOINT** | **60** | **Normal, degenerative disease, congenital, Infections/inflammation, trauma** |
| **4.** | **EXTREMITIES** | **20** | **Normal, congenital, Infections/inflammation, trauma, masses- benign/malignant** |
| **SECTION B. MAMMOGRAPHY- 50 (Reports under Supervision)** | | | |
| **5.** | **POSITIONING** | **20** | |
| **6.** | **NORMAL** | **20** | |
| **7.** | **ABNORMAL** | **30** | **masses- benign/malignant, Infections/inflammation** |
| **8.** | **DUCTOGRAM** | **1** | |
| **SECTION C. CONTRAST STUDIES- 90 (Assists and Reports under Supervision)** | | | |
| **9.** | **BARIUM** | **15** | **Swallow, meal and follow through, Enema, loopogram** |
| **10.** | **FISTULOGRAM /SINOGRAM** | **5** | **Any indication** |
| **11.** | **SIALOGRAM** | **2** | **Calculus, duct , mass** |
| **12.** | **IVU** | **20** | **Congenital, calculi, obstruction, masses, trauma** |
| **13.** | **MCUG** | **15** | **Congenital, Reflux, trauma, post-operative, masses, Infections/inflammation** |
| **14.** | **RCUG** | **15** | **Strictures, trauma, congenital** |
| **15.** | **HSG** | **15** | **Endometrial, fallopian tube, cervix** |
| **16.** | **OTHERS** | **3** | |
| **SECTION D. ULTRASONOGRAPHY- 125 (Observes 60%; Performs under supervision 40%)** | | | |
| **17.** | **Abdomen** | **40** | **Liver, gallbladder, spleen, kidneys, peritoneum, retroperitoneum-** masses- benign /malignant, vascular, trauma, Infections/Inflammatory conditions. |
| **18.** | **Pelvis** | **20** | **Urinary bladder, prostate, ovaries, uterus, adnexia,** Transplant kidney |
| **19.** | **Obstetric** | **30** | **All Trimesters- normal, abnormal- fetal growth, placental, amniotic fluid, fetal demise** |
| **20.** | **Neck** | **10** | **Thyroid, parathyroid, salivary glands, vessels, masses,** Infections/Inflammatory conditions |
| **21.** | **Breast** | **10** | Masses- benign /malignant, Duct, Infections/Inflammatory conditions. |
| **22.** | **Scrotum** | **5** | Masses- benign /malignant, congenital, Infections/Inflammatory, vascular conditions |
| **23.** | **Neonatal** | **5** | **Head, Hip, Spine** |
| **24.** | **Doppler** | **5** | **Carotid, Lower limb veins and Arteries, Renal, others** |
| **SECTION E. COMPUTED TOMOGRAPHY - 50 (Patient Preparation and Reports under supervision)** | | | |
| **25.** | **Brain** | **25** | **Cerebrovascular disease, Masses-** benign /malignant**, trauma,** Infection/inflammatory conditions, vascular, Adult/Child, demyelinating diseases |
| **26.** | **Abdomen/Pelvis** | **10** | **Masses-** benign /malignant**, calculi, trauma,** Infection/inflammatory conditions, vascular |

| | | | |
|---|---|---|---|
| 27. | **Chest** | **5** | **Congenital, Masses-** benign /malignant**, calculi, trauma, interstitial lung disease,** Infection/inflammatory conditions, vascular, COAD, Pleural lesions |
| 28. | **CT Angiogram** | **3** | **Any indication** |
| 29. | **Spine** | **3** | **Congenital, Trauma,** Degenerative changes with complication, masses |
| 30. | **Joints** | **2** | **Trauma, degenerative** |
| 31. | **Head and Neck** | **2** | **Facial bones, Sinuses, Airway, Salivary glands, Mastoids, Ear, Orbits- Congenital, Masses-** benign /malignant**, calculi, trauma,** Infection/inflammatory conditions, vascular |
| **SECTION F. MAGNETIC RESONANCE IMAGING-30 (Patient Preparation and Reports under supervision)** | | | |
| 32. | **Brain** | **10** | **Cerebrovascular disease, Masses-** benign /malignant**, trauma,** Infection/inflammatory conditions, vascular, Adult/Child, demyelinating diseases |
| 33. | **Spine** | **12** | **Congenital, Trauma,** Degenerative changes with complication, masses |
| 34. | **Abdomen/Pelvis** | **2** | **Masses-** benign /malignant**,** Infection/inflammatory conditions, vascular |
| 35. | **MRI Angiogram** | **2** | |
| 36. | **Joints** | **2** | **Congenital, trauma, degenerative,** Infection/inflammatory |
| 37. | **Head and Neck** | **2** | **Facial bones, Sinuses, Airway, Salivary glands, Mastoids, Ear, Orbits- Congenital, Masses-** benign /malignant**, calculi, trauma,** Infection/inflammatory conditions, vascular |
| **SECTION G. INTERVENTIONAL PROCEDURES-5 (Observes and Assists)** | | | |
| 38. | CT guided | **2** | **Any indication** |
| 39. | Ultrasound guided | **3** | **Any indication** |
| **SECTION H. CONVENTIONAL ANGIOGRAPHY- 1 (Observes)** | | | |
| 40. | **Any Indication** | | **Diagnostic or interventional** |
| **SECTION I. NUCLEAR MEDICINE SECTION - 5 (Observes)** | | | |
| 41. | **Any Indication** | **5** | **Renal, thyroid, bone scans** |

## SECTION A. PLAIN RADIOGRAPHY

| REGISTRATION | PATIENT'S DATA | STUDY DETAILS | SUPERVISOR |
|---|---|---|---|

| HOSPITAL NO. | DATE | NAME | AGE | SEX | INDICATION | SIGNIFICANT FINDINGS | IMPRESSION / DIFFERENTIAL DIAGNOSIS | CONSULTANTS NAME SIGNATURE |
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## DECLARATION

I declare that the details documented in this book represents work that I have personally done or been part of.

I am aware that appropriate filling of the log book is a pre-requisite to writing my exam.

I am aware that documenting work that I have not been part of can prevent me from writing the exam.

NAME: …….

SIGNATURE ……..

DATE: …….

# NATIONAL POSTGRADUATE COLLEGE OF NIGERIA

# FACULTY OF RADIOLOGY RESIDENCY LOG BOOK

LOG BOOK FOR PART 2

| TRAINEE'S NAME |
| --- |
| |

RESIDENT'S DATA

| | |
|---|---|
| | |
| (SURNAME) | (OTHER NAMES) |
| | |
| (ADDRESS) | |
| | |
| (TRAINING CENTRE) | |
| | |
| (CONSULTANT IN CHARGE OF TRAINING) | |
| | |
| | |
| (DATE TRAINING COMMENCED) | (EXAM PART) |
| | |
| (RESIDENTS SIGNATURE) | (DATE) |
| | |
| *I certify that the trainee has been personally involved in the radiological management of the cases listed in this log book.* | |
| | |
| SIGNED (CONSULTANT-IN-CHARGE) | (DATE) |

CASES FOR DOCUMENTATION IN LOG BOOK

| S/N | PART | NO | DETAILS |
|---|---|---|---|
| **SECTION A. PLAIN RADIOGRAPY – 200 (Reports under Supervision 40%, independent 60%)** | | | |
| 42. | **CHEST** | **70** | **Normal, congenital, Infections/inflammation, trauma, masses- benign/malignant, airway disease, interstitial disease, pleural disease** |
| 43. | **SPINE** | **50** | **Normal, degenerative disease, congenital, Infections/inflammation, trauma, masses- benign/malignant** |
| 44. | **JOINT** | **60** | **Normal, degenerative disease, congenital, Infections/inflammation, trauma** |
| 45. | **EXTREMITIES** | **20** | **Normal, congenital, Infections/inflammation, trauma, masses- benign/malignant** |
| **SECTION B. MAMMOGRAPHY- 50 (Reports under Supervision 40%, independent 60%)** | | | |
| 46. | **POSITIONING** | **20** | |
| 47. | **NORMAL** | **20** | |
| 48. | **ABNORMAL** | **30** | **masses- benign/malignant, Infections/inflammation** |
| 49. | **DUCTOGRAM** | **1** | |
| **SECTION C. CONTRAST STUDIES- 90 (Performs procedure & Reports under Supervision 50%, independently 50%)** | | | |
| 50. | **BARIUM** | **15** | **Swallow, meal and follow through, Enema, loopogram** |
| 51. | **FISTULOGRAM /SINOGRAM** | **5** | **Any indication** |
| 52. | **SIALOGRAM** | **2** | **Calculus, duct , mass** |
| 53. | **IVU** | **20** | **Congenital, calculi, obstruction, masses, trauma** |
| 54. | **MCUG** | **15** | **Congenital, Reflux, trauma, post-operative, masses, Infections/inflammation** |
| 55. | **RCUG** | **15** | **Strictures, trauma, congenital** |
| 56. | **HSG** | **15** | **Endometrial, fallopian tube, cervix** |
| 57. | **OTHERS** | **3** | |
| **SECTION D. ULTRASONOGRAPHY- 125 (Performs procedure & Reports under Supervision 30%, independently 70%)** | | | |
| 58. | **Abdomen** | **40** | **Liver, gallbladder, spleen, kidneys, peritoneum, retroperitoneum-** masses- benign /malignant, vascular, trauma, Infections/Inflammatory conditions. |
| 59. | **Pelvis** | **20** | **Urinary bladder, prostate, ovaries, uterus, adnexia,** Transplant kidney |
| 60. | **Obstetric** | **30** | **All Trimesters- normal, abnormal- fetal growth, placental, amniotic fluid, fetal demise** |
| 61. | **Neck** | **10** | **Thyroid, parathyroid, salivary glands, vessels, masses,** Infections/Inflammatory conditions |
| 62. | **Breast** | **10** | Masses- benign /malignant, Duct, Infections/Inflammatory conditions. |
| 63. | **Scrotum** | **5** | Masses- benign /malignant, congenital, Infections/Inflammatory, vascular conditions |
| 64. | **Neonatal** | **5** | **Head, Hip, Spine** |
| 65. | **Doppler** | **5** | **Carotid, Lower limb veins and Arteries, Renal, others** |
| **SECTION E. COMPUTED TOMOGRAPHY - 50 (Patient Preparation and Reports under supervision 50%, independently 50%)** | | | |
| 66. | **Brain** | **25** | **Cerebrovascular disease, Masses-** benign /malignant**, trauma,** Infection/inflammatory conditions, vascular, Adult/Child, demyelinating diseases |

| | | | |
|---|---|---|---|
| 67. | **Abdomen/Pelvis** | **10** | **Masses-** benign /malignant**, calculi, trauma,** Infection/inflammatory conditions, vascular |
| 68. | **Chest** | **5** | **Congenital, Masses-** benign /malignant**, calculi, trauma, interstitial lung disease,** Infection/inflammatory conditions, vascular, COAD, Pleural lesions |
| 69. | **CT Angiogram** | **3** | **Any indication** |
| 70. | **Spine** | **3** | **Congenital, Trauma,** Degenerative changes with complication, masses |
| 71. | **Joints** | **2** | **Trauma, degenerative** |
| 72. | **Head and Neck** | **2** | **Facial bones, Sinuses, Airway, Salivary glands, Mastoids, Ear, Orbits- Congenital, Masses-** benign /malignant**, calculi, trauma,** Infection/inflammatory conditions, vascular |
| **SECTION F. MRI -30 (Patient Preparation and Reports under supervision 50%, independently 50%)** | | | |
| 73. | **Brain** | **10** | **Cerebrovascular disease, Masses-** benign /malignant**, trauma,** Infection/inflammatory conditions, vascular, Adult/Child, demyelinating diseases |
| 74. | **Spine** | **12** | **Congenital, Trauma,** Degenerative changes with complication, masses |
| 75. | **Abdomen/Pelvis** | **2** | **Masses-** benign /malignant**,** Infection/inflammatory conditions, vascular |
| 76. | **MRI Angiogram** | **2** | |
| 77. | **Joints** | **2** | **Congenital, trauma, degenerative,** Infection/inflammatory |
| 78. | **Head and Neck** | **2** | **Facial bones, Sinuses, Airway, Salivary glands, Mastoids, Ear, Orbits- Congenital, Masses-** benign /malignant**, calculi, trauma,** Infection/inflammatory conditions, vascular |
| **SECTION G. INTERVENTIONAL PROCEDURES-5 (Assists 30%, independently 70%)** | | | |
| 79. | CT guided | **2** | **Any indication** |
| 80. | Ultrasound guided | **3** | **Any indication** |
| **SECTION H. CONVENTIONAL ANGIOGRAPHY- 1 (Assists)** | | | |
| 81. | **Any Indication** | | **Diagnostic or interventional** |
| **SECTION I. NUCLEAR MEDICINE SECTION - 5 (Assists)** | | | |
| 82. | **Any Indication** | **5** | **Renal, thyroid, bone scans** |

## SECTION A. PLAIN RADIOGRAPHY

| REGISTRATION | | *PATIENT'S DATA* | | | *STUDY DETAILS* | | | SUPERVISOR |
|---|---|---|---|---|---|---|---|---|
| HOSPITAL NO. | DATE | *NAME* | *AGE* | *SEX* | *INDICATION* | *SIGNIFICANT FINDINGS* | *IMPRESSION / DIFFERENTIAL DIAGNOSIS* | CONSULTANTS NAME SIGNATURE |
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## DECLARATION

I declare that the details documented in this book represents work that I have personally done or been part of.

I am aware that appropriate filling of the log book is a pre-requisite to writing my exam.

I am aware that documenting work that I have not been part of can prevent me from writing the exam.

NAME: …….

SIGNATURE ……..

DATE: …….

# NATIONAL POSTGRADUATE MEDICAL COLLEGE OF NIGERIA
## FACULTY OF RADIOLOGY
### CRITERIA FOR GRADING OF DISSERTATIONS

**Name of Candidate-**

**Title of Dissertation-**

| **Section of Dissertation** | | **Assigned Marks** | **Candidate's Score** |
|---|---|---|---|
| 1. | Topic / Title Page | 2 | |
| 2. | Abstract (2) /Introduction (3) | 5 | |
| 3. | Aim & Objectives (3) / Justification (3) / Hypothesis & Sub-Hypothesis (2) | 8 | |
| 4. | Gross Anatomy (3) / Radiological Anatomy (5) ( Including Quality of Line Drawings & Medical Images) | 8 | |
| 5. | Literature Review: Style (3);Comprehensiveness (3) ; Currency of Cited Literature (3);*Vancouver Style/* Format (3) | 12 | |
| 6. | Materials & Methods: Study Design (3) / Informed Consent (3) / Data Collection (3) /Method of Statistical Analysis of Data (3) / Limitations of Study (3) | 15 | |
| 7. | Results: Demography (Age Range / Mean Age / Sex Distribution of Cases – 2) ; Depth of Analysis (4); Interpretation of Results (4) ; Quality of Tables & Captions / Quality of Statistical Illustrations & Legends i.e. Linear Graphs / Pie Charts / Bar Charts / Scatter Plots (4); Quality of Medical Images & Legends (4) | 18 | |
| 8. | Discussion: Sequence of the Discussion (3); Presentation of Cited Literature (3); Comparison of the Results from the Current Study with Previous Studies and Highlighting Areas of Agreement or Differences (5) ; Contribution to Knowledge (2); Breaking of New Ground (2) | 15 | |
| 9. | Conclusion: Highlights of the Important Findings of the Study with Emphasis on the Outcome of Clinical Hypothesis (2) / Clinical Sub-hypothesis (2) Testing | 4 | |
| 10. | List of References: Conformity with *Vancouver Style* Format (2); Layout of Book References (2); Currency of References (1); Comprehensive of References (1) | 6 | |
| 11. | Approval from Institutional Ethics Review Committee | 2 | |
| 12. | Miscellaneous: Spelling (2); Grammar (2); Syntax (1) | 5 | |
| | Total Score (%) | 100 | |

**Comment-**

**CURRICULUM FOR PARTS I and II RADIATION & CLINICAL ONCOLOGY**

# Introduction

**Radiation and Clinical Oncology (Radiotherapy)** is a branch of clinical medicine that uses ionizing radiation either alone or in combination with other modalities for treatment of patient with malignant or other disease

**Radiation Oncology** includes responsibility for the diagnosis, treatment, follow up and supportive care for the cancer patients as an integral part of the multidisciplinary management of patients

The specialty of Radiation Oncology involves all aspects of radiation therapy and clinical oncology with a view to provide comprehensive care for cancer patients.

The purpose of this document is to define the present curriculum for each phase of training. Training will be delivered in a modular fashion and training objectives are identified for all the constituent subspecialties of Radiation and Clinical Oncology (Radiotherapy), completion of which will lead to the award of the Fellowship in Radiation and Clinical Oncology (FMCR- RCO) of the National Postgraduate Medical College of Nigeria. Training for the Fellowship in Radiation Oncology of the National Postgraduate Medical College of Nigeria must take place in departments accredited for training by the National Postgraduate Medical College of Nigeria (NPMCN). Training schemes will be centered on teaching in specialist hospitals with radiotherapy facilities and personnel. All training centers will be visited regularly by the NPMCN for the purpose of accreditation.

## THE CORE CURRICULUM GENERAL COMPETENCIES

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| | | |

| | | |
|---|---|---|
| **1. Able to relate knowledge of clinical and radiological anatomy, physics and biology to diagnosis and therapy** | Understand clinical and radiological anatomy | Able to identify landmarks, key structures including vessels, lymph nodes on CT and MRI<br>Able to interpret X-ray, CT, MRI and PET imaging<br>Able to apply knowledge of the biological and physics basis of RT to clinical practice |
| **2. Able to diagnose and stage cancer** | Understands the epidemiology and aetiology of the cancer.<br>Knows the indications for urgent referral by family doctors/GP<br>Knows the staging systems and prognostic indices<br>Aware of the techniques available and limitations of histology and immunohisto-chemistry and other specialist techniques | Able to take a focused history and perform a focused examination<br>Able to recommended appropriate diagnostic and staging investigations |
| **3. Able to assess prognosis** | Knows the effect of performance status, stage, age, co-morbidity, histological type and other prognostic factors | Able to identify prognostic factors |
| **4. Able to assess if there is a significant genetic/ proteomic basis for the cancer** | Knows the features of the personal and family medical history that indicate a high risk of a genetic basis of the disease<br>Understands when referral for genetic counselling is appropriate<br>Knows how a gene abnormality affects the patient's prognosis | Able to take an accurate family history<br>Able to discuss the possibility of referral for genetic counselling with the patient<br>Able to explain to the patient how the treatment options may be altered by a genetic abnormality |

| **Learning Outcomes** | **Knowledge** | **Skills/Expertise** |
|---|---|---|
| **5. Able to discuss treatment** | Understands the indications | Able to inform patients on |

| | | |
|---|---|---|
| **options in the light of the prognosis** | for curative therapy and its side effects<br>Understands benefits and toxicity of palliative treatment | treatment options and discuss the individual risk/benefit and to elicit the patient's wishes with regard to the aims of treatment |
| **6. Able to develop an evidence based treatment strategy and to assess patients for curative and palliative external beam radiotherapy and brachy-therapy** | Understands the indications for treatment and the risks and benefits of different treatment options.<br>Aware of the results of major randomized trials that have influenced present practice<br>Aware of local, national and/or international guidelines | Able to take an appropriate history and perform and appropriate examination.<br>Able to develop a treatment plan based on own expertise and by discussions in the multidisciplinary teams |
| **7. Able to evaluate and synthesise research evidence to change practice** | Knows and can evaluate the published research evidence<br>Aware of and can evaluate ongoing trials of both radiotherapy and systemic therapy<br>Knows the national and international guidelines | Able to discuss evidence at MDT and contribute to guideline development<br>Able to discuss with colleagues involvement in clinical trials<br>Able to synthesise departmental, evidence based guidelines for the management of tumour sites<br>Able to introduce new treatments and techniques to a department |
| **8. Able to consent patients for radiotherapy** | Understands the acute and long term risks of radiotherapy, the aims of treatment and the prognosis | Able to communicate about these issues and risk/benefit ratio with patients<br>Able to take informed consent from patients and complete the form accurately |
| **9. Able to prescribe appropriate dose and fractionation schedule for curative and palliative external beam radiotherapy and brachy-therapy** | Knows dose/fractionation schedules in common use | Able to define appropriate treatment schedule according to stage of disease, performance status of patients and concomitant systemic therapy, knowledge relative to TV and OAR |
| **Learning Outcomes** | | |

| | Knowledge | Skills/Expertise |
|---|---|---|
| **10. Able to develop a radio-therapy treatment strategy and technique** | Knows the radiotherapy modality and possible beam arrangements<br>Knows the patient position and immobilization technique<br>Knows the method of tumour localisation | Able to communicate effectively to the planning radiographers and physicists the imaging and treatment technique and document all aspects of the planning process clearly |
| **11. Able to determine the GTV, CTV, ITV, PTV, OAR and PRV as appropriate for external beam radiotherapy and brachytherapy** | Able to interpret diagnostic imaging (including CT, PET and MR)<br>Understands the use of cross-sectional imaging in planning<br>Understands the clinical and radiological parameters associated with planning 2D conventional and 3D conformal radiotherapy | Able to define a treatment volume<br>Able to define organs at risk and outline them<br>Able to define DVH based 3D conformal planning constraints |
| **12. Able to evaluate an external beam radiotherapy/brachy-therapy treatment plan in collaboration with physicists and radiographers and knowing the responsibilities of own and others actions** | Knows the ICRU guidelines for prescribing, reporting and recording dose<br>Knows the general process and workflow to achieve a treatment plan , treatment sessions and follow up (national or local recommendations) | Able to critically assess the dose distribution within the treatment volume and organs at risk<br>Able to identify whether a treatment plan is adequate and suggest ways of improving an inadequate plan<br>Able to take responsibility for the complete treatment plan |
| **13. Able to evaluate the risk of a EBRT/brachytherapy treatment plan** | Knowledge of the tolerance of the organs at risk and dose limitations | Able to critically assess the dose distribution within the treatment volume and organs at risk<br>Able to balance tumour control against potential damage to organs at risk |

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **14. Able to modify treatment plans according to patient's individual needs, pre-morbid conditions, toxicity of radiotherapy and systemic treatments etc.** | Aware of normal tissue morbidity and its impact on target volume definition<br>Understands risks of re-treatment with radiation based on normal tissue tolerance limits<br>Understands the type and severity of the toxicity added to radiotherapy by systemic treatments | Able to judge how to modify treatment plans based on patient's comorbidity and toxicity of systemic therapies<br>Able to assess when re-treatment is acceptable and prescribe appropriate dose and fractionation |
| **15. Able to participate in Quality assurance and follow safety policies** | Knowledge of the quality assurance procedures for the accelerators: measurements, required maintenance and levels of uncertainties accepted<br>Knowledge of the quality assurances procedures for treatment :level of tolerance accepted for set up margins, for TPS calculations and evaluations | Able to contribute to the quality assurance and general safety policies of the department |
| **16. Aware of the clinical implications of IMRT and of other techniques such as stereotactic and particle radiotherapy** | Can describe the theoretical benefits and risks of IMRT<br>Aware of the use of IMRT in different tumour sites<br>Aware of the need for quality assurance for IMRT and other techniques | Able to evaluate and give the final approval to an IMRT plan and –where available – to other plans such as those for stereotactic and particle radiotherapy |
| **17. Able to contribute to planning using IMRT and other techniques such as stereotactic, particle and IGRT** | Able to define, GTV, CTV and PTV as appropriate<br>Knows dose constraints for normal tissue | Able to draw the volumes of interest of a plan<br>Able to specify dose and tissue constraints for relevant organs |
| **18. Able to verify a radiotherapy treatment** | Aware of the techniques that are available to verify treatment plans | Able to assess accuracy of patient set-up and recommend adjustments |
| **19. Aware of the clinical implications of IGR** | Understands the indications, aims and know the methods available | Able to assess accuracy of patient set-up and recommend adjustments |

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **20. Aware of the clinical implications and procedures of brachytherapy using sealed and unsealed sources** | Understands the indications and aims of treatment<br>Can describe the methods available<br>Able to describe the principles of dose prescription<br>Is aware of the radiation protection issues<br>Understands the acute and long term toxicities and can define the organs at risk | Able to practice the basic procedures of brachytherapy and to gain an operational knowledge of the specific techniques<br>Able to apply radiation protection principles when assessing patients receiving brachytherapy |
| **21. Able to assess and manage patients undergoing external beam radiotherapy and brachytherapy** | Understands early reactions to radiotherapy and their management | Able to assess and treat patients in an on-treatment clinic |
| **22. Be able to modify course of radiotherapy treatment for individual patients according to severity of reactions including adjustment for gaps in treatment** | Understands the radiobiology associated with curative radiotherapy | Able to modify course of radiotherapy treatment for individual patients |
| **23 Be able to assess patients for combined modality therapy** | Understands the circumstances in which this might be considered | Able to elicit the patient's wishes with regard to the aims of treatment<br>Able to discuss the side effects and risk/benefit ratio with patients |
| **24 Able to administer and take clinical responsibility for the delivery of radiation therapy together with systemic agents (and where necessary to work in collaboration with other medical specialists involved in systemic therapies ) on an in- or out-patient basis** | Understand the implications of systemic treatments | Able to modulate the treatment with drugs and radiation according to the patient situation – if needed, in collaboration with other specialists |
| **25. Able to consent patients for phase 2 and phase 3 trials trials and maintain appropriate research records** | Understand research ethics<br>Knowledge of Good Clinical Practice (GCP) and national laws related to research on | Able to discuss options of entering a clinical trial |

| Learning Outcomes | Knowledge | Skills/Expertise |
|---|---|---|
| **26. Able to evaluate response of treatment and define follow-up plan** | Knowledge of patterns and time frame of relapse<br>Knowledge of RECIST and of the other common criteria for formalized response evaluation | Able to follow national/local guidelines or design a plan for follow-up<br>Able to use the appropriate methods for evaluating the response to treatment |
| **27. Able to diagnose suspected relapse** | Knowledge of signs and symptoms of relapse, tumour markers and appropriate imaging | Able to take an appropriate history and perform a focuses examination in out-patient clinics<br>Able to identify appropriate investigations for patients suspected of having relapsed<br>Able to interpret imaging (CT, MRI, PET) |
| **28. Able to develop a management plan for patients whose disease has relapsed alone or in collaboration with other specialists** | Aware of the role of surgery, interventional radiology, radiotherapy, chemotherapy, monoclonal antibodies, tyrosine kinase inhibitors, interferons, interleukins, symptom control and palliative care in patients with relapsed disease | Able to elicit the patient's wishes with regard to the aims of treatment and to give the treatment alone or in collaboration with other specialists |

The NPMCN expects that trainee **appraisal takes place within each module of training and at the end of each year of training**. The purpose of appraisal is to assess the progress of the trainee through each module to anticipate and correct any deficiencies in training at an early stage.

The First FNPMCN and Final FNPMCN Part A Examinations currently test knowledge through multiple choice, essays questions.
The Final FNPMCN Part B Examination assesses competence (interpretative, analytical and communication skills) while Part C will assess Research skills.

## Training programmes Radiation and Clinical Oncology(Radiotherapy)

### DURATION OF TRAINING

Each trainee in Radiation and Clinical Oncology will undertake a programme of structured training over a minimum period of five(6) years full time in order to achieve a level of competency in all aspects of radiation oncology that will enable him/her to practice as a specialist.

### PART 1(36 M0NTHS)

- Radiation biology – 4 months
- Medical physics – 5 months
- Biostatistics- 2 months
- Radiation safety – 2 months.
- Radiation and clinical oncology practice -10 months

**Clinical rotations (mandatory**)-

- Surgery, (2 months)
- Gynaecology, (2 months)
- Medicine, (2 months)
- Paediatrics, (2 months)
- Radiology (2 months)
- Pathology (3 months)
- The Part I Fellowship Examination in Radiation and Clinical Oncology of the NPMCN comprises

a) MCQ , OSCE and oral examinations

- Radiation physics and radiation safety
- Radiation Biology

- Medical Statistics
- Clinical Oncology
- Pathology of Neoplastic Disease
- Clinical and Oral Examinations in Radiation Physics, Radiation Biology and Clinical Oncology.

b) Clinical Examinations comprise of long and short cases

## A. PART I FMCR RADIATION AND CLINICAL ONCOLOGY TRAINING (36 months)

CONTENTS OF TRAINING AND LEARNING OUTCOMES TOTAL :129UNITS

| S/No | Course Name | Course Code | MODE OF DELIVERY | ASSESSMENT METHODS | Course Unit | Learning outcome |
|---|---|---|---|---|---|---|
| 1 | ACLS | CBC701 | Didactic Lectures **Demonstrations** | Written Examinations Oral examination Procedure log Objective structured clinical examination | 2 units | Advanced Life Support (ALS) is a set of life-saving protocols and skills that extend Basic Life Support to further support the circulation and provide an open airway and adequate ventilation (breathing). |
| 2 | Medical physics, Radiation safety | RCO 710 | Lectures, Tutorials, Assignments, self-directed learning | MCQ OSCE Oral examination | 20 | Understanding physics of radiation and its clinical applications for purposes of management of oncology patients and protection of personnel |
| 3 | Radiobiology | RCO 711 | Lectures, Tutorials, Assignments, self-directed learning | MCQ OSCE Oral examination | 25 | Understanding the impact of radiation on biological matter and clinical manifestations |
| 4 | Pathology | RCO 712 | Lectures, Tutorials, Assignments, self-directed learning | MCQ OSCE Oral examination | 34 | -Understanding the biology of normal and cancer cell function and growth, on both microscopic and molecular levels<br>- Integration of pathology skills and knowledge into the management of **patients with cancer** |
| 5 | Biostatistics | RCO 713 | Lectures, Tutorials, Assignments, self-directed learning | MCQ, OSCE Oral examination | 8 | Application of basic knowledge of biostatistics in the management of oncology patients and research. |
| 6 | Radiation and clinical oncology practice | RCO 714 | Lectures, Tutorials, Seminars,clinicals/ practicals, Assignments, self-directed learning, conferences | MCQ, OSCE Clinical and **Oral examinations**, **short and long cases** | 42 | Understanding and Instituting optimal plan for individualized patient management using radiation beams and other treatment modalities |

# COURSE CBC 710

## Outline for Full ACLS Provider Course

**Approximate course duration: 10 hours 15 minutes**
**(Student-instructor ratio for learning stations is 6:1)**

American Heart Association.

| Lesson Map | Course Event | Duration (min) | Type of Lesson |
|---|---|---|---|
| ACLS START | Welcome, Introductions, and Course Administration | 5 | |
| ACLS 1A-B | ACLS Course Overview and Organization | 5 | |
| ACLS 2A-B | BLS and ACLS Surveys | 20 | |
| ACLS 3A-F | Management of Respiratory Arrest | 45 | PWW T |
| ACLS 4A-C | CPR and AED Practice and Testing | 45 | PWW T |
| ACLS 5A-B | The Megacode and Resuscitation Team Concept | 25 | |
| ACLS 6A-D | Cardiac Arrest (VF/Pulseless VT) | 90 | |
| ACLS 7A-J 8A-K | ACS and Stroke Learning Station | 90 | |
| ACLS 9A-E | Bradycardia/PEA/Asystole | 45 | |
| ACLS 10A-E | Tachycardia, Stable and Unstable | 45 | |
| ACLS 11A-D | Putting It All Together | 95 | |
| ACLS T3-5 | Megacode Test | 60 | T |
| ACLS T6-7 | Written Test | 45 | T |
| ACLS REM | Remediation | Variable | T |
| **Total instructional time with 6:1 student-to-instructor ratio: approximately 10 hours 15 minutes (not counting breaks and transition times)** | | | |

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**COURSE RCO 710. LEARNING TOPICS IN MEDICAL PHYSICS AND RADIATION SAFETY**

| | COURSE TITLE | CREDIT UNIT |
|---|---|---|
| | Radiation and interactions with matter | 3 |
| | Fundamental radiation quantities and units | 2 |
| | External photon beam radiation therapy | 3 |
| | Electron beam radiation therapy | 2 |
| | Treatment planning and delivery for photon and electron beams | 3 |
| | Fundamentals of sealed sources, radionuclides and brachytherapy | 2 |
| | Unsealed source radionuclide therapy | 2 |
| | Radiation protection | 3 |
| | **Sub-total** | **20** |

**COURSE CONTENT OF MEDICAL PHYSICS AND RADIATION PROTECTION**

**2.1 Radiation interactions with matter**

- Fundamentals of an atom
- Structure - nucleus, orbital shells, energy levels, binding energy
- Particles - proton, neutron, electron, positron
- atomic number, atomic weight, isotope, isomer Atomic energy levels,
- Nuclear forces and Nuclear energy levels,
- Electromagnetic radiation,
- Electromagnetic spectrum,
- Energy quantization,
- Relationship between Wavelength and Frequency
- Energy Nuclear Transformations: Natural and artificial radioactivity, Decay
- constant, Activity, Physical, Biological and Effective half-lives, Mean life, Decay
- processes, Radioactive series
- Energy - conservation of mass and energy, mass-energy conversion
- Photon absorption, scattering processes and electron interactions
- Photon interactions i.e. coherent (elastic) scattering, photoelectric effect, Compton scattering, pair production, annihilation radiation, characteristic radiation, photonuclear reactions
- Processes of attenuation: exponential attenuation, energy transfer, energy absorption
- Interaction coefficients: coefficients of attenuation, energy transfer and absorption (in relation to relative importance of interactions in photon beam therapy)
- Electron interactions: ionisation, excitation, heat production, radioactive interaction (bremsstrahlung), relative rate of energy loss and directional changes through collisional and radioactive processes, stopping power, range, scattering power, linear energy transfer
- Radionuclide decay processes e.g. alpha, beta, positron, gamma, electron capture, internal conversion

- Radionuclide production e.g. natural and artificial radioactivity,
- Exponential radioactive decay e.g. decay constant, half-life (physical, biological, effective), mean life, daughter products, radioactive equilibrium
- Definition and units: Activity, apparent activity, specific activity, air-kerma rate constant and reference air-kerma rate
- Basic principles of X-ray production
- The X-ray tube,
- Continuous spectrum,Characteristic spectrum,
- Efficiency of X-ray production,
- Distribution of X-rays in space,
- Specifications of beam quality,
- Measurement of beam quality,
- Bremsstrahlung and characteristic radiation production by electron bombardment
- Efficiency of x-ray production and its dependence on electron energy and target atomic number

**2.2 Radiation quantities, units, image production and use in radiation therapy**

- Absorbed dose, Ionization vs. Energy,
- Stopping Power,
- Linear Energy Transfer (LET),
- Bragg curve,Definition of particle range.
- Radiation measurements and calibration: Radiation Detectors: Gas, Solid – state, Scintillation, Ionisation chambers, semi-conductor detectors eg diodes and MOSFETs, thermoluminescent and optically stimulated luminescence dosimeters (TLDs and OSLs) , Photographic film, radiochromic film, Geiger-Muller counters, scintillation counters, chemical dosimeters
- . Exposure, Dose, Kerma: Definitions, Units (Old, New), Interrelationships between units. Variation with energy and material
- equivalent dose, effective dose, attenuation coefficient
- CT scanning
- Plain film,
- fluoroscopy,
- MRI,
- ultrasonography,
- nuclear medicine imaging including PET
- Imaging techniques used to verify treatment accuracy Port films, Electronic portal imaging, Cone beam CT

**2.3 External photon beam radiation therapy**

- Radiotherapy Equipment: Grenz rays, Contact, Superficial, Orthovoltage or Deep therapy,Super voltage,Megavoltage therapy.

- Construction of a linear accelerator, orthovoltage unit and superficial therapy unit. photon beam can be generated from the units
- alteration of beam aperture using Cerrobend blocking, multileaf collimators and independent jaws
- design and function of multileaf collimators including awareness of issues created by rounded leaf edges
- types of wedge filters:. physical wedges and dynamic wedging
- construction of a Cobalt–60 unit and generation of therapeutic beam characteristics of kV and MV photon beams
- Intensity and angular distribution
- Beam quality: energy spectra, effective energy, half value layer
- Beam variation:. change in characteristics with maximum electron energy, voltage, current and filtration as applicable
- Beam edges and penumbra and their relation to beam energy
- measurements of an external photon beam, including choice of suitable radiation detector,
- Beam measurement: radiation quality, output and inverse square law
- Measurement protocols i.e. IAEA megavoltage absolute dosimetry protocol for megavoltage photon beams
- Dose distribution - kV and MV beam profiles, depth dose curves, construction of isodose charts
- Dose distribution in tissue produced by external beam photon radiation
- Radiation components i.e. primary and scattered radiation
- Dose distribution i.e. percentage depth dose, beam profile, isodose charts, flatness and symmetry, penumbra, surface dose (entrance and exit) and skin sparing
- Factors affecting dose distribution and beam output i.e. effects of field size and shape, source-skin distance, beam quality or energy; and beam modifying devices on dose distribution and beam output
- Effects of tissue heterogeneity and patient irregularity: effects on dose distribution of patient contour, bone, lung, air cavities and prostheses; and also dose within bone cavities, interface effects, effects of electronic disequilibrium
- tissue-air ratio, scatter air ratio, tissue phantom ratio, tissue-maximum ratio, output factor, back scatter factor, peak scatter factor, off-axis ratio, percentage depth dose
- effects on dose distribution of irregular or offset fields and the associated clinical implications of changes in beam aperture: compare and contrast the use of Cerrobend blocking, multileaf collimators and independent jaws
- dose modification techniques
- Methods of compensation for patient contour variation and/or tissue inhomogeneity including wedging and compensating filters
- Shielding of dose-limiting tissues
- The use of bolus and build-up material

- Fixed SSD and isocentric techniques
- Simple techniques: parallel opposed fields, multiple fields
- Complex techniques: rotation therapy (full or partial), conformal therapy, IMRT

**2.4 Electron beam radiation therapy**

- Generation of an electron beam from a linear accelerator
- characteristics of an electron beam – energy spectra, energy specification, variation of mean energy with depth, photon contamination
- difference between electron and heavy charged particle (in particular proton) interaction with matter
- Assessment of electron beam radiation, including choice of suitable radiation detector, specifically:Beam measurement: radiation quality, output
- Measurement protocols: IAEA megavoltage dosimetry protocol for mega electron volt (MeV) electron beams
- Dose distribution in tissue from an electron beam in terms of: percentage depth dose, beam profiles, isodose charts, flatness and symmetry, penumbra, surface dose
- Effects of field size and shape, source-skin distance, energy, beam collimation on dose distribution and beam output
- Effects of heterogeneity and patient irregularity i.e. effect on dose distribution of surface obliquity, air gaps, lung, bone, air filled cavities, external and internal shielding
- methods of field shaping for different beam energies and the effect on surface dose

**2.5 Treatment planning and delivery for photon and electron beams**

- Different equipment and methods for patient simulation
- Processes of 2-D and 3-D planning
- Principles of intensity modulated radiation therapy and inverse treatment planning and features of step-and-shoot and dynamic deliveries including dynamic arcs
- Methods of determining body contour, location of internal structures including critical tissues and target volume including comparison of CT, MRI and PET
- Choice of beam energy, field size, beam arrangement and the use of bolus
- Use of field junctions: Photon-photon junctions, Photon-electron junctions, Electron-electron junctions
- Calculation of monitor units and/or treatment time , dose calculation algorithms including Clarkson (including equivalent tissue-air ratio corrections), superposition/convolution, Monte Carlo and pencil beam methods, their comparative advantages and limitations
- Accuracy of treatment planning and delivery
- Methods of patient monitoring and ensuring reproducibility of patient positioning throughout treatment and planning including immobilization methods, treatment set-up, lasers, portal imaging
- Image-guided radiation therapy, including the use of cone beam CT and fiducial markers
- Tolerance levels for field shift

- Consistency of patient contour and position of normal and tumour tissues during the course of treatment
- Accuracy of calibration, stability of beam parameters, accuracy of isodose calculation
- Determination of mechanical and radiation accuracy of treatment machines and simulators including the light field, cross-wire images, optical distance indicators
- Systematic and random errors
- Avoidance and detection of dose delivery errors including record and verify systems, select and confirm procedures, and interlocks
- Potential errors arising from computer control of set up and treatment machine operation
- In-vivo dosimetry techniques
- use of radiation phantoms and dedicated dosimetry tools for fixed SSD and isocentric patient treatments

**2.6 Fundamentals of sealed source radionuclides and brachytherapy**

- Radioactive sources used in sealed source brachytherapy
- Construction: source construction, including filtration
- Properties: spectra of radiation emitted, half-life, usual specific activity
- Measurement of source activity and dose rates, choice of suitable detectors and calibration
- Clinical decision-making: compare the advantages of radionuclides in various clinical circumstances
- Commonly used: caesium-137, iridium-192, iodine-125, palladium-106, strontium-90
- Historical and less commonly used: radium-226, cobalt-60, yttrium-90
- Management: handling, cleaning, inspection, storage and transport
- Types of brachytherapy procedures: surface applications, eye plaques, interstitial implants, intracavitary techniques
- Source Dose Rate: low, medium, high and pulsed dose rate
- Dose distributions: compare isodoses surrounding ideal sources and clinical sources
- Delivery techniques: remote afterloading machines, manual afterloading
- ICRU dose specification system: current ICRU recommendations for interstitial and gynaecological treatment specifications
- Current dosage systems: Paris system, production of conformal dose distributions using a single, stepping source
- Procedures for beta emitters: surface and ophthalmic applications, intravascular techniques, techniques of delivery – unique applicators and methods of use

**2.7 Unsealed source radionuclide therapy**

- concepts of uptake, distribution and elimination physical, biological and effective half life
- methods of dose estimation: the Medical Internal Radiation Dose (MIRD) and other methods of estimating dose to target tissues and critical organs
- radioactive sources used in unsealed source therapy

- Properties: spectra of radiation emitted, half-life, physical form and technique of delivery to patient and use in clinical practice [
- Measurement of activity and dose rates
- Commonly used: Iodine-131, strontium-90, samarium-153
- Less commonly used: phosphorus-32, yttrium-90
- Management: safe handling, storage, transport, clean up of spills

**2.8 Radiation protection**

- The ALARA Principle, Radiation Incident and Radiation Accident
- ICRP recommended dose limits; the basis for international recommended limits; specific ICRP and national radiation protection standards,
- regulatory frameworks in Nigeria
- Practical dose minimisation practices and procedures (time, dose, distance, shielding)
- Typical environmental dose levels and doses from diagnostic medical exposures
- Medical exposure in contrast to exposure of the public and occupational exposure (justification, optimisation and dose limits)
- Working procedures for use with radiation sources including simulators, CT, external beam therapy, brachytherapy and unsealed sources
- Minimisation of dose to patients, staff and general public including safety procedures for staff, control of areas and radiation sources, radiation protection surveys, personal monitoring, area monitoring, construction of rooms to house sources and radiation generators
- Recommended dose limits for foetal exposure and the human data from which these have been derived
- Safe operation of teletherapy and brachytherapy equipment
- Risk of induction of secondary tumours
- Equivalent dose-tissue weighing factor
- Prevention of accidental exposures in radiotherapy
- Radiation protection issues with imaging technology
- Medical exposure
- Occupational exposure
- Public exposure and emergency planning
- Stochastic and deterministic effects
- Radiation carcinogenesis
- Hereditary effects of radiation
- Effects of radiation on the embryo and fetus
- Documentation and reporting requirements relating to radiation incidents and accidents

## COURSE RCO 711: LEARNING TOPICS IN RADIOBIOLOGY

| S/No | COURSE TITLE | CREDIT UNIT |
|---|---|---|
| 1 | Introduction to Radiobiology | 2 |
| 2 | Normal cell structure and functions relevant to neoplasia | 2 |
| 3 | Radiation Quality and Dose response for tumour control | 2 |
| 4 | Tumour growth and Mechanisms of malignant celltransformation and progression | 3 |
| 5 | Radiation-induced cellular damage and repair | 2 |
| 6 | Linear quadratic dose response and cell survival | 2 |
| 7 | Hypoxia and the oxygen effect | 1 |
| 8 | Fractionation and the '5 Rs' | 2 |
| 9 | Radiation effects and quantification | 2 |
| 10 | Radiation carcinogenesis | 1 |
| 11 | Combination of radiation with other therapies and tumour re-irradiation | 2 |
| 12 | Specialised radiation therapytechniques | 1 |
| 13 | Molecular analysis in oncology and application of cancer biology insystemic therapy | 3 |
| | Sub-total | 25 |

COURSE CONTENT OF RADIOBIOLOGY

Introduction to Radiobiology- **2units**

- Anti-proliferative effect ionizing radiation
- relationship between radiosensitivity and cellular reproductive activity: "Law of Bergonie and Tribondeau"
- recognition and quantification of normal tissue injury
- acute and late reactions and the notion of treating to 'tolerance'
- evolution of fractionated treatment and ram's testis experiment
- demonstration of clinical cures with fractionated external radiation treatment
- adverse effect of treatment protraction
- evolution of "standard" fractionation schedules

**Normal cell structure and functions relevant to neoplasia-** 2 **units**

- Normal cell structure and the structure of eukaryotic genes
- Chromosome packaging and DNA replication and the importance of maintaining genomic integrity
- RNA transcription and translation and .Epigenetic effects on gene expression
- Cell cycle phases and functions
- Checkpoints and their molecular controls
- Major cell cycle regulators e.g. pRB, p53, cyclins, cyclin-dependent kinases
- Cell cycle kinetic parameters

- Physiological controls of the cell cycle
- Extra cellular agents affecting cell growth /survival e.g. growth factors, hormones
- Growth factor receptors
- Signal transduction e.g. MAPK/ERK, RAS,RAF pathways
- Changes in the physiological controls that occur in, or promote oncogenic transformation
- Over-expression of EGF
- EGFR mutation and up-regulation
- Autonomous functioning of signal transduction pathways
- HPV mediated loss of p53 and pRB function

**1.3 Radiation Quality and Dose response for tumour -** 2 **units**

- Types of ionising radiation
- Linear energy transfer (LET) and its relationship to direct and indirect DNA damage, free radicals and free radical scavengers
- Relative biological effectiveness (RBE)
- The relationship between LET and OER
- Shape of the dose-response curve
- The determinants of the steepness of the dose-response curve
- The concept and significance of the Therapeutic Ratio
- Concepts of radiocurability and radiation responsiveness
- Major factors influencing tumour control
- Physical Factors including dose, dose rate, radiation quality, temperature
- Chemical Factors including oxygen, radiosensitizers and radio-protectors
- Biological Factors including cell type and radiosensitivity, clonogen number, host factors
- Technical Factors including geographic miss
- Tumour control probability curves

**1.4 Tumour growth and Mechanisms of malignant cell transformation and progression - 3 units**

- Tumour doubling time (TD)
- Potential doubling time (Tpot)
- Cell cycle time (Tc)
- Growth fraction (GF)
- Cell loss factor
- The effect of tumour microenvironment on growth rate
- The concept and mechanism of accelerated repopulation following radiation
- Activation of oncogenes/loss of tumour suppressor genes
- point mutations.insertions, deletions, translocations, and amplifications
- comparative genomic hybridization, in-situ hybridization and spectral karyotyping
- Stable and unstable aberrations
- Knudson’s 2-hit hypothesis
- Global demethylation, promoter hypermethylation

- Aberrant histone acetylation
- Models of tumour initiation and progression
- In vitro characteristics of transformed and malignant cells
- Tumour angiogenesis and vasculogenesis
- Steps in the metastatic cascade

**1.5 Radiation-induced cellular damage and repair - 2 units**

- Targets of radiation damage
- Types of DNA lesions caused by ionising
- radiation and DNA damage repair mechanisms
- Assays for DNA damage
- Radiation sensitivity in different phases of the cell cycle
- DNA double strand break repair
- Modes of cell death following ionising radiation
- Concepts of reproductive death and clonogenicity
- The bystander effect
- The genetic diseases that affect DNA repair/clinically apparent radio-sensitivity (eg. Ataxia telangectasia)

**1.6 Linear quadratic dose response and cell survival - 2 units**

- Relationship between dose/fraction and tissue α/β ratio
- Effect of incomplete repair between fractions
- Biological Effective Dose (BED)
- Dose rate effects in brachytherapy
- The concept of cell survival curves
- In-vitro and in-vivo techniques to generate survival curves
- Dose rate effects on cell survival
- The biophysical basis of α and β in the linear quadratic formula
- Acute and late responding normal tissues
- Limitations of the linear quadratic formula

**1.7 Hypoxia and the oxygen effect -1 unit**

- Modification of radiation-induced DNA damage by oxygen
- The Oxygen Enhancement Ratio (OER)
- Evidence supporting the clinical significance of tumour hypoxia
- Methods used to overcome the effect of tumour hypoxia and their rationale:
- Tumour responses to hypoxia occurring at the molecular level
- Consequences of molecular responses to hypoxia

**1.8 Fractionation and the '5 Rs' - 2 units**

- Intrinsic Radiosensitivity
- Repair
- Reoxygenation

- Redistribution
- Repopulation
- Definition and rationale for non-standard fractionation schedules :Hyperfractionation, Accelerated fractionation, Hypofractionation
- Reasons behind the differences in 'typical' fraction schedules employed for curative versus non-curative (palliative treatments) including differences in treatment aim, differing concern re late toxicity, dose required to achieve an effect

**1.9 Radiation effects and quantification - 2 units**

- Effects of radiation on normal Tissues
- Acute, sub-acute and late toxicity from radiation
- The meaning of latency with regard to normal tissue effect
- Parallel and Series arrangement of functional sub units
- Flexible and hierarchical kinetic models
- The abscopal effect
- Post radiation regeneration of normal tissues
- The concept of normal tissue/organ tolerance
- Relationship between tolerance dose and irradiated volume
- The mechanism of effect and consequences of radiation on Parenchymal tissues, Connective tissue.Vascular systems. immune system
- Acute syndromes following high doses of total body radiation
- Quantification of radiation effects
- Methods of biological dosimetry for unplanned / uncontrolled radiation exposure
- Effects of radiation on human embryo and foetus
- Factors influencing effect type and risk including dose and stage of gestation
- The definition of doubling dose
- Principles of toxicity scoring systems
- Examples of toxicity scoring systems used in
- current clinical practice
- Tolerance doses of normal tissues/organs

1.10 **Radiation carcinogenesis -1 unit**

- Dose-response curve for radiation carcinogenesis
- Threshold versus non-threshold uncertainty
- Assumptions and recommendations for dose limits in radiation protection
- Relevance of integral dose in radiotherapy to second cancer induction risk

**1.11 Combination of radiation with other therapies and tumour re-irradiation – 3 units**

Radiobiological basis and rationale for combining surgery and radiation in the preoperative, postoperative and intra-operative

- settings
- Rationale and sequencing of therapies
- Mechanisms of cytotoxic enhancement by
- Chemotherapy: independent action, additive

- and synergistic interactions
- Biological cooperation: (hypoxic cell sensitisers and cytotoxins)
- Temporal modulation ( EGFR blockade, endocrine agents)
- Spatial cooperation and concept of 'sanctuary sites'
- Normal tissue protection
- Impact on acute and late side effects arising from combining radiation with other treatments
- Radiobiological principles for consideration of re-treatment (initial radiotherapy dose (EQD2), volume, volume of overlap, technique used)
- Effect of radiation modifiers used in treatment of the first tumour
- Time interval between therapy courses and concept of forgotten dose
- Re-irradiation tolerance of normal tissues

**1.12 Specialized radiation therapy techniques 1 unit**

- The radiobiological principles as they relate to brachytherapy including low dose rate, high dose rate and pulsed treatments
- The radiobiological principles and implications of specialised methods for external beam radiation delivery (ablative stereotactic radiosurgery and radiation therapy, tomotherapy, intensity-modulated radiation therapy (IMRT) and charged particle therapy)

**1.13 Molecular analysis in oncology and application of cancer biology in systemic therapy3units**

- Classification of systemic agents including:( cytotoxic chemotherapy, endocrine therapy, cell membrane receptor blockers, cell signaling pathway inhibitors and radio-sensitisers and protectors)
- The mechanism of action of commonly used systemic therapies including phase specific and cell cycle specific agents
- Common molecular targets for therapy e.g. angiogenesis, signal transduction, DNA repair, apoptosis and examples of therapies directly at these targets
- Individualisation of systemic treatments based on molecular features
- Nucleic acid hybridisation including Northern and Southern analysis, DNA microarrays, competitive genomic hybridisation (CGH)
- Protein analysis: Western analysis immunoprecipitation, immunohistochemistry, proteomics (2-dimensional gels, mass
- spectrometry)
- PCR(polymerization chain reaction), quantitative RT-PCR
- DNA sequencing
- Detection of single nucleotide polymorphisms (SNPs), mutations in tumours
- Knockout, knockin and transgenic mice
- RNA interference (RNAi)
- Tissue microarrays (TMAs)
- In-situ hybridisation e.g. fluorescent in-situ hybridisation (FISH), chromogenic in-situ hybridisation (CISH)
- Systems biology and bioinformatics including definitions, and application to DNA microarrays and proteomics

## 3. COURSE RCO 712. LEARNING TOPICS IN PATHOLOGY

| | COURSE TITLE | CREDIT UNIT |
|---|---|---|
| | Introduction to cancer pathology | 3 |
| | Pathology of Radiation damage in normal tissue | 1 |
| | Introduction to Clinicopathological Integration | 2 |
| | Pathology of Specific cancers: | |
| | • Breast | 2 |
| | • Lung and Mediastinum | 2 |
| | • Head and | 2 |
| | • Skin | 2 |
| | • Male Reproductive System | 2 |
| | • Female Reproductive System | 2 |
| | • Urinary Tract | 2 |
| | • Gastrointestinal Tract | 2 |
| | • Central Nervous System | 2 |
| | • Haematology | 2 |
| | • Musculoskeletal & Connective Tissue | 2 |
| | • Paediatric | |
| | • Metastatic Disease | 2 |
| | • Non-Malignant | 2 |
| | | 2 |
| | **Sub-total** | 34 |

### COURSE CONTENT OF PATHOLOGY

3.1 **Introduction to cancer pathology**

- Introduction to neoplasms
- Major histological types of cancer: Carcinoma, Sarcoma, Lymphoma, Melanoma
- Typical cytological features of malignant cells as compared with those of normal cells
- Typical biological behaviour of benign and malignant neoplasms
- Neoplasia,differentiation, anaplasia,,aneuploidy
- Cancer stem cells and cancer cell lineages,,monoclonality

- Tumour heterogeneity
- Pathways of spread
- Molecular basis of cancer and cancer genetics
- Molecular techniques
- Microarrays
- Tissue arrays
- RT-PCR
- Dysregulations of cancer-associated genes
- Chromosomal changes
- Gene amplification
- Epigenetic changes
- Polymorphisms
- Initiation and promotion
- Molecular basis of multistep carcinogenesis
- Chemical, radiation and microbial carcinogenesis
- Malignant transformation
- Precursor lesions and field effect
- Proto-oncogenes, oncogenes, oncoproteins
- Growth factors and growth factor receptors
- Signal-transducing proteins
- Transcription factors
- DNA repair defects and genomic Instability
- Limitless replicative potential: telomerase
- Stromal microenvironment
- Mechanisms of invasion and metastasis
- Sustained angiogenesis
- Mechanisms of cell death
- Apoptosis (in normal and tumour cells, morphological and biochemical features, molecular pathway leading to apoptosis e.g. Bcl-2, p53-dependent and independent pathways, ceramide)
- Mitotic death (types, cell division post radiation and timing)
- Necrotic death and radiation-induced senescence
- Other modes of death: autophagy,,entosis
- Tumour immunology
- Tumour antigens

**3.2 Pathology of Radiation damage in normal tissue**

- The pathogenesis and clinical manifestations of radiation injury to normal tissues/organs : neural tissue, skin, mucosa, bone, the eye, thyroid, lungs, heart, bowel, kidney, liver, testis, ovary

- The concept of tolerance dose (including TD5/5 and TD 50/5) for specific tissues/organs
- Patient related factors that affect normal tissue damage from radiation

**3.3 Introduction to Clinicopathological Integration**

- General principles of laboratory diagnosis of malignancy
- Biopsy methods
- Handling of specimens
- Histological analysis
- Grading systems
- Immunohistochemistry
- Serum tumour markers
- Staging and classification systems
- TNM general principles and terminology
- Commonly applied staging/ classification systems
- Interpreting pathology report / pathological prognostic factors
- advantages and disadvantages of synoptic reporting
- difficulties and uncertainties of pathological diagnosis

**3.4 Pathology of specific cancers**

3.4.1 Epidemiology (population statistics)

- Incidence (in population)
- Age (of onset)
- Gender predilection
- Geographical distribution

3.4.2 Aetiology (individual causative factors) and pathogenesis

- Genetic/Chromosomal abnormalities
- Environmental
- Nonhereditary predisposing conditions
- Associated familial cancer syndromes

3.4.3Natural History

- Precursor lesions
- Field effect
- Patterns of spread and biological behaviour

3.4.4 Clinical Presentation

- Common symptoms and signs (link to pathology)
- Effects of the tumour on the host
- Paraneoplastic syndromes
- Cancer cachexia

- Local effects e.g. destructions of adjacent tissues, obstruction or compressions of hollow structures
- Hormonal effects
- Characteristic imaging findings (link to pathology)

Laboratory diagnosis of malignancy

- Macroscopic appearance and growth patterns
- Microscopic appearance and growth patterns
- Histological subtypes and classification
- Link to predicted biological behavior
- Laboratory methods, including frozen section analysis and electron microscopy
- Characteristic cellular appearance and architecture
- Grading systems
- Immunohistochemistry
- Molecular techniques, chromosomal changes, flow cytometry
- Uncertainty in microscopic diagnosis
- Normal histology and structure of tissue of origin i.e. distinguish normal from pathological areas
- Differential diagnosis i.e. other histologies to consider in relation to anatomical location

3.4.6 Staging and classification systems

- TNM principles and terminology
- Commonly applied staging systems
- Commonly applied classification systems

COURSE CODE RCO 713 **LEARNING TOPICS IN BIOSTATISTICS**

| S/No | COURSE TITLE | CREDIT UNIT |
|---|---|---|
| 1 | BASIC STATISTICS | 3 |
| 2 | STASTISTICAL BASIS FOR PLANNING AND INTERPRETATION OF CLINICAL TRIALS | 2 |
| 3 | PLANNING A TRIAL | 3 |
| | **SUB-TOTAL** | **8** |

COURSE CONTENT OF BIOSTATISTICS

4.**1 Basic Statistics**

- Frequencies (categorical variables)
- Frequency distributions (numerical variables)
- Histograms
- Frequency polygon
- Frequency distribution of the population
- Shapes of frequency distributions
- Cumulative frequency
- Median and quartiles
- Quantiles and percentiles
- Cross tabulations
- Scatter plots
- Displaying time trends
- Mean, median and mode
- Measures of variation
- Range and interquartile range
- Variance
- Degrees of freedom
- Standard deviation standard error
- Interpretation of the standard deviation
- Change of units
- Coefficient of variation
- Calculating the mean and standard deviation from a frequency distribution
- Sampling variation and standard errors
- Understanding standard deviations and standard errors

**4.2 Statistical basis for planning and interpretation of clinical trials**

- Advantages & disadvantages
- Retrospective & Prospective studies
- Controlled & uncontrolled trials
- Single blind & double blind studies

- Phase I,II & III trials
- Ethics (Helsinki declaration/Good clinical practice)

### 4.3 Planning a trial

- Establishing objectives – short term and long term
- Determining the appropriate criteria
- Establishing grounds for inclusion and exclusion of patients
- Determining how many treatment schedules are to be completed
- Determining the treatment schedules and any appropriate modifications
- Determining the method of allocation of treatment; the allocation ratio and the method and timing of randomization
- Determining what measures are to be taken, how they will be taken, who will take them, at what times (s) and where they will be recorded.
- Designing, the appropriate forms of documentation
- Determining the proposed duration of the trial, either in terms of a fixed closing date, or the entry of a predetermined number of patients.
- Establishing conditions under which the trial may be terminated earlier than planned & procedures for detecting these conditions.
- Re-assessing the proposed trial in terms of ethics, appropriateness to the short & long terms objectives, feasibility & the availability of resources.
- Writing the protocol
- Running a pilot study

- **COURSE RCO 714. LEARNING TOPICS IN RADIATION AND CLINICAL ONCOLOGY PRACTICE**

**Clinical radiotherapy, chemotherapy and targeted therapy in Management of site specific malignancies**

| | Course Title | Course Unit |
|---|---|---|
| 1. | Onco-anatomy | 3 |
| 2. | Principles of oncology | 2 |
| 3. | **Diagnostic Radiology and Nuclear Medicine** | 1 |
| 4. | **Principles of Treatment Planning** | 3 |
| 5. | **Cancer chemotherapy** | 3 |
| 6. | Lung and Mediastinum | 2 |
| 7. | Head and Neck | 2 |
| 8. | Skin | 2 |
| 9. | Male Reproductive System | 2 |
| 10. | Urinary Tract | 2 |
| 11. | Gastrointestinal Tract | 2 |
| 12. | Central Nervous System | 2 |
| 13. | Haematology | 2 |
| 14. | Musculoskeletal & Connective Tissue | 2 |
| 15. | Paediatric | 2 |
| 16. | Metastatic Disease | 2 |
| 17. | Non-Malignant | 2 |
| 18. | Unknown Primary | 2 |

## 1. COURSE CONTENT OF ONCO-ANATOMY

### 1.1Neuro-anatomy

- Functional and anatomical compartments of the cerebrum and cerebellum.
- Brainstem
- Ventricular system
- Cranial nerves including their origin and distribution (intra and extra cranial)
- Spinal cord and cauda equina
- Meninges
- Brachial plexus
- Sacral plexus
- Innervation of the upper and lower limbs
- Autonomic nervous system

### 1.2. Head and neck anatomy

- Nasopharynx
- Oropharynx
- Oral cavity
- Tongue

- Paranasal sinuses
- Major salivary glands
- Larynx
- Hypopharynx
- Thyroid gland
- Parathyroid glands
- Pituitary gland
- Orbits
- Paranasal/facial sinuses
- Course and relations of the internal and external carotid arteries and their major branches bilaterally
- Course and relations of internal and external jugular veins and their major tributaries bilaterally
- Anterior and posterior triangles of the neck
- Supraclavicular fossa
- Pterygopalatine fossa
- Temporal and infratemporal fossae
- Base of skull including pituitary fossa, cavernous sinus, Meckel's cave, Rathke'spouch, clivus.
- All vascular and neural foramina for major vessels, cranial nerves and their branches traversing the base of skull

**1.3 Thoracic anatomy**

- Mediastinum
- Trachea and main bronchi
- Lung
- Pleura and pleural cavities
- Heart and great vessels
- Azygos vein
- Oesophagus
- Thoracic course of the thoracic duct
- Breast
- Chest wall anatomy

**1.4 Abdominal anatomy**

- Stomach
- Duodenum
- Liver
- Spleen
- Gall bladder and billiary tract
- Pancreas
- Kidneys

- Adrenal glands
- Ureters
- Cysterna chyli and abdominal course of the thoracic duct
- Abdominal wall anatomy

**1.5 Pelvic anatomy**

- Rectum
- Anal canal
- Bladder
- Male and female urethra
- Prostate
- Testes, epidydimis, vas deferens, seminal vesicles
- Penis
- Ovaries
- Fallopian tubes
- Uterus
- Cervix
- Vagina
- Vulva

**1.6 Upper and lower limbs**

- Axilla
- Inguinal and femoral canals
- Dermatomes and myotomes of the upper and lower limbs
- Muscular compartments and major muscles of the limbs

COURSE CONTENT OF **PRINCIPLE OF ONCOLOGY**

**2.1 Molecular and Genetic Oncology**

- Genetic pre disposition
- Congenital syndrome
- Chromosomal abnormalities
- Hereditary tumors
- Protooncogenes ,Oncogenes And Tumor Suppressor genes
- Multifactorial causation
- Nutritional aspects in cancer causation and prevention.
- Environmental causes of cancer
- Biological - protozoal, bacterial, viral
- Chemical - Classes of carcinogenic chemicals, smoking
- Physical - trauma, irradiation (UV rays, X rays and Gamma rays and particulate radiations)
- Occupational cancers
- Cell cycle- DNA repair; apoptosis.
- Invasion and metastasis, angiogenesis and lymph angiogenesis.

- Cell signaling and interactive networks.
- Immune response.
- Gene Therapy
- Somatic correction of gene defect
- Genetic pro-drug activation
- Genetic immunomodulation

**COURSE CONTENT OF DIAGNOSTIC RADIOLOGY AND NUCLEAR MEDICINE**

- Radiographic diagnosis of malignant and non-malignant conditions
- Radiological Procedures with reference to Radiotherapy practices
- Study of Ultrasound, CT Scans, MRI Scans, PET scans, as applicable for management of cancer.
- Nuclear imaging and therapeutic modalities as applicable to management of cancer.

**COURSE CONTENT OF PRINCIPLES OF TREATMENT PLANNING**

**4.1. Treatment planning for photon beams: ICRU 50 an NCAP terminologies.**

- Determination of body contour and localization.: Plain film, Fluoroscopy, CT, MRI, Ultrasonography, PET CT
- Simulator based. Methods of correction for beam's oblique incidence, and body Inhomogeneties
- SSD technique and isocentric (SAD) technique: Descriptions and advantages of SAD technique
- Combination of fields: Methods of field addition, Parallel opposed fields, Patient thickness vs. Dose uniformity for different energies in a parallel opposed setup,
- Multiple fields (3 fields, 4 field box and other techniques).
- Integral Dose. Wedge field technique, Rotation Therapy (Arc, and Skip), Tangential fields.
- Beam balancing by weighting.
- Total and hemi-body irradiation.
- Field junctions.
- Limitations of manual planning.

**4.2 Description of a treatment planning system (TPS):**

- 2D and 3D TPS
- Beam data input, Patient data input (simple contour, CT, MR data, Advantages of transfer through media Input devices- Digitizer, floppies, DAT devices, Magneto-optical disks, direct link with CT, MR)
- Beam selection and placement, Beam selection and placement, Beam's Eye View (BEV),
- Dose calculation and display (Point dose, Isodose curves, Isodose surfaces, Color wash).
- Plan optimization and evaluation tools: Dose volume Histograms (Cumulative and Differential), Hard copy output, Storage and retrieval of plans.

**4.3 Alignment and Immobilization:**

- External and internal reference marks,

- Importance of Immobilization methods (Plaster of Paris casts, Perspex casts, bite block, shells, head rests, neck roll, Alpha-Cradles. Thermoplastic materials, polyurethane foams. Methods of beam marks, and front / back pointers.
- Treatment execution: Light field, Cross hair, ODIs, Scales in treatment machines.
- Treatment verification : Port films, Electronic portal imaging devices, Invivo patient dosimetry (TLD, diode detectors, MOSFET, Film, etc),
- Changes in patient position, target volume , and critical volume during course of treatment.

**4.4 Electron Beam**

□□Therapy Production of electron beams: Production using accelerators.

- Characteristics of electrons, Surface dose, percentage depth dose, beam profiles, Isodose curves and charts, Flatness and Symmetry. Beam collimation, variation of percentage depth dose and output with filed size, and SSD, photon contamination
- Energy spectrum, Energy specifications, variation of mean energy with depth.
- measuring instruments for electron beam dosimetry Treatment
- planning: Energy and field size choice, air gaps, and obliquity,
- Tissue in- homogeneity : lung, bone, air filled cavities. Field junctions (with either electron or photon beam).
- External and internal shielding.
- Arc therapy,
- Use of bolus in electron beam.
- □□Total Skin Electron Irradiation, Intraoperative Radiation therapy.

**4.5 Physical Principles of Brachytherapy:**

- Properties of an ideal brachytherapy source,
- Sources used in brachytherapy: Ra-226, Cs-137, Ir-192, Au-198, Co-60, I-125,I-131 ,P-32,Sr-90, Yt-90, Ru-106, Ta-182 and other new radionuclides.
- Therapy with Unsealed sources
- Physical properties of sealed and unsealed sources.
- Radiation hazards

**4.6 Source construction including filtration, comparative advantages of these radionuclides**

- □Historical background.
- Radiation and Dose units: Activity used, Exposure, Absorbed dose, mg-hr, curie, milli-curie destroyed, milligram Radium equivalent, Roentgen, Rad, Gray.
- Source strength specification, Brachytherapy Dose calibrator

**4.7 Technique of brachytherapy:**

- Preloaded, after loading (manual and remote), Merits and Demerits.
- Surface, Interstitial, Intracavitary, Intraluminal, Intravascular , Systemic brachytherapy ,
- Low, Medium, High and Pulsed Dose Rates.
- Remote after loading machines.

**4.8 Dosage Systems:**

- Manchester System, Paris System
- Patient selection,
- Volume specification,
- Geometry of implant, Number,
- Strength and Distribution of radioactive sources,

- Source localization,
- Dose calculation,
- Dose rate specification,
- Record keeping ICRU 38.

**4.9 Planning of brachytherapy facility**

- Rooms and equipment,
- Storage and `Movement control,
- Source inventory, Disposal,
- Regulatory requirements of Beta-ray brachytherapy including methods of use, inspection, storage and transport of sources, dose distribution

**4.10 Unsealed Radionuclides:**

- Concepts of uptake, distribution and elimination,
- Activities used in clinical practice,
- Estimation of dose to target tissues, and critical organs,
- Procedures for administering radionuclide to patients

**4.11 Quality Assurance in radiotherapy.(QART)**

- Overview of QART: Need for quality system in Radiotherapy,
- Quality system: Definition and practical advantages, Construction, Development and implementation of a Quality system
- Quality Assurance of simulator/CT simulator Co-60, Linear Accelerator
- Acceptance testing of Simulator, TPS, Co-60, Linear Accelerator

**4.12 Radiation Protection and Regulatory Aspects:**

- Statutory Framework
- Principles underlying International Commission on Radiation Protection (ICRP)
- recommendations, ICRP and National radiation protection i.e; Atomic Energy Regulatory Board (AERB) standards. Effective dose limits (ICRP and AERB)
- Protection mechanisms: Time, Distance and Shielding.
- Permissible doses for Radiation workers and Public including Pregnant Women.
- Concept of "As low as Reasonably Achievable" (ALARA) Personnel and Area
- Monitoring; Need for personnel monitoring, Principles of film badge, TLD badge
- used for personnel monitoring. Pocket dosimeter
- Need for area monitoring, Gamma Zone monitors, Survey meters Regulatory aspects and Calibrations.

**4.13 Procedural steps for installation and commissioning of a new radiotherapy facility** (Teletherapy and Brachytherapy).

- Approval of Standing Committee on
- Radiotherapy Development Program.
- Type approval of unit. Site plan, Layout of installation / Associated facility:
- Primary, Secondary barriers, leakage and scattered radiation.
- Regulatory requirement in procurement of teletherapy / brachytherapy source(s).

**4.14 Conformal radiotherapy (CRT):**

- Principles, Advantages over conventional methods,
- Essential requirements for conformal radiotherapy.
- Various methods of CRT: customized field shaping using conventional coplanar beams.

- Multiple non-coplanar MLC beams conforming to target shape.

## 5. COURSE CONTENT OF CANCER CHEMOTHERAPY

### 5.1 Basic Principles of chemotherapy

- Principles of cell kill by chemotherapeutic agents, drug resistance, phase specific and cycle specification
- Basic principles underlying the use of chemotherapeutic agents
- Basic for designing different chemotherapy schedules. .
- Chemotherapy practice in various malignancies
- Classification and mode of action of cytotoxic drugs.
- Chemotherapy practice & results/toxicities in sequential & concomitant chemoradiotherapy.
- The general principles of pharmacokinetics; factors affecting drug concentration 'in vivo' including route and timing of administration, drug activation, plasma concentration, metabolism and clearance.
- Toxicity of drugs. Early, intermediate and late genetic and somatic effects of common classes of anticancer drugs.
- Drug administration and Precautions in the safe handling of cytotoxic drugs
- Supportive care for chemotherapy.
- Basic concepts of Chemotherapy and Irradiation Interaction
- Newer chemotherapeutic agents

### 5.2 Principles of combinations of therapy,

- dose response curves,
- adjuvant and neoadjuvant chemotherapy,
- sanctuary sites,
- high dose chemotherapy,
- regional chemotherapy.

.

**Endocrine manipulation and biological response modifiers.**

- Mode of action and side effects of common hormonal preparations used in cancer therapy (including corticosteroids).
- ajor biological response modifiers such as interferons, interleukins and growth factors and knowledge of their side effects.
- Gene Therapy
- Pharmacokinetics and Pharmacodynamics

### 5.4 Assessment of New Agents, Principles of phase I, II, and III studies.

## 6. COURSE CONTENT OF CLINICAL RADIOTHERAPY, CHEMOTHERAPY AND TARGETED THERAPY IN MANAGEMENT OF SITE SPECIFIC MALIGNANCIES

- Breast
- Lung and Mediastinum
- Head and
- Skin

- Male Reproductive System
- Female Reproductive System
- Urinary Tract
- Gastrointestinal Tract
- Central Nervous System
- Haematology
- Musculoskeletal & Connective Tissue
- Paediatric
- Metastatic Disease
- Metastasis of Unknown Origin
- AIDS related Malignancies
- Oncologic Emergencies
- Paraneoplastic syndromes
- Benign Diseases

## PART II FMCR (RADIATION AND CLINICAL ONCOLOGY)

## SCOPE OF TRAINING:

- **DURATION: PART 2 (36 MONTHS)**

1. Clinical Radiation Oncology and Clinical Oncology (24 months)
   *optional 3-12 months overseas exposure in a comprehensive cancer center after a minimum period of 12 months post-Part 1.

2. Clinical Research (12 months).

## FUNDAMENTAL COMPONENTS OF PART II TRAINING PROGRAMME

1. Case presentations & discussion- once a week
2. Seminar – Once a week
3. Journal club- Once a week
4. Grand round presentation (by rotation departments and subspecialties)-once a week
5. Faculty lecture teaching- once a month
6. Clinical Audit-Once a Month
7. A poster and have one oral presentation at least once during this training period in a recognized conference.

## EXAMINATION

The Part II Fellowship in Radiation and Clinical Oncology of the NPMCN Examination, which is a final examination covering all the subspecialties within clinical Radiotherapy and clinical Oncology is in three parts:

- Part A comprising of 3 Papers – Paper 1 (multiple choice questions from all modules),
- Part B (Clinical and Oral examinations including demonstration of radiotherapy planning techniques on mannequins)
- Part C (Defense of Book of Dissertation and 6 case reports)

## POSTINGS

1. Major tenure of posting should include care of inpatients, out patients, day care, isolation, special clinics, terminally ill patients and maintenance of case records for both in & out patients
2. Linear Accelerator/Cobalt Teletherapy Floor
3. Simulator
4. CT simulator
5. Brachytherapy LDR/MDR/HDR/PDR
6. Computerized TPS
7. Mould room
8. Medical physics lab
9. Chemo-room
10. Others

Following support department posting are listed: -
1. Pathology
2. Radiodiagnosis
3. Nuclear Machine
4. Gynecology, GI surgery, Otorhinolaryngology, Neurosurgery and Pulmonary Medicine.
5. Molecular Oncology and genetics

**RESEARCH**

The student would carry out the research project and write a thesis/ dissertation in accordance with NPMCN guidelines. He/ she would also be given exposure to partake in the research projects going on in the departments to learn their planning, methodology and execution so as to learn various aspects of research.

**LOG BOOK (PART II)**

A candidate shall maintain a log book of operations (assisted / performed) during the training period, certified by the concerned post graduate teacher / Head of the department / consultant.
This log book shall be made available to the College for their perusal at the time of application for final examination.
The candidate will maintain the record of all academic activities undertaken by him/her in log book .
1. Personal profile of the candidate
2. Educational qualification/Professional data
3. Record of case histories
4. Procedures learnt
5. Record of case Demonstration/Presentations
6. Every candidate, at the time of application for Part II examination, will be required to submit performance record (log book) containing details of the work done by him/her during the entire period of training as per requirements of the log book. It should be duly certified by the supervisor as work done by the candidate and countersigned by the administrative Head of the Institution

# RADIATION ONCOLOGY (PART II) TRAINING PROGRAMME CURRICULUM

## CONTENT OF TRAINING AND LEARNING OUTCOMES

| S/No | Course Name | Course Code | Mode Of Delivery | Assessment Methods | Course Unit | Learning outcome |
|---|---|---|---|---|---|---|
| 1 | Radio-therapy Techniques and Treatment planning system | RCO 810 | Lectures, Tutorials, Seminars, Assignments, self-directed learning, Conferences | MCQ OSCE Oral examination | 24 | Understand the delivery of radiation and in-depth technical knowhow of equipment as well as physics and sequelae related to radiotherapy and oncology. Become competent in the use of various radiation equipment, techniques, treatment planning, radiation dose prescription, treatment verification, treatment delivery; chemotherapy, immunotherapy administration and management of related complications |
| 2 | Clinical Radiation Oncology and Clinical Oncology | RCO 811 | Lectures, Tutorials, Seminars, Assignments, self-directed learning, Conferences | MCQ , OSCE, Practical demonstration of treatment planning on mannequins Oral examination | 65 | -Possess necessary knowledge, skills and attitude to prevent, diagnose and manage various cancers<br>-Become competent in the use of various radiation equipment, techniques, treatment planning, radiation dose prescription, treatment verification, treatment delivery; chemotherapy,immunotherapy administration and management of related complications |

## 1. COURSE RCO 810: LEARNING TOPICS IN RADIOTHERAPY TECHNIQUES AND TREATMENT PLANNING SYSTEM

| S/No | COURSE TITLE | CREDIT UNIT |
|---|---|---|
| 1 | Oncologic Imaging and Target volume | 3 |
| 2 | Applied external photon beam radiation therapy | 3 |
| 3 | Applied electron beam radiation therapy | 2 |
| 4 | Applied sealed source radionuclides and brachytherapy | 3 |
| 5 | Advanced Treatment Planning using a treatment planning system | 3 |
| 6 | Principles of inverse planning and Intensity Modulated Radiation Therapy (IMRT) | 3 |
| 7 | Stereotactic radiotherapy and special irradiation techniques | 2 |
| 8 | Complex treatment planning (with the aid of a dedicated CT-simulator) | 2 |
| 9 | High LET Radiation and Proton beam radiation therapy | 2 |
| 10 | Commissioning and quality assurance of external photon and electron beam radiation therapy equipment | 1 |
| | **Sub total** | **24** |

## 1. COURSE CONTENT RADIOTHERAPY TECHNIQUES AND TREATMENT PLANNING SYSTEM

### 1.1 Oncologic Imaging and Target volume

- Imaging modalities, procedures and technology
- Study and understanding of axial radiological anatomy,
- Image handling in radiotherapy
- identification of tumours and organ structures
- Disease oriented imaging
- Delineation and contouring volumes of tumours and organs at risk
- Target volume determination in clinical practice {Gross Tumour Volume (GTV), Clinical Target Volume (CTV), Planning Target Volume (PTV)}
- ICRU (International Commission for Radiation Units and Measurements) recommendations
- Implementation of treatment plans based on volumes.

### 1.2 Applied external photon beam radiation therapy

- X ray tube
- Cobalt-60 units
- Linear accelerators
- Specialized collimating systems
- Absorbed dose distributions
- Target volume specification
- Target absorbed dose specification in external beam radiotherapy
- Target absorbed dose specification in brachytherapy
- Dosimetry and treatment planning for three-dimensional conformal radiotherapy (3D-CRT)
- Immobilization for 3D-CRT
- Imaging for radiation oncology; use of imaging for treatment planning
- Comparison of image-guided radiation therapy techniques
- Interpretation of 3-D rendering and dose-volume histograms
- Verification of setup and dose delivery (portal imaging, in-vivo dosimetry)
- CT and cone beam CT
- New technologies in radiation oncology; IMRT/IGRT
- Clinical advantages and disadvantages of intensity modulated radiation therapy
- Differences between stationary field and rotational (arc) IMRT or VMAT.
- Informatics (DICOM, networking, Picture Archival Communication System (PACS) , Oncology information systems(OIS). data management)

**1.3 Applied electron beam radiation therapy**

- Simple techniques: single fields, multiple adjacent fields, multiple energy
- Specialised techniques: electron arc therapy, total skin electron irradiation

**1.4 Applied sealed source radionuclides and brachytherapy**

- Clinical uses of surface applications, eye plaques, interstitial implants, intracavitary techniques
- Selection of source dose rate: low, medium, high and pulsed dose rate
- Planning: methods of reconstruction and dosage calculation using radiography, CT, MRI and US
- ICRU dose specification system: current ICRU recommendations for interstitial and gynaecological treatment specifications
- Current dosage systems: Paris system, production of conformal dose distributions using a single, stepping source

**1.5 Advanced Treatment Planning using a treatment planning system**

- Two-dimensional (2D) or three-dimensional (3D) treatment plan using a simulator with patient contouring or a CT-simulator,
- Three-dimensional (3D) treatment plan using a simulator with patient contouring or a CT-simulator,
- Anatomical reconstruction using diagnostic CT information acquired in treatment position,
- Identification of target volumes and critical structures.

- Treatment procedure using either a cobalt unit or a linear accelerator.
- Assessment and correction of Patient position during treatment
- Advanced Mould room Techniques and immobilization devices
- Brachytherapy using intracavitary, interstitial and intraluminal afterloading techniques with individual dose-planning

### 1.6 Principles of inverse planning and Intensity Modulated Radiation Therapy (IMRT)

- Application of 3D compensator
- Static IMRT (Step and Shoot technique)
- Dynamic IMRT (sliding window technique)
- Dynamic arc IMRT
- Micro –MLC
- Tomotherapy methods
- Time gated (4D) radiotherapy
- Merits and demerits of IMRT

### 1.7 Stereotactic radiotherapy and special irradiation techniques

- Stereotactic Radiotherapy (SRT :Physics and Principles, Techniques, Description of units .Stereotactic planning principles ( quality assurance for stereotactic treatments, achievable target dose homogeneity and peripheral dose fall-off)
- Stereotactic Radio surgery (SRS) and), Physical aspects and limitations of stereotactic radiosurgery and fractionated stereotactic radiation therapy ( hardware and software components of stereotactic equipment)
- Stereotactic body Radio therapy (SBRT).Merits and demerits.
- Gamma Knife
- LINAC based
- .Cyber Knife
- Tomotherapy
  - Virtual simulation,
- Intensity modulated radiation therapy (IMRT),
  - Image-guided radiotherapy (IGRT),
  - Intra-operative radiation therapy (IORT),
  - Adaptive radiotherapy(ART),
  - Respiratory gating
  - Total body irradiation (TBI) Physical aspects of total body irradiation
  - Total skin electron irradiation (TSEI)
  - Three-dimensional (3-D) image-based brachytherapy planning.

### 1.8 Complex treatment planning (with the aid of a dedicated CT-simulator)

- Application of MRI, PET and/or PET/CT information using image-fusion technology.
- Identification of Target volumes and organs at risk.

- Use of Beam's-Eye Views and Dose Volume Histograms (DVH) .
- 3D Conformal treatment plan using multiple fields and/or segments based on forward or inverse treatment planning.
- Treatment with a linear accelerator using a multi-leaf collimator (MLC).
- Use of Portal imaging verification protocols and in-vivo dosimetry

**1.9 High LET Radiation and Proton beam radiation therapy**

- Comparison and contrast with low LET radiation.
- Neutron source (including 252 Cf) and Boron Capture Neutron Therapy (outline only).
- Advantages and disadvantages of neutrons, RBE values, hazards of low dose and low energy neutrons, use in radiotherapy, combination with low LET, current clinical results.
- Other high LET particles: protons, high energy heavy nuclei, application to radiotherapy, current clinical results
- Production of proton beams for clinical use including the key principles and advantages of the cyclotron and synchrotron
- Proton beam dose distribution in tissue : Beam profile and percentage depth dose, Clinical modification of Bragg peak and beam collimation, Beams produced by passive scattering foils and active scanning

**1.10 Commissioning and quality assurance of external photon and electron beam radiation therapy equipment**

- Process of acceptance testing: mechanical, optical, radiation and safety considerations
- Process of commissioning: data acquisition and establishment of baseline values for quality management of equipment installation
- Quality assurance relating to radiation therapy equipment including mechanical, optical and radiation parameters for quality management, frequency of testing
- Concept of tolerances and action levels in relation to quality assurance measures

## COURSE RCO 811: LEARNING TOPICS IN CLINICAL RADIATION AND CLINICAL ONCOLOGY

### 2.1 COURSE CONTENT OF OVERVIEW OF BASIC RADIOTHERAPY TREATMENT PLANNING 2units

- Basic radiotherapy planning by orthogonal x rays or a conventional fluoroscopic simulator using bony landmarks, skin marks, intraluminal or intracavitary contrast media and/lead wire or radio-opaque marks identifying target volumes and critical structures.
- Manual calculation of dose distributions using isodose charts or a simple 2D calculation programme on a contour reconstruction.
- Use of superficial/orthovoltage units for the treatment of skin cancer or superficial tumours.
- Treatment by a Cobalt /LINAC unit using simple field arrangements
  Brachytherapy using manual/remote after loading with standard dosimetry.
- Simple mould room techniques.

### 2.2. COURSE CONTENT OF CLINICAL RADIOTHERAPY, CHEMOTHERAPY AND TARGETED THERAPY IN MANAGEMENT OF SITE-SPECIFIC MALIGNANCIES

2.2.1 Head and Neck Cancer 3units

- Oral cavity
- Oropharynx
- Nasopharynx
- Hypopharynx
- Larynx
- Nasal cavity and paranasal sinuses
- Eye and orbit
- Salivary glands `
- Thyroid gland
- Others (e.g. cervical lymph node metastases, melanoma )

2.2.2 Gastrointestinal (GI) tract 3units

- Oesophagus
- Stomach
- Liver and biliary tract
- Pancreas
- Colon/rectum
- Anus

2.2.3 Thorax 3units

- Non-small cell lung cancer
- Small cell lung cancer
- Thymomas and/or mediastinal tumours
- Mesothelioma

2.2.4 Bone and soft tissue 3units

2.2.5 Skin cancer, including malignant melanoma and non-melanoma tumours 3units

2.2.6 Breast cancer 3units

2.2.7 Gynaecology 3units

- Cervix
- Endometrium
- Ovaries and fallopian tubes
- Vagina
- Vulva

2.2.8 Genitourinary (GU) tract 3units

- Prostate
- Bladder
- Testes/seminoma
- Testes/ non-seminoma
- Kidneys
- Ureter
- Urethra
- Penis

2.2.9 Haematology and Lymphomas 3units

- Hodgkin's disease
- Non-Hodgkin's lymphoma
- Leukemia

2.2.10 Central nervous system 3units

- Intracranial tumours in the adult including pituitary tumours
- Intracranial tumours in childhood
- Spinal cord tumours

2.2.11 Cancer of unknown primary 3units

2.2.12 Radiotherapy for palliation 3units

- Skeletal metastases
- Brain metastases
- Spinal cord compression
- Superior vena cava syndrome
- Obstructive syndromes
- Bleeding syndromes

2.2.13 Paediatric tumours 3units

2.2.14 AIDS related Malignancies 3units

2.2.15 Oncologic Emergencies 3units

2.2.16 Paraneoplastic syndromes 3units

2.2.17 Re-irradiation 3unit

2,2.18 Benign diseases

| Course Title | Course Unit |
|---|---|
| 2.1Head and Neck Cancer | 3 |
| 2.2 Gastrointestinal (GI) tract | 3 |
| 2.3Thorax | 3 |
| 2.4 Bone and soft tissue | 3 |
| 2.5 Skin cancer, including malignant melanoma and non-melanoma tumours | 3 |
| 2.6 Breast cancer | 3 |
| 2.7 Gynaecology | 3 |
| 2.8 Genitourinary (GU) tract | 3 |
| 2.9 Haematology and Lymphomas | 3 |
| 2.10 Central nervous system | 3 |
| 2.11 Cancer of unknown primary | 3 |
| 2.12 Radiotherapy for palliation | 3 |
| 2.13 Paediatric tumours | 3 |
| 2.14 AIDS related Malignancies | 3 |
| 2.15 Oncologic Emergencies | 3 |
| 2.16 Paraneoplastic syndromes | 3 |
| 2.17 Re-irradiation | 3 |
| 2.18 Benign diseases | 3 |
| 2.19 Geriatric Oncology. | 3 |
| 2.20 Molecular and Genetic Oncology | 3 |
| Clinical Radiotherapy, Chemotherapy and Targeted Therapy in Management of Site Specific Malignancies: | 60 |
| Palliative and Supportive Care | 3 |
| . Overview of Basic Radiotherapy Treatment Planning | 2 |
| Subtotal | 65 |

3Unit

2.2.19 Geriatric Oncology.

3units

2.2.20 Molecular and Genetic Oncology

3units

**3.1 Course content of palliative and supportive care** **3units**

- Symptoms /Signs of advanced cancer
- Palliation of compression and obstruction due to malignancy
- Palliation of brain & spiral cord metastasis
- Palliation of bleeding catastrophes
- Palliation of bone metastasis
- Palliation of visceral recurrences and metastases
- Pain management: Pain control, WHO guidelines for adults & children
- Patient's and relatives' counseling on end stage management
- Guidelines for palliative care
- Management of terminally ill patients.
- Different pharmacologic & non-pharmacology methods
- Palliative chemotherapy
- Home care
- Hospice care
- Physical, social, spiritual & other aspects
- Others

MD programme in Radiology refers to the year of sub-specialization when the Resident in his or her fifth year chooses one of the topics below to study in depth. The Research interest, areas of studies and areas of Teaching will be related to this chosen subject of sub-specialization. Being a more narrowed aspect of Radiology, there is more focused attention with resultant development of the Resident into a recognized authority in the area of Sub-specialization

Each resident is expected to undertake lectures in any one of the below courses in accordance with the expected area of research.

| **COURSES** | **Course Code** |
|---|---|
| Advanced Radiotherapy Planning | RCO 910 |
| Advanced Principles of Clinical Radiotherapy | RCO 911 |
| **Health Research & Management** | |
| Research Methodology in medicine | CBC 801 |
| Health Resources Management | CBC 802 |
| Seminars | RCO 939 |
| Dissertation | RCO 940 |

**RADIATION AND CLINICAL ONCOLOGY: Any of the following, each carrying 2 credit units**

**RCO 910 ADVANCED RADIOTHERAPY PLANNING**

## ADVANCED PRINCIPLES OF RADIOTHERAPY PLANNING

Cancer staging using imaging and treatment planning in oncologic imaging; Imaging anatomy and the pathways of spread for the common cancer types; Staging systems for common cancer types such current TNM, clinical staging classification, etc and knowledge of their limitations; Application of imaging techniques including ultrasound, computed tomography, magnetic resonance imaging, nuclear medicine and hybrid techniques PET/CT and PET/MRI for cancer staging; Appropriate choice of imaging techniques and/or the appropriate sequence of imaging techniques in the investigation of

specific clinical problems in oncologic imaging; Appreciation of common imaging ‘false positives’ and ‘false negatives’ in cancer staging, and the role of different imaging techniques for lesion characterization; National and international guidelines for staging common cancer types; Principles of structured and criteria-based reporting in imaging oncology; Treatment planning in oncologic imaging; Role of imaging in treatment planning e.g. surgery, radiotherapy; National and international guidelines in treatment planning in oncologic imaging.

**RCO 911 ADVANCED CLINICAL RADIOTHERAPY**

## ADVANCED PRINCIPLES OF CLINICAL RADIOTHERAPY

Cancer biology and treartment relevant to imaging; Aetiopathogenesis of oncogenesis, angiogenesis, lymphangiogenesis and metastasis including genomics and proteomics; Principles of treatment including surgery, locoregional therapies, chemotherapy, bone marrow/stem cell transplantation, immunotherapy and radiotherapy; Detailed biology of different tumour types, particularly the most common cancers: lung, breast, colorectal, and prostate; Treatment strategies of different tumour types, particularly the most common cancers: lung, breast, colorectal, and prostate; Acute and chronic complications of oncologic treatment and their imaging features; Imaging techniques in oncologic imaging; Advanced techniques and contrast agents in oncologic imaging; cancer screening and surveillance; cancer response assessment and clinical trials.

| | | | | |
|---|---|---|---|---|
| **RDL** | **939** | **SEMINARS** | **=** | **6 CREDIT UNITS** |
| **RDL** | **940** | **THESIS/DISSERTATION** | **=** | **12 CREDIT UNITS** |

# NATIONAL POSTGRADUATE MEDICAL COLLEGE OF NIGERIA
## FACULTY OF RADIOLOGY
### CRITERIA FOR GRADING OF DISSERTATIONS

**Name of Candidate-**

**Title of Dissertation-**

| **Section of Dissertation** | | **Assigned Marks** | **Candidate's Score** |
|---|---|---|---|
| 1. | Topic / Title Page | 2 | |
| 2. | Abstract (2) /Introduction (3) | 5 | |
| 3. | Aim & Objectives (3) / Justification (3) / Hypothesis & Sub-Hypothesis (2) | 8 | |
| 4. | Gross Anatomy (3) / Radiological Anatomy (5) ( Including Quality of Line Drawings & Medical Images) | 8 | |
| 5. | Literature Review: Style (3);Comprehensiveness (3) ; Currency of Cited Literature (3);*Vancouver Style/* Format (3) | 12 | |
| 6. | Materials & Methods: Study Design (3) / Informed Consent (3) / Data Collection (3) /Method of Statistical Analysis of Data (3) / Limitations of Study (3) | 15 | |
| 7. | Results: Demography (Age Range / Mean Age / Sex Distribution of Cases – 2) ; Depth of Analysis (4); Interpretation of Results (4) ; Quality of Tables & Captions / Quality of Statistical Illustrations & Legends i.e. Linear Graphs / Pie Charts / Bar Charts / Scatter Plots (4); Quality of Medical Images & Legends (4) | 18 | |
| 8. | Discussion: Sequence of the Discussion (3); Presentation of Cited Literature (3); Comparison of the Results from the Current Study with Previous Studies and Highlighting Areas of Agreement or Differences (5) ; Contribution to Knowledge (2); Breaking of New Ground (2) | 15 | |
| 9. | Conclusion: Highlights of the Important Findings of the Study with Emphasis on the Outcome of Clinical Hypothesis (2) / Clinical Sub-hypothesis (2) Testing | 4 | |
| 10. | List of References: Conformity with *Vancouver Style* Format (2); Layout of Book References (2); Currency of References (1); Comprehensive of References (1) | 6 | |
| 11. | Approval from Institutional Ethics Review Committee | 2 | |
| 12. | Miscellaneous: Spelling (2); Grammar (2); Syntax (1) | 5 | |
| | Total Score (%) | 100 | |

# JUNIOR REGISTRAR LOGBOOK

# FOR

# RADIOTHERAPY & ONCOLOGY

**PERSONAL DETAILS**

SURNAME.....

OTHER NAMES..... (BLOCK LETTERS)

NPMCN REGISTRATION NUMBER:.....

DATE OF BIRTH .....

(DD/MM/YY)

Registered address

.....

.....

EMAIL ADDRESS.....

Date of Commencing SR supervised Training .....

Name of training Institution .....

Institutions & Periods/Dates

1 .....

2 .....

3 .....

4 .....

Date of Assessment.....

Names of Assessors: :i.Dr.....

Designation.....

ii.DR.....

Designation.....

I certify that I have checked and verified this Logbook

.....

Date.....

Head of Department (Name & Signature).....

## INTRODUCTION

A Senior Registrar is mandated to fulfill the requirements of his/her log book.

This must be duly signed by the supervising Consultants and submitted to the College together with a THREE yearly reports from and signed by the Head of Department and two supervising Consultants from his/her Institution(s)

Where not specified in the logbook, a SR must show evidence of:

1) Participation in ongoing regular unit meetings(pathology, radiology, oncology etc)

2) Active in regular departmental audit meetings,

3) Active in clinical research and teaching activities.

4) At least 3 supervised clinical/seminar presentations,

**FORMAT FOR YEARLY ASSESSMENT FOR SENIOR REGISTRAR**

| **Personal Attributes** | **Strengths** | **Areas Of Improvement** | **Score** |
|---|---|---|---|
| **1. <u>Presentation</u>**<br>Personal/physical appearance | | | |
| **2. <u>Communication</u>**<br>Patient, relatives and any other interested parties.<br><br>Effective verbal skills. Present ideas and information concisely. Inspires confidence in colleagues. Keeps others well informed etc<br><br>● **Interpersonal relations**<br><br>Work colleagues and superiors | | | |
| **3. <u>Management</u>**<br>**Planning and Organization**<br><br>Sets goals and priorities. Plans ahead and utilizes resources effectively. Ability to meet deadlines and monitor tasks. | | | |
| **4. <u>Judgement</u>**<br>Considers pros and cons before making decisions. Considers risks. Considers impact of decisions and seeks advice. | | | |
| **5. <u>Leadership</u>**<br>Effectively manages situations and implements changes when required. Motivates, coordinates, guides and develops subordinates through actions and attitudes. | | | |
| **6. <u>Ethics</u>**<br>Observance of both the patient's and the doctor's rights. Considers the ethical impact of decisions. Demonstrates actions and attitudes of integrity. | | | |

| | | | |
|---|---|---|---|
| **7. Reliability**<br>Can achieve goals without supervision. Dependable and trustworthy. | | | |
| **8. Quality of Work**<br>Achieves high quality of work that meets requirements of the job. | | | |
| **9. Quantity of Work**<br>Achieves or exceeds the standard amount of work expected on the job. | | | |
| **10. Initiative**<br>A self-starter. Provides solutions to problems. | | | |
| **11. Cooperation**<br>Willingness to work with others as a team member | | | |
| **12. Assessment by other disciplines**<br>Professional conduct, reliability and quality of work. | | | |
| **13. Participation in clinical audit, clinical governance and Continuous Professional Development** | | | |
| **14. Teaching**<br>Junior medical and dental staff. Nurses and other health professionals. | | | |
| **15. Research**<br>Participation in ongoing research. | | | |
| **16. Others** | | | |

**Score 1 – 5**

**1 is the worst score and 5 is the best score. Meet candidate quarterly and discuss strengths and areas of improvement. Consolidate with rating from other departments for overall score.**

## SECTION 2: Activities to be done;

**Part I – 1st year of the senior registrar period**

Date of Assessment: ……

Name of Assessor: ……..

| **Activities** | | | | | |
|---|---|---|---|---|---|
| | **Poor** | **Satisfactory** | **Good** | **Excellent** | **Not done** |
| Outpatient clinics: New patients, Review and SIM clinics | | | | | |
| Ward round attendance and participation | | | | | |
| Chemotherapy Administration | | | | | |
| Brachytherapy | | | | | |
| Chart round attendance and participation | | | | | |
| Journal Club attendance and participation | | | | | |
| MDT meetings attendance and participation | | | | | |

Any additional comments:

Signed: …… Date: ……

**<u>Part II</u> – 2nd year of the senior registrar period**

Date of Assessment: ……

Name of Assessor: ……..

| **Activities** | | | | | |
|---|---|---|---|---|---|
| | **Poor** | **Satisfactory** | **Good** | **Excellent** | **Not done** |
| Outpatient clinics: New patients, Review and SIM clinics | | | | | |
| Ward round attendance and participation | | | | | |
| Chemotherapy Administration | | | | | |
| Brachytherapy | | | | | |
| Chart round attendance and participation | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Journal Club attendance and participation | | | | | |
| MDT meetings attendance and participation | | | | | |

Any additional comments:

Signed: ..... Date: .....

**<u>Part III</u> – 3rd year of the senior registrar period**

Date of Assessment: .....

Name of Assessor: ……..

| **Activities** | | | | | |
|---|---|---|---|---|---|
| | **Poor** | **Satisfactory** | **Good** | **Excellent** | **Not done** |
| Outpatient clinics: New patients, Review and SIM clinics | | | | | |
| Ward round attendance and participation | | | | | |
| Chemotherapy Administration | | | | | |
| Brachytherapy | | | | | |
| Chart round attendance and participation | | | | | |
| Journal Club attendance and participation | | | | | |
| MDT meetings attendance and participation | | | | | |

Any additional comments:

Signed: …… Date: ……

## SECTION 3: Procedures to be done;

## Patient Management Log Book:

## A. RADIOTHERAPY TREATMENT

## Minimum 50 Patients

# 1. Breast cancer

**SCORING KEY**

**Score 1 – 5**

**1 is the worst score and 5 is the best score. Meet candidate quarterly and discuss strengths and areas of improvement. Consolidate with rating from other departments for overall score.**

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Inten;t any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 2. Gynaecological cancers

# (Cervix, Uterus, Vulva, Ovary)

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1, | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 3. Thorax- Lung Cancer

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 4. Gastrointestinal Cancers

**Esophagus, Gastric, Rectal, Anal Cancers**

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 5. Head and Neck/ENT Cancers

**Lip and Oral Cavity, Oropharynx, Hypopharynx, Nasopharynx, Larynx, Paranasal Sinus Cancers, Salivary Glands**

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 6. Urological Cancers and Male Genital Cancers

**Kidney, Bladder, Prostate, Penile and Testis**

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 7. Skin Cancers and Melanoma

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 8. Bone and Soft Tissue Tumours

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 9. Adult Neurological Tumours (PNS and CNS)

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 10. Paediatric Malignancies

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 11. Lymphoreticular Malignancies and Myeloma

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 12. Kaposi Sarcoma

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 13. Brachytherapy

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Procedure/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

**RADIOTHERAPY TREATMENT Overall Comments:**

**Supervisor 1:**

**DATE: …… NAME: ……..…..SIGNATURE: ……..**

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**Supervisor 2:**

**DATE: …… NAME: ……..…..SIGNATURE: ……..**

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## B. SYSTEMIC THERAPY: Chemotherapy/Hormonal and Targeted Therapy Treatment

## Minimum 30 Patients

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Regimes and prescription(BSA) | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |
| 6. | | | | | | |
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| 8. | | | | | | |
| 9. | | | | | | |
| 10 | | | | | | |
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| 15 | | | | | | |
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| 19 | | | | | | |
| 20 | | | | | | |
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| 22 | | | | | | |
| 23 | | | | | | |
| 24 | | | | | | |
| 25 | | | | | | |
| 26 | | | | | | |
| 27 | | | | | | |
| 28 | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 29 | | | | | | |
| 30 | | | | | | |

**Systemic Therapy Overall Comments:**

**Supervisor 1:**

**DATE: …… NAME: ……..….. SIGNATURE: ……..**

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**Supervisor 2:**

**DATE: …… NAME: ……..….. SIGNATURE: ……..**

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**Overall assessment by Head, Department of Radiotherapy and Oncology**

Registrable for EXAM
……..

Extend Assessment by six months:…….

Non Registrable for
EXAM……

# SENIOR REGISTRAR LOGBOOK

# FOR

# RADIOTHERAPY & ONCOLOGY

**PERSONAL DETAILS**

SURNAME.....

OTHER NAMES..... (BLOCK LETTERS)

NPMCN REGISTRATION NUMBER:.....

DATE OF BIRTH .....

(DD/MM/YY)

Registered address

.....

.....

EMAIL ADDRESS.....

Date of Commencing SR supervised Training .....

Name of training Institution .....

Institutions & Periods/Dates

1 .....

2 .....

3 .....

4 .....

Date of Assessment.....

Names of Assessors: :i.Dr.....

Designation.....

ii.DR.....

Designation.....

I certify that I have checked and verified this Logbook

.....

Date.....

Head of Department (Name & Signature).....

## INTRODUCTION

A Senior Registrar is mandated to fulfill the requirements of his/her log book.

This must be duly signed by the supervising Consultants and submitted to the College together with a THREE yearly reports from and signed by the Head of Department and two supervising Consultants from his/her Institution(s)

Where not specified in the logbook, a SR must show evidence of:

5) Participation in ongoing regular unit meetings(pathology, radiology, oncology etc)

6) Active in regular departmental audit meetings,

7) Active in clinical research and teaching activities.

8) At least 3 supervised clinical/seminar presentations,

**FORMAT FOR YEARLY ASSESSMENT FOR SENIOR REGISTRAR**

| **Personal Attributes** | **Strengths** | **Areas Of Improvement** | **Score** |
|---|---|---|---|
| **17. <u>Presentation</u>**<br>Personal/physical appearance | | | |
| **18. <u>Communication</u>**<br>Patient, relatives and any other interested parties.<br><br>Effective verbal skills. Present ideas and information concisely. Inspires confidence in colleagues. Keeps others well informed etc<br><br>● **Interpersonal relations**<br><br>Work colleagues and superiors | | | |
| **19. <u>Management</u>**<br>**Planning and Organization**<br><br>Sets goals and priorities. Plans ahead and utilizes resources effectively. Ability to meet deadlines and monitor tasks. | | | |
| **20. <u>Judgement</u>**<br>Considers pros and cons before making decisions. Considers risks. Considers impact of decisions and seeks advice. | | | |
| **21. <u>Leadership</u>**<br>Effectively manages situations and implements changes when required. Motivates, coordinates, guides and develops subordinates through actions and attitudes. | | | |
| **22. <u>Ethics</u>**<br>Observance of both the patient's and the doctor's rights. Considers the ethical impact of decisions. Demonstrates actions and attitudes of integrity. | | | |

| | | | |
|---|---|---|---|
| **23. Reliability**<br>Can achieve goals without supervision. Dependable and trustworthy. | | | |
| **24. Quality of Work**<br>Achieves high quality of work that meets requirements of the job. | | | |
| **25. Quantity of Work**<br>Achieves or exceeds the standard amount of work expected on the job. | | | |
| **26. Initiative**<br>A self-starter. Provides solutions to problems. | | | |
| **27. Cooperation**<br>Willingness to work with others as a team member | | | |
| **28. Assessment by other disciplines**<br>Professional conduct, reliability and quality of work. | | | |
| **29. Participation in clinical audit, clinical governance and Continuous Professional Development** | | | |
| **30. Teaching**<br>Junior medical and dental staff. Nurses and other health professionals. | | | |
| **31. Research**<br>Participation in ongoing research. | | | |
| **32. Others** | | | |

**Score 1 – 5**

**1 is the worst score and 5 is the best score. Meet candidate quarterly and discuss strengths and areas of improvement. Consolidate with rating from other departments for overall score.**

## SECTION 2: Activities to be done;

**Part I – 1st year of the senior registrar period**

Date of Assessment: ……

Name of Assessor: ……..

| **Activities** | | | | | |
|---|---|---|---|---|---|
| | **Poor** | **Satisfactory** | **Good** | **Excellent** | **Not done** |
| Outpatient clinics: New patients, Review and SIM clinics | | | | | |
| Ward round attendance and participation | | | | | |
| Chemotherapy Administration | | | | | |
| Brachytherapy | | | | | |
| Chart round attendance and participation | | | | | |
| Journal Club attendance and participation | | | | | |
| MDT meetings attendance and participation | | | | | |

Any additional comments:

Signed: …… Date: ……

**<u>Part II</u> – 2nd year of the senior registrar period**

Date of Assessment: ……

Name of Assessor: ……..

| **Activities** | | | | | |
|---|---|---|---|---|---|
| | **Poor** | **Satisfactory** | **Good** | **Excellent** | **Not done** |
| Outpatient clinics: New patients, Review and SIM clinics | | | | | |
| Ward round attendance and participation | | | | | |
| Chemotherapy Administration | | | | | |
| Brachytherapy | | | | | |
| Chart round attendance and participation | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Journal Club attendance and participation | | | | | |
| MDT meetings attendance and participation | | | | | |

Any additional comments:

Signed: ..... Date: .....

**<u>Part III</u> – 3rd year of the senior registrar period**

Date of Assessment: .....

Name of Assessor: ……..

| **Activities** | | | | | |
|---|---|---|---|---|---|
| | **Poor** | **Satisfactory** | **Good** | **Excellent** | **Not done** |
| Outpatient clinics: New patients, Review and SIM clinics | | | | | |
| Ward round attendance and participation | | | | | |
| Chemotherapy Administration | | | | | |
| Brachytherapy | | | | | |
| Chart round attendance and participation | | | | | |
| Journal Club attendance and participation | | | | | |
| MDT meetings attendance and participation | | | | | |

Any additional comments:

Signed: …… Date: ……

## SECTION 3: Procedures to be done;

## Patient Management Log Book:

## A. RADIOTHERAPY TREATMENT

## Minimum 50 Patients

# 1. Breast cancer

**SCORING KEY**

**Score 1 – 5**

**1 is the worst score and 5 is the best score. Meet candidate quarterly and discuss strengths and areas of improvement. Consolidate with rating from other departments for overall score.**

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Inten;t any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5. | | | | | | |

## 2. Gynaecological cancers

## (Cervix, Uterus, Vulva, Ovary)

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1, | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 3. Thorax- Lung Cancer

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 4. Gastrointestinal Cancers

**Esophagus, Gastric, Rectal, Anal Cancers**

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5. | | | | | | |

# 5. Head and Neck/ENT Cancers

**Lip and Oral Cavity, Oropharynx, Hypopharynx, Nasopharynx, Larynx, Paranasal Sinus Cancers, Salivary Glands**

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 6. Urological Cancers and Male Genital Cancers

**Kidney, Bladder, Prostate, Penile and Testis**

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 7. Skin Cancers and Melanoma

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 8. Bone and Soft Tissue Tumours

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 9. Adult Neurological Tumours (PNS and CNS)

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 10. Paediatric Malignancies

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 11. Lymphoreticular Malignancies and Myeloma

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 12. Kaposi Sarcoma

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Simulation/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

# 13. Brachytherapy

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Procedure/Treatment Technique/Planning and Prescription | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |

**RADIOTHERAPY TREATMENT Overall Comments:**

**Supervisor 1:**

**DATE: ……. NAME: ……..…..SIGNATURE: ……..**

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**Supervisor 2:**

**DATE: ……. NAME: ……..…..SIGNATURE: ……..**

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## B. SYSTEMIC THERAPY: Chemotherapy/Hormonal and Targeted Therapy Treatment

## Minimum 30 Patients

| | Patient's initials and File Number | DATE | Diagnosis and Treatment Intent; any previous Treatment | Regimes and prescription(BSA) | Patient Outcome | Supervisor Score and Signature |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |

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| 5. | | | | | | |
| 6. | | | | | | |
| 7. | | | | | | |
| 8. | | | | | | |
| 9. | | | | | | |

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| 14 | | | | | | |

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| 25 | | | | | | |
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| 28 | | | | | | |
| 29 | | | | | | |

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|---|---|---|---|---|---|---|
| 30 | | | | | | |

**Systemic Therapy Overall Comments:**

**Supervisor 1:**

**DATE: …… NAME: ……..…..SIGNATURE: ……..**

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**Supervisor 2:**

**DATE: …… NAME: ……..…..SIGNATURE: ……..**

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**Overall assessment by Head, Department of Radiotherapy and Oncology**

Registrable for EXAM ……..

Extend Assessment by six months:…….

Non Registrable for EXAM……

**Comment-**

**RECOMMENDED TEXT BOOKS AND JOURNALS BOOKS**

1. Liebel and Philips text book of radiation oncology Richard T, Hoppe MD, FACR, FASTRO, Theodore Locke Philips MD, FACR, FASTRO, Mack Roach III MD, FACR.

2. Perez and Brady's Principles and Practice of Radiation Oncology, Edward C Halperin MD, MA, FACR, Carlos A Perez MD, Luther W Brady .

3. Cancer – Principles and Practice of Oncology Vincent T De Vita, Jr. Theodore S, Lawarence, Steven A Rosenbergo, Stevven A.

4. Clinical Radiation Oncology Leonard L Gunderson, Joel E Tepper.

5. Bethesda Handbook of Clinical Oncology by Carmen J Allegra MD (Editor), Jame Abraham MD (Editor), James L Gulley MD (Editor).

6. Handbook of evidence based radiation Oncology ,Dr. Eric K Hansen, Dr, Mack Roach III.

7. Moss's Radiation Oncology: Rational, Technique, Results (1994) William ThomasMoss, and James Daniel Cox.

8. Text Book of Radiotherapy, Gilbert H Fletcher.

9. Treatment planning in Radiation Oncology Faiz M Khan.

10. Oxford Handbook of Oncology, Jim Cassidy, Donald Bissett, Roy A J Spence Obe.

11. The Physics of Radiation Therapy: Mechanisms, Diagnosis and Management by Faiz M Khan.

12. The Physics of Radiology , Haold Elford Johns, John Robert Cunningham.

13. Radiobiology for the Radiologist (current Edition) Eric J Hall.

14. The Chemotherapy source Book Michel C Perry.

15. Text Book of Medical Oncology , Franco Cavalli, Stan B Kaye, Heine H Hansen, James O Armitage, Martine J.

16. Surgical Oncology: Contemporary principles and Practice, K. I. Bland, John M Daly, Constantine P Karakousis.

17. Basic Clinical Radiobiology, Edited by G Gordon Steel

18. Principles And Management of Cancer, Tejinder Kataria, Hemant Singhal,Dinesh Chand Doval

19. Cancer Biology, Roger J.B.King,Mike W .Robins

**JOURNALS**

1. International Journal of Radiation Oncology, Biology, Physics.
2. Annals of Oncology
3. British Journal for Cancer
4. CA-A Cancer Journal for clinicians
5. Cancer
6. Cancer of clinical Oncology
7. Journal of Clinical Oncology
8. Journal of Cancer Research and therapeutics
9. Medscape Oncology
10. Seminars in Oncology
11. Seminars in Radiation Oncology
12. The Lancet
13. The new England Journal of Medicine
14. Radiotherapy and Oncology, Elsevier
15. Lancet Oncology-Elsevier
16. Acta Oncologica
17. Nature reviews Clinical Oncology
18. Natures Clinical Practice oncology

# RECOMMENDATIONS

**Orientation Programme for ALL new Residents**

- All Residents must possess the 2018 Curriculum and use/refer to it all

- This has been scientifically proven to help student attain and sustain focus throughout the period of a programme, aiming to get the most out of such programmes

- A Pre- and Post-Test must be carried out on the contents of the Curriculum. Since assessment drives knowledge, this will ensure they familiarize themselves with the contents of the Curriculum
- The scores of the Pre- and Post-Tests should contribute to the final institutional Assessment of the Part 1 Residency programme to determine the preparedness of the Resident to attempt the Part 1 Fellowship Examinations

- Only Residents who are qualified for the examinations in which the seek to attempt should be recommended to apply for the Fellowship Examinations

**Faculty Development Programme for all Trainers and Examiners**

- The 2020 Curriculum MUST be made available to **ALL** Trainers and Examiners

- A Faculty Development Programme that will involve the full participation of all Trainers is **STRONGLY** recommended

Schematic representation of the Proposed Curriculum of the 6year Radiology Residency Programme +/- Academic Postdoctoral Degree (MD/PhD) as desired by individual Trainee

**APPENDIX 1**

The 6-year Programme

Part I Diagnostic Radiology Residency

1st 3 years will be for reinforcement of Basic Sciences (Pathophysiology, Radiologic Anatomy), Medical Physics, Instrumentation, Postings into various relevant disciplines for a predetermined length of time, Clinical Radiology/
At the end of 3years, Resident applies for Part I Fellowship examination

Outcome?

Fail? Repeat after six months

Pass!!! continue to Part II or

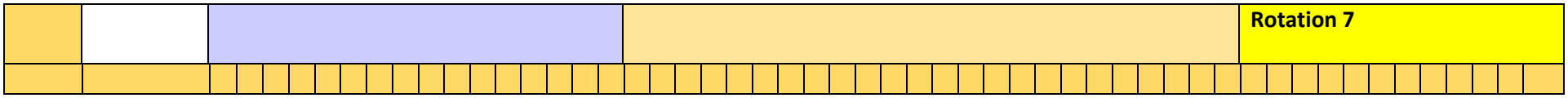
Register into a Postgraduate Programme in University of Trainee's Choice for MD or PhD using Part I result notification as the required prerequisite for admission into PG Programme concluding with Presentation of Thesis and award of Academic degree

Part II – 3year Programme
The first of the three years being devoted to General Radiology and commencement of work on Dissertation and collection of short cases for the

Trainee desiring to complete Professional Programme can return to Programme at Part II level at the successful completion of the Academic post-Doctoral programme, the PhD Thesis being acceptable as equivalent to Dissertation. Book of short cases must however be presented for Defense at the end of programme

compilation of Book of short cases; Clinical Radiology, and other courses eg Management and Leadership courses, Health Informatics, Health safety and Environment, Regulatory Medicine, etc.
Years 2 and 3 are devoted to sub-specialization in the Candidate's choice of subspecialty
Conclude with Clinical examinations of sorts and defense of Dissertation and Book of Case Reports

| Part 1 | Months | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rotations | Rotation 1 | | | Rotation 2 | | | Rotation 3 | | | Rotation 4 | | Rotation 5 |
| | **Year 1** | **Gross Anatomy** | **Pathology** | Radiologic Anatomy, Techniques | Radiologic Physics and Instrumentation | | | | | | | | |
| | | | | | **1** | 2 | 3 | 4 | Radiologic Anatomy, Techniques | Radiologic Anatomy, Techniques | **5** | **6** | **7** | **8** | Radiologic Anatomy, Techniques | 9 | 10 | Radiologic Anatomy, Techniques | **Rotation 5** |
| | Rotations | **Didactic lectures, Seminars, Interdepartmental meetings, Image Reporting, Call duties, Research work** | | | | | | | | | | | |
| | **Year 2** | **Rotation 5** | | **Rotation 6** | | | **Rotation 7** | | | **Rotation 8** | | **Rotation 9** | |
| | | **Didactic lectures, Seminars, Interdepartmental meetings, Image Reporting, Call duties, Research work** | | | | | | | | | | | |
| | **Year 3** | **Rotation 9** | **Rotation 10** | | | **Rotation 11** | | | **Rotation 12** | | Apply for Fellowship Examinations | **Rotation 13** | |
| | | **Didactic lectures, Seminars, Interdepartmental meetings, Image Reporting, Call duties, Research work** | | | | | | | | | | | |
| Part 2 SUBSPECIALIZATION | Year 4 | Prepare Research Proposal for submission | | | | Commence work on Dissertation | | | | | | | |
| | | **Rotation 1** | | | | | **Rotation 2** | | | | | | **Rotation 3** |
| | | **Didactic lectures, Seminars, Interdepartmental meetings, Image Reporting, Call duties, Research work** | | | | | | | | | | | |
| | Year 5 | **Rotation 3** | | | | | **Rotation 4** | | | | | **Rotation 5** | |
| | | **Didactic lectures, Seminars, Interdepartmental meetings, Image Reporting, Call duties, Research work, Teaching** | | | | | | | | | | | |
| | Year 6 | **Rotation 5** | | | | **Rotation 6** | | | | | Apply for Fellowship Examinations | | |




At a glance view of the 2018 Curriculum: Rotations in Part 1 are three (3) months long. There are 11 of such Rotations that will enable the Registrar to go through all sections of Investigations in the Radiology Department and have contacts with the various Heads of Units.
In the earlier Rotations (weeks 1-8), exposure to Human Anatomy and Pathology (one month each} is incorporated into this Curriculum.
Thereafter, two weeks will be spent in each of the 10 Disciplines/Specialties listed below as shown on the Map. This number of weeks (2) was determined, in recognition of the fact that the much needed exposure can be accommodated in the Curriculum, if the outside Rotation is limited to two weeks being careful not to overly topple the service rendering schedules, in recognition that available number of Residents per Departmental Units is not adequate enough to carry out services in the Department.
The Residents on these "External" Postings must maximize the limited time made available. A comprehensive Report must be submitted to the Residency Training Coordinator at the end of each External Postings

1. **Pediatrics**
2. **General Internal Medicine**
3. **Neurology**
4. **Respirology**
5. **Neurosurgery**
6. **Orthopedic Surgery**
7. **General Surgery**
8. **Radiation Oncology**
9. **ICU**
10. **Emergency Medicine**

Before the end of the Part 1 Fellowship, each Registrar is expected to choose a Specialty of personal interest to spend four to six weeks in, in any Institution of choice. This is termed ELECTIVE.
There are several electives one can choose from including, **Gynecological Oncology, Cardiology, Cardiothoracic Surgery, Vascular Surgery, Urology, Plastic Surgery and OBGYN,**
A detailed Report of such an activity must be submitted to the Radiology Residency Training Coordinator of the Institution. This Report contributes to the Resident's Portfolio.
The intradepartmental Rotations are designed as Hands-on sessions where Residents acquire skills and bring them into contact with their Consultants / Heads or Unit for training and mentoring. At the end of each Rotation, an Intradepartmental Assessment is carried out on each Resident. This way, weak Residents will be identified early for purposes of remediation.

A Typical Rotation:

| | | |
|---|---|---|
| **Genitourinary systems imaging –** | **Mondays** | **Such a Unit is headed by a Consultant. Academic Day** |
| **General Ultrasonography** | **Tuesdays** | **A Resident so rostered will carry out the above services** |
| **on the allocated days for 3months** | | |
| **Academic Day** | **Wednesdays** | **In the case of a Senior Resident, 6 months is spent in** |
| **each Rotation. At the end of each Rotation,** | | |
| **M RI** | **Thursdays** | **the Head of Unit conducts an Examination, the Result of** |
| **which is submitted to the Residency** | | |
| **Computed Tomography** | **Fridays** | **Training Coordinator for collation.** |

Outcomes of these Assessments are kept for eventual Reference when performance of the Resident, needs to be referred to. This frequent Assessments and other academic activities are expected to keep the Candidates focused in their Training Programme. Also, weak students are identified early for remediation.

Also, before the ends of years 2 and 3, the Resident must conduct two Research activities, the findings of which**,** must be presented one each at a Conference. This also will contribute to the Resident's Portfolio

## Part II

Rotations in Part II are six (6) months long. The Residents at this stage are Senior Residents. They are the first Teaching and mentoring contact with the Residents, Teaching being one of their Responsibilities.
As shown in the Map above, the Part II Residents strengthen what they learnt in the earlier years (1-3years) in these 4$^{th}$ and 5$^{th}$ years.
In the 5th year, an aspect of Radiology is selected by the Part II Resident in which to Subspecialize, gaining Mastery in such aspects of Radiology.

## APPENDIX III: LIST OF TRAINING CENTERS IN RADIOLOGY

The departments of Radiology of the underlisted training institutions are the existing centers approved for postgraduate training in either Radiodiagnosis or Radiotherapy or both, as at January 2020. Each training center exercises admission discretion into its residency programme without any influence from the Faculty of Radiology or the National Postgraduate Medical College. Candidates are therefore advised to seek for admission directly from the institution of their choice. However, it is in the best interest of candidates that such admission is sought after passing the Primary examination because the duration of training given by most training centers does not seem to take account of time necessary to prepare for that part of the examination.

1. University of Nigeria Teaching Hospital, Enugu.
2. University College Hospital, Ibadan.
3. Lagos University Teaching Hospital, Lagos.
4. University of Calabar Teaching Hospital, Calabar.
5. University of Ilorin Teaching Hospital, Ilorin.
6. University of Benin Teaching Hospital, Benin.
7. Obafemi Awolowo University Teaching Hospital, Ile-Ife.
8. University of Port Harcourt Teaching Hospital, Port Harcourt.
9. University of Maiduguri Teaching Hospital, Maiduguri.
10. National Hospital, Abuja.
11. Lagos State University affiliated Teaching Hospitals, Lagos.
12. Aminu Kano Teaching Hospital, Kano
13. Usmanu Dan Fodio Teaching Hospital, Sokoto
14. Lily Hospital, Warri

15. Federal Teaching Hospital, Irrua
16. Federal Teaching Hospital, Gombe
17. Ahmadu Bello University Teaching Hospital, Zaria
18. Benue State University Teaching Hospital Makurdi
19. Braithwaite Memorial Teaching Hospital, Port Harcourt
20. University of Medical Sciences, Ondo
21. Federal Teaching Hospital, Owo

## APPENDIX IV: PROGRAMME AND PRIZES IN RADIOLOGY

As a way of bringing out the best in each candidate and promoting competitive learning atmosphere, the following programmes and prizes exist in the Faculty as at 2020:

1. One year abroad programme

   Each year the best candidate in the Part I examination of the Faculty has the opportunity of being nominated to spend one year in an overseas radiology-training department with modern imaging modalities. Other faculties also compete yearly for this programme under the auspices of the National Postgraduate Medical College.

2. Bayo Banjo Prize – Best candidate in the Part I examination
3. Sanya Sonuga Prize – Best candidate in Part II Clinical Radiology
4. S. B. Lagundoye Prize – Candidate with the best Part II Dissertation
5. Prof B.C. Umerah Prize – Best Candidate in Clinical Radiology
6. Prof Francis Durosinmi-Etti – Best Candidate in Part II Radiation and Clinical Oncology