A Course in DIAGNOSTIC RADIOLOGY AND CT

Detailed syllabus and lecturers (Provisional)

Course dates: 10 – 12 February 2027

Summary

		LECTURES etc.
Diagnostic Radiology	& CT	19.5 h
Demonstrations and visits		1.5 h
TOTAL CONTACT TIME =		20.5 h

Day 1: Diagnostic Radiology physics toolkit; design of imaging systems

1. Design of the digital x-ray unit
   Lecturer: Louise Giansante

Types of x-ray units: radiography, fluoroscopy/fluorography, dental. Design of the generator and x-ray tube. The x-ray spectrum. Automatic exposure control and scatter rejection techniques. Design of flat panel and stimulated luminescence detectors. Design of image intensifiers and TV camera. Interventional techniques: selection and use of contrast media, rotational angiography, digital subtraction.

2. Design of the digital mammography unit
   Lecturer: Louise Giansante

Imaging geometry, design of the x-ray tube. The x-ray spectrum. Automatic exposure control and scatter rejection. Detectors in mammography.

3. The multi-slice CT scanner
   Lecturer: Sue Edyvean

Scanner geometry and scan modes. Scanner components, tube and generator design, filtration, collimation (including adaptive collimation), detector design. Acquisition of projection data, flying focal spot and detector resampling.

4. Patient dosimetry techniques.
   Lecturer: Louise Giansante

Patient dose indicators and definitions, including $CTDI_{VOL}$ for wide-beam CT. Techniques for harvesting and measuring patient dose indicators. Quantifying patient size. Using diagnostic reference levels.

5. Reconstruction techniques for CT
   Lecturer: Elly Castellano

2D and 3D filtered back-back projection. Iterative reconstruction techniques: algebraic, statistical, model-based and hybrid techniques.

6. Digital image processing and presentation
Lecturer: Ed McDonagh

Pre- and post-processing of digital images. Digital image processing techniques: grey-scale harmonisation, edge enhancement, noise reduction. 3D image rendition for rotation angiography and CBCT. Achieving consistent digital image presentation.

7. PACS, DICOM and image displays
Lecturer: Ed McDonagh

PACS architecture and workflows. The DICOM standard. Reporting workstations, display technology and the grayscale standard display function. HL7 and IHE frameworks.

8. Image quality assessment.
Lecturer: Elly Castellano

Image quality metrics. Objective and subjective measures of image quality. Factors that affect measured performance in x-ray and CT. General methods for optimising image quality. Imaging criteria and diagnostic confidence. Observer studies.

Day 2: Performance and testing

9. Performance of digital X-ray detectors
Lecturer: Ed McDonagh

Types and characteristics of digital detectors. Digital detector options for specific clinical tasks. Pixel size and Nyquist limit. MTF, signal transfer properties, noise power spectra and detective quantum efficiencies of clinical detectors. Detector exposure indices. Common detector artefacts.

10. X-ray Quality Control I
Lecturer: Jamie Dormand

The Quality Assurance cycle and legislative requirements. Guidance for Quality Assurance. Quality control of tubes and generators, recommended test techniques and equipment.

11. X-ray Quality Control II
Lecturer: Jamie Dormand

Quality control of automatic exposure control systems. Quality control of fluoroscopy systems, mammography equipment and digital detectors. Recommended test techniques and equipment. Quantitative QA.

12. Quantitative image quality analysis
Lecturer: Ed McDonagh

Pre-requisites for quantitative measurement. Measurement of the modulation transfer function, noise power spectra, and detective quantum efficiency in digital x-ray imaging. Measurement of modulation transfer function and noise power spectra in CT.

13. Performance of CT imaging systems 1
Lecturer: David Platten

Tube current modulation and its implementation by different manufacturers. Organ-based tube current modulation and automated tube voltage selection. Performance assessment of tube current modulation.

14. Performance of CT imaging systems 2
Lecturer: David Platten

CT image artefacts and how to avoid them. Performance assessment of advanced CT systems. Task-specific image quality metrics.

15. CT quality control
Lecturer: Jamie Dormand

Recommended tests for routine, acceptance and commissioning of CT. Methodology, guidance and test equipment.

16. Calculation of effective dose
Lecturer: Ruby Callister

From absorbed dose to effective dose in x-ray and CT. Simulation techniques, tools and phantoms. Size-specific dose estimates (SSDE) in CT. Organ dose conversion factors normalised to $CTDI_{VOL}$ and DLP.

Day 3: Clinical applications and optimisation

17. Digital system design and optimisation in clinical practice
Lecturer: Laurence King

The optimisation process for digital systems. Equipment selection. Considering the imaging task. Configuring protocols and image processing. Clinical examples.

18. Developments in digital detector technology
Lecturer: Dimitra Darambara

Ideal characteristics of digital image detectors. Future directions and challenges. Systems currently under development.

20. Advances in CT in radiology
Lecturer: Laurence King

Wide area detector arrays. Dual source CT. Photon counting CT. Dual energy CT. ECG-gated acquisition and ECG-gated tube current modulation in cardiac CT. 4D CT: perfusion and respiratory gating techniques.

19. Advances in x-ray imaging techniques
Lecturer: Alistair Mackenzie

Digital tomosynthesis applications in mammography. Contrast-enhanced mammography. Artificial Intelligence applications.

21. CT in radiotherapy
Lecturer: David Bernstein

CT for radiotherapy verification. In-room kV and MV systems. 4D CT and adaptive radiotherapy. Quality assurance for treatment verification.

22. CT in nuclear medicine
Lecturer: Iain Murray

Hybrid systems and image fusion. CT for attenuation correction in PET and SPECT. Artefacts and misregistration. Staffing issues for hybrid CT systems.

23. CT optimisation in clinical practice
Lecturer: Laurence King

Optimisation techniques and strategies for CT. Image review, scan techniques, image reconstruction, and radiographic practice. Clinical examples.