Hong Kong Association of Medical Physics

Certification of Medical Physicists

Certification Examinations

Parts I and Part II

Guide to Candidates

and

Application Form

Contents

Chapter 1

Examination System and Format

Background

The Hong Kong Association of Medical Physics ("HKAMP") operates a certification system for its member. The requirements and procedures for certification are outlined in the document "**Specialist Training for Physicists - The Road to Certification**" attached in Appendix A. The Certification Examinations are partial fulfillment of the requirements for certification of the medical physicists who did not go through a formal resident physicist training programme.

Format of Examination

The examination consists of two parts: Part I multiple-choice questions ("MCQ") written examination and Part II (written + viva) examination. A candidate must pass both parts of the examination in order to pass the Certification Examination in a specific specialty of medical physics. Part I examination is focused on the basic principles and concepts of a broad spectrum of medical physics covering common core, radiotherapy physics, imaging physics, engineering physics and clinical aspect of health physics. Part II examination is mainly focused on one of the specialties (to be specified by the candidate at the time of application) as listed below.

(i) Radiotherapy Physics
(ii) Imaging Physics
(iii) Engineering Physics
(iv) Health Physics

Part I Certification Examination

The Part I certification examination shall be conducted by 5 local examiners of different specialties to be appointed by HKAMP. The MCQ paper is prepared jointly by the local examiners in the following manner. Each examiner shall select 20 MCQ questions from a bank of questions in one of the five medical physics specialties or sub-specialties, namely common core, radiotherapy physics, imaging physics, engineering physics and clinical aspect of health physics. The MCQ questions are prepared based on the syllabus of the Part I Certification Examination. The selected questions shall be combined to form a draft paper which shall be sent to an external moderator for vetting. The chief examiner shall finalize the paper by incorporating the comments and suggestions as made by the moderator. The duration of the Part I examination is 3 hours.

The MCQ questions shall approximately be distributed as follow:

Common core	20
Radiotherapy physics:	20
Imaging physics:	20
Engineering physics:	20
Health physics:	20

For each MCQ, the candidate will be awarded 1 mark for giving a correct answer to the question. No marks will be given for an incorrect answer or not giving an answer to the question or giving multiple answers.

For the entire MCQ paper, each section shall receive a minimum of 8 marks and the total score of the paper shall be 60% (60 marks) or above to warrant a pass of the paper. Any score below 40% (8 marks) in any section will be regarded failure of that section and that of the entire paper.

Part II Examination

Part II Resident Physicist Examination is consisted of a written examination (Part IIA) and a viva examination (Part IIB) and will be focused on one of the specialties as listed under Part I Examination above.

Part IIA examination is mainly focused on testing theoretical knowledge, calculations, problem solving, etc. It shall be conducted by an examiner appointed by HKAMP. The examiner shall prepare 5 long questions to form a draft paper, which shall be sent to an external moderator for vetting. The chief examiner shall finalize the paper by incorporating the comments and suggestions made by the moderator. The duration of the Part IIA examination is 1.5 hours. Part IIA examination is usually held about 3 weeks before Part IIB examination. Candidates will have to pass Part IIA in order to be eligible to attempt Part IIB.

Part IIB is more focused on logbook and questions related to professionalism and scenario handling. It shall be conducted by four examiners to be appointed by HKAMP. One of examiners shall normally be an external examiner. At least one of the examiners shall be specialist in the same or closely related specialty of the examination. The Part IIB examination shall last approximately 1.5 hours.

Candidates will have to pass both Part IIA and Part IIB in order to pass Part II Examination.

Chapter 2

Scope of Coverage for Part I and Part II Certification Examination

The scope of the certification examinations is tabulated as follows. Details of the syllabus are given in Appendix B.

Part I Certification Examination

Compulsory Modules- To be taken by all candidates	**Coverage**
Common core	Basic physics (classical and relativistic mechanics, electricity and magnetism, optics, physics of fluids and gases, quantum mechanics, solid states physics, thermodynamics, statistical physics), atomic and nuclear physics, production of X-rays, interaction of ionizing radiation with matter, radiation detectors and instrumentation, measurement of ionizing radiation, statistics, introduction of human anatomy and physiology, etc
Radiotherapy physics & systems	Principles and characteristics of major radiotherapy equipment, properties and characteristics of superficial X-ray and megavoltage photon and electron beams, principles of radiotherapy, principles of external beam treatment planning and dose calculations, radiation therapy simulation, delivery and verification, quality assurance of radiotherapy equipment, radiation protection in radiotherapy, introduction to radiobiology etc.
Medical imaging physics & systems	X-ray systems, film-screen radiography and film processing, fluoroscopic imaging systems, basic principles of CT, MRI, ultrasound and nuclear medicine imaging modalities, etc.
Radiation safety & protection	Radiation effects on human, protection quantity and units, radiation protection principles, radiation survey and measurement, practical radiation protection in hospital environment, administrative measures and legislative control, etc.
Basic engineering physics	Engineering physics principles, radiological equipment safety, principles of radiological equipment management etc.

Part II Certification Examination

Compulsory Modules	**Coverage**
Advanced radiation protection To be taken by all candidates	Radiation protection and shielding techniques for radiological facilities, site planning, machine commissioning and radiation survey, risk assessment, patient protection, personnel monitoring, documentation etc.
Elective Modules	**Coverage**
Advanced radiotherapy physics & systems A compulsory module for candidates taking the Certification Examination in Radiotherapy Physics.	Superficial X-ray, high-energy photon and electron beams dosimetry and calibrations, brachytherapy dosimetry and source calibration, principles of external beam treatment planning, computerized planning and calculation algorithms, external beam radiotherapy techniques, brachytherapy techniques, physical aspects of quality assurance, acceptance and commissioning of radiotherapy equipment, radiation safety and protection in radiotherapy, statistical techniques in radiotherapy, radiobiology principles used in radiotherapy etc.
Advanced medical imaging physics & systems A compulsory module for candidates taking the Certification Examination in Imaging Physics.	Digital imaging, CT, MRI, ultrasound, nuclear medicine, special imaging systems, radiation safety and protection in diagnostic radiology, etc.
Advanced engineering physics A compulsory module for candidates taking the Certification Examination in Engineering Physics.	Principles of radiological equipment and dosimetry instrument, equipment project management, practical engineering maintenance, radiotherapy and radio-diagnostic physics in practice, health and safety, etc.
Advanced health physics A compulsory module for candidates taking the Certification Examination in Health Physics.	Atomic structure, X-ray production and interaction of radiation, nuclear structure and radioactivity, radiological quantities and units, radiation instrumentation and measurements, physical characteristics of the X-ray machines, radiobiology and biological effects of radiation, risk of cancer and hereditary diseases and effective dose, deterministic effects, internal dosimetry and external dosimetry, general principles of radiological protection, operational radiological protection, particular patient radiological protection aspects, particular staff radiological protection aspects, typical doses from diagnostic procedures, risks from foetal exposure, quality control and quality assurance, calibration of radiation instrumentation and dosimeters, Hong Kong regulations on radiation protection, international standards of radiation safety and protection, radioactive waste management, particle accelerator physics, radiological emergency planning and response, protection against non-ionizing radiations and safety and control of medical devices.

Chapter 3

Guidance Notes for Candidates Taking Part I & Part II Certification Examination

Part I Certification Examination

Multiple-choice Papers

1 The examination paper will consist of 100 MCQs, which will be based on the syllabus for the Certification Examination. The duration of the examination is 3 hours. The paper will be presented in the form of a combined MCQ paper/answer book. The candidates are not allowed to copy the questions from the paper or take the paper away from the examination room.

2 Each MCQ comprises of a question or statement and five answers, which are labeled (A) to (E). Candidates are asked to write down on the paper at the space provided immediately below the question the alphabet which represents the best answer to the question or the best item to complete the statement. Candidates should answer all the MCQs.

3 Candidates should use black ink and write neatly to answer the questions. If the examiners cannot read your writing they will be unable to give you full credit for your knowledge.

4 The MCQs will approximately be distributed as follow:

Common core:	20
Radiotherapy physics:	20
Imaging physics:	20
Engineering physics:	20
Health physics:	20

5 The Scoring System

For each MCQ, the candidate will be awarded 1 mark for giving a correct answer to the question. No marks will be given for an incorrect answer or not giving an answer to the question or giving multiple answers.

For the entire MCQ paper, each section shall receive a minimum of 8 marks and the total score of the paper shall be 60% (60 marks) or above to warrant a pass of the paper. Any score below 40% (8 marks) in any section will be regarded failure of that section and that of the entire paper.

6 Results of the examination will be sent to the candidates individually. Any query or appeal to the examination should be addressed to the Secretary of Examination Committee. The candidate should state clearly the query or appeal, the reasons for raising it and provide relevant information about the examination including, his/her name, name of the examination, time and venue of the examination etc.

Sample Questions

The sample MCQs below serve only as random examples of the scope and format of the examination.

1 Which of the following is most responsible for nuclear medicine imaging?

(A) Proton
(B) Neutrino
(C) Neutron
(D) X-ray
(E) Gamma ray

Answer: E

2 The use of X-ray grid is to

(A) improve contrast
(B) decrease exposure
(C) increase X-ray penetration
(D) decrease scatter radiation to patient
(E) none of the above

Answer: A

3 According to IE60601 electrical safety standards for medical electrical equipment, high voltage generators of diagnostic X-ray equipment is classified as

(A) Class I Equipment
(B) Class I Type A Equipment
(C) Class II Equipment
(D) Class II Type B Equipment
(E) Class II Type C Equipment

Answer: A

4 The accelerating waveguide of medical linear accelerators is

(A) an evacuated glass envelope tube
(B) an evacuated circular and hollow copper tube.
(C) a circular and hollow copper tube.
(D) a SF6 gas-filled circular and hollow copper tube.
(E) None of the above

Answer: B

5 Where λ is the decay constant of a radionuclide, and $t_{½}$ is the half-life of it, which of the following is the correct relation between them?

(A) $\lambda = t_{½} / \ln 2$
(B) $\lambda = \ln 2 / t_{½}$
(C) $1/\lambda = (t_{½}) (\ln 2)$
(D) $\ln\lambda = 2t_{½}$
(E) $2\lambda = 1/ t_{½}$

Answer: B

6 A radionuclide undergoes electron capture. Which of the following is the correct consequence?

(A) The atomic number increases by 1
(B) The atomic number remains unchanged
(C) The atomic number decreases by 1
(D) There is a beta decay
(E) There is an alpha decay

Answer: C

7 Which of the following principle is not a principle of radiation protection recommended by the International Commission on Radiological Protection?

(A) Lowest cost principle
(B) Justification principle
(C) As low as reasonably achievable principle
(D) Dose limitation principle
(E) Optimization principle

Answer: A

8 Which of the following working area is least likely to be classified as a controlled area?

(A) An operational area where it is likely that persons working inside will receive a dose exceeding 6mSv in a year
(B) A room in which five mobile X-ray machines are regularly being stored
(C) An isotope preparation room in a nuclear medicine department
(D) An operational area housing the control panel of to a 15MV linear accelerator
(E) A low dose rate afterloading treatment room

Answer: B

Part II Resident Physicist Examination

1 The examination is consisted of a written examination (Part IIA) and a viva examination (Part IIB). Part IIA shall include 5 long questions, and is usually held about 3 weeks before Part IIB examination. Candidates will have to pass Part IIA in order to be eligible to attempt Part IIB. Part IIB shall be conducted by a panel of 4 examiners, one of whom is usually an external examiner. The examination time for Part IIA and IIB each shall be approximately 1 hour and 30 minutes. Candidates are considered to have passed the Part II after they have passed both Part IIA and Part IIB. Candidates have to pass Part IIA before attempting PART IIB.

2 The examination will mainly be based on, but not limited to, the relevant parts of the syllabus of Part II Resident Physicist Examination given in Appendix A. For Part IIB, the candidate's portfolio also serves as a reference for the examiners.

3 For each specialty, the examination will be focused on major topics as follows:

(a) Radiotherapy Physics:
Radiation protection, radiation dosimetry, external beam treatment planning, brachytherapy, and quality assurance.

(b) Imaging Physics:
Radiation protection, digital imaging, CT, MRI, ultrasound and nuclear medicine (with QA included in each topic).

(c) Engineering Physics:
Principles of radiological equipment and its ancillary instrumentation, equipment project management, practical engineering maintenance, radiotherapy and radio-diagnostic physics in practice and health and safety.

4 Part IIA and part IIB each carries 50% of the total scores. Candidates should get at least 50% of the score for each part and the total scores should be at least 60% to pass the Part II examination. Candidates failing Part IIA will be notified and will not be allowed to attempt Part IIB of that year.

	Full score	Passing score for individual part	Overall passing score
Written examination Part IIA	50	25	-
Viva examination Part IIB	50	25	-
TOTAL	100	-	60

5 A candidate is required to submit a softcopy of portfolio (max 50 pages, double line spacing) 4 weeks before the Part IIB exam date to Secretary of the Examination Committee, Hong Kong Association of Medical Physics. A maximum of 20% of viva examination marking (i.e., 10 marks) will be assigned to the quality of the portfolio.

6 English shall be used during the examination.

Chapter 4

Examination Application Procedures and Requirements

The Examinations

The Certification Examination is to qualify the successful candidates for the next phase of certification process. Qualified candidates may apply for the following examinations:

(i) Certification Examination in Radiotherapy Physics
(ii) Certification Examination in Imaging Physics
(iii) Certification Examination in Engineering Physics
(iv) Certification Examination in Health Physics

General Requirements

(i) Candidates applying for sitting in Part I Certification Examination shall, on the day of examination, have at least one year of recognized full-time equivalent working experience as a Physicist. A candidate with 11 months or more of recognized full-time equivalent working experience may still apply provided his/her application is supported by his/her Senior Physicist.
(ii) Candidates applying for sitting in Part II Certification Examination shall, on the day of examination, have at least two year of recognized full-time equivalent working experience as a Physicist in a training center accredited by HKAMP. A candidate with 1 year and 11 months or more of recognized full-time equivalent working experience may still apply provided his/her application is supported by his/her Senior Physicist.
(iii) A candidate shall pass the Part I Examination before sitting for the Part II Examination.
(iv) The candidate applying for sitting in Part I or II of the Certification Examination shall be a member (Full or Associate Member) of HKAMP.

Application Procedures

(i) The Secretary of Examination Committee shall announce the examination date and application deadline which are available in http://www.hkamp.org. Application for Certification Examination shall be made before the application deadline using the application form appended below. The form is available in http://www.hkamp.org.
(ii) Each application shall be supported by a Proposer and a Supporter. Both of them shall be a Certified Medical Physicist and a FULL Member of HKAMP and one of them shall be a direct supervisor of the applicant.
(iii) A crossed cheque made payable to "Hong Kong Association of Medical Physics Limited" shall be submitted together with the application with the following amount:
  (a) HK$2,000 for Part I Examination
  (b) HK$3,000 for Part II Examination (Part IIA + IIB)
(iv) The examination fee is non-refundable.
(v) The fee for retaking Part IIA will be $1,500, and the same for retaking Part IIB.
(vi) Candidates passing Part IIA may carry the result to Part IIB exams in subsequent years. For example, if he/she passes a Part IIA result, but fails the Part IIB, he/she needs only to retake the Part IIB in the next year. Fees can also be carried over to the next year, and therefore the candidate will only need to pay $1,500 for the Part IIA attempt.
(vii) If the candidate passes Part IIA and fails IIB in the first year, he/she can choose whether or not to retake Part IIA in the subsequent attempt. The result of the most recent attempt will be recorded and counted in the final result of Part II.
(viii) Candidates will be allowed a maximum of 3 attempts for each of Part IIA and IIB.
(ix) Documentary proof for the duration of service as a physicist as claimed by the applicant shall be submitted with the application form.
(x) Applicant shall submit the completed application with the exact examination fee to the Secretary of the Examination Committee, Hong Kong Association of Medical Physics at the address below:
  Mr. Alvin Li
  Medical Physics Department, G/F
  North District Hospital
  Sheung Shui, Hong Kong

(xi) A candidate is required to submit a softcopy of portfolio (max 50 pages, double line spacing) 4 weeks before the Part IIB exam date to Secretary of the Examination Committee, Hong Kong Association of Medical Physics.

Appendix A

Specialist Training for Medical Physicists – The Road to Certification

1 Certified Medical Physicists

1.1 Definition of a Certified Medical Physicist:-
Certified Medical Physicists are qualified medical physicists who are competent by virtue of their education and training to practice medical physics safely and professionally without supervision. They are able to assume personal responsibility for the research, development and application of medical physics in support of clinical and/or health services. The professional qualities of a Certified Medical Physicist should be manifested as a technical and scientific expert (a problem solver), communicator, collaborator/team member, manager, scholar/teacher/mentor, and developer/researcher. Their work is predominantly intellectual and varied, and requires the exercise of original thought and judgment and the ability to supervise the technical and administrative work of others.

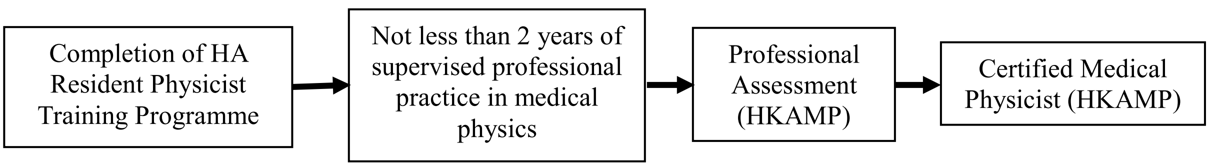
As a Certified Medical Physicist he/she has completed the specialist training and acquired a broad and general appreciation of the physical and/or engineering sciences as well as thorough insight into the special features of his/her own specialty of medical physics. In due time, he/she will be able to give authoritative scientific advice and to assume responsibility for the direction of important tasks in his/her respective specialty of medical physics. He/she is professionally competent with the following abilities:

- Define a problem and formulate strategies for solving it
- Interpret novel or non-standard data
- Make value judgements in unfamiliar situations
- Communicate scientific advice clearly and accurately to others
- Recognise fault situations and take suitable corrective action
- Appreciate the limitations of one’s knowledge

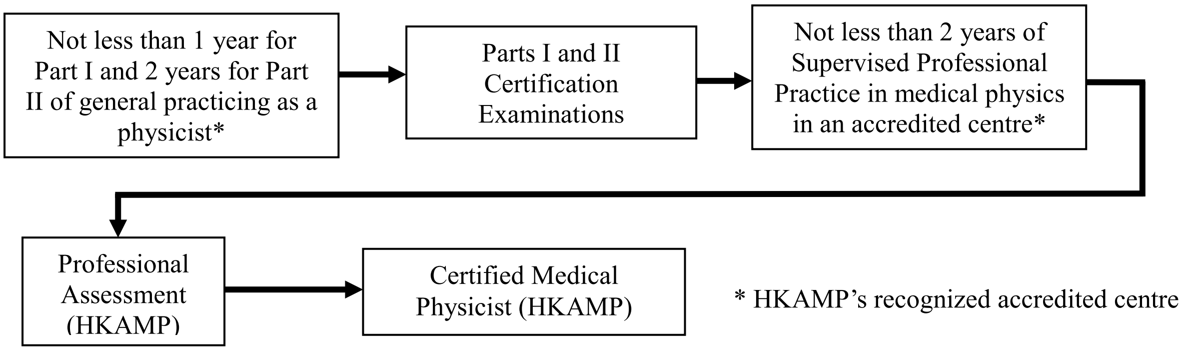
2 How to become a Certified Medical Physicist

A practicing Physicist may become a Certified Medical Physicist by one of the following routes:-

(a) **Route A**: Via a recognized formal resident physicist training programme. Currently, only the Resident Physicist Training Programme operated by Hospital Authority (“HA”) is recognized by HKAMP as a formal training programme.



(b) **Route B**: Via the General Experience route. This is an alternative route for those candidates who did not go through any formal training programs.



3 Certification via Route A

3.1 Resident Physicist Training Program – A candidate who has successfully completed a recognized residency training programme has acquired a general theoretical knowledge and basic practical skills in his specialty of training.

3.2 Supervised Professional Practice – The next phase of the certification process of a candidate is professional competency training through supervised practice as a Physicist in a particular medical physics specialty for a duration of not less than 2 years. Each candidate applying for certification in a particular specialty of medical physics shall have acquired the core competencies as specified for that specialty. To ensure that he/she can achieve an adequate level of professional competency in the selected specialty of medical physics, the candidate must be practicing under the supervision of a Certified Medical Physicist in an accredited training centre where a comprehensive range of equipment facilities and clinical services relevant to that specialty are available. He/she shall have the competency to practice on a broad range of medical physics services relevant to the specialty he/she is applying for certification. The required core competencies are given in the Appendix below.

3.3 HKAMP Professional Assessment – The candidate should be able to demonstrate to a professional interview panel the required level of knowledge and competency in the specialty of medical physics he/she is applying for certification. The candidate should also submit a portfolio of his/her work for assessment by the professional assessment panel. The candidate shall be a Full Member of HKAMP when making an application for HKAMP professional assessment.

3.4 Certification – A candidate may be granted Certification in the relevant specialty of medical physics upon satisfactory completion of processes as given in 3.1 to 3.3 above.

4 Certification via Route B

4.1 General Practice as a Medical Physicist – To qualify for taking the Parts I and II certification examinations, a medical physicist who did not go through a formal residency training programme shall have acquired not less than two years of recognized full time equivalent working experience in medical physics.

4.2 Parts I and II Certification Examinations – A candidate shall pass both Parts I and II of the Certification Examination.

4.3 Supervised Professional Practice – To qualify for taking the Professional Assessment in a particular specialty of medical physics, a candidate shall have (i) passed the Certification Examination in the same specialty and (ii) been in practice in the same specialty as a medical physicist for not less than two years full time equivalent under the supervision of a Certified Medical Physicist in an accredited training centre where a comprehensive range of equipment facilities and clinical services relevant to that specialty are available. The candidate shall have acquired the competency to practice on a broad range of medical physics services relevant to his/her specialty of practice. The required core competencies for different specialties are given in the Appendix below.

4.4 HKAMP Professional Assessment – The candidate should be able to demonstrate to the professional interview panel the required level of experience and competency in the specialty of medical physics he/she is applying for certification. When making an application the candidate shall submit a portfolio of his/her work for review by the professional assessment panel before he/she is invited for the interview. The candidate shall be a Full Member of HKAMP when making an application for HKAMP professional assessment.

4.5 Certification – A candidate may be granted Certification in the relevant specialty of medical physics upon satisfactory completion of processes as specified in 4.1 to 4.4 above.

Appendix

(A) Core Competencies in Radiotherapy Physics:

1 Physics aspects of operation and application of:
- (a) Megavoltage accelerator based external beam delivery equipment, e.g. linear accelerator, tomotherapy machine, cyberknife.
- (b) Afterloading brachytherapy delivery system
- (c) Superficial X-ray therapy unit
- (d) Conventional treatment simulator
- (e) CT simulator or planning CT scanner
- (f) Treatment planning computer system
- (g) Radiation dosimetry and beam data acquisition equipment

2 Equipment management
- (a) Maintenance arrangement
- (b) Acquisition and procurement

3 External beam radiation dosimetry
- (a) Electron and photon beam dosimetry measurement
- (b) Dose calibration
- (c) Beam data measurement
- (d) Processing, transfer and verification of radiation beam data to treatment planning system

4 External beam treatment planning and dose calculation, treatment simulation and verification

5 Physics, dosimetry and QA of special external beam treatment techniques, including
- (a) External electron and photon beam dosimetry measurement
- (b) SRS/SRT
- (c) TBI
- (d) IMRT
- (e) IGRT

6 Patient dosimetry, including in vivo measurement using ionization chamber, TLD, film, diode detectors and calculation

7 Quality assurance of radiotherapy equipment as listed in (1) above, including
- (a) Acceptance testing
- (b) Commissioning
- (c) Periodic quality control

8 Brachytherapy dosimetry, treatment planning and delivery, quality assurance

9 Therapeutic applications of unsealed radioisotopes, dosimetry and quality assurance

10 Custody and management of radioactive sources and wastes

11 Preparation of sealed and unsealed radioisotopes for therapeutic applications, including
- (a) Calibration
- (b) Testing
- (c) Periodic quality control

12 Radiation safety and protection, including:
- (a) Radiation safety and emergency measures in radiotherapy
- (b) Compliance with local legislative and licensing requirements, code of practice and local rules
- (c) Room shielding design and calculation for radiotherapy equipment and facilities
- (d) Optimization

(e) Risk assessment

13 Testing and calibration of radiation monitors
14 Radiation monitoring and survey
15 Radiotherapy network system management and administration
16 Research and development techniques
17 Statistics skills
18 Human anatomy and physiology
19 Radiobiology
20 Training and teaching skills
21 Professional ethics
22 Professional development and management skills
   (a) Professional awareness
   (b) Communication skills
   (c) General management
   (d) Quality management
   (e) Information technology

(B) Core Competencies in Imaging Physics:

1 Physics aspects of operation and application of
   (a) General and fluoroscopic X-ray systems
   (b) Mobile X-ray unit
   (c) Digital radiography system
   (d) Computed radiography system
   (e) Mammography system
   (f) Ultrasound systems
   (g) Cardiovacular and/or angiographic imaging system
   (h) MRI system
   (i) CT system
   (j) SPECT and/or PET systems
   (k) Image distribution and PACS systems
   (l) Screen film systems and film processing
2 Equipment management
   (a) Maintenance arrangement
   (b) Acquisition and procurement
3 Quality assurance of imaging equipment as listed in (1) above, including
   (a) Acceptance testing
   (b) Commissioning
   (c) Periodic quality control
4 Image/data acquisition, processing and analysis
5 Image/data management
6 Patient dosimetry, including in vivo measurement using ionization chamber, TLD, film, diode detectors and calculation
7 Radiation safety and protection, including:
   (a) Radiation safety and emergency measures in diagnostic radiology
   (b) Compliance with local legislative and licensing requirements, code of practice and local rules
   (c) Room shielding design for diagnostic radiology equipment and facilities
   (d) Optimization
   (e) Risk assessment
   (f) Compliance with ICRP requirements and recommendations
8 Testing and calibration of radiation monitors
9 Radiation monitoring and survey
10 MRI safety
11 Preparation of radioisotopes for imaging applications, including
   (a) Calibration
   (b) Testing
   (c) Periodic quality control
12 Custody and management of radioactive sources and wastes
13 Research and development techniques
14 Statistics skills

15 Training and teaching skills
16 Professional ethics
17 Professional development and management skills
   (a) Professional awareness
   (b) Communication skills
   (c) General management
   (d) Quality management
   (e) Information technology

(C) Core Competencies in Engineering Physics:

1 Competencies in applied engineering
   (a) Principles, concepts and design of radiological equipment
   (b) Multi-engineering knowledge and skills in electrical, electronic, mechanical, hydraulic, pneumatic, microwave, vacuum engineering
   (c) IEC standards requirements of radiological equipment
   (d) Acceptance testing of equipment in compliance with relevant performance and safety standards
   (e) Equipment safety aspect in terms of radiation, electrical, mechanical hazards
   (f) Quality Assurance and Preventive Maintenance Inspection
   (g) Practical Equipment Maintenance experiences
   (h) Building services engineering (desirable)
2 Competencies in applied physics
   (a) Principles of linear accelerator physics including electromagnetic theory, optics, vacuum, radiation physics, etc.
   (b) Principles of diagnostic X-ray physics including X-ray production, image quality, etc.
   (c) Principles of radiation measurements including beam energy, beam uniformity, absorbed dose calibration, radiation survey, leakage radiation assessment, use of radiation instruments, etc.
   (d) Principles of treatment planning, patient dosimetry, and treatment QA (desirable)
3 Competencies in professional standing
   (a) Independent, interdependent and self-learning learning skills
   (b) Problem solving and creative thinking skills
   (c) Interpersonal and teamwork skills
   (d) Communication and training skills
   (e) Project management skills
   (f) Technical management and advisory skills
   (h) Health and safety skills

(D) Core Competencies in Health Physics:

1 A knowledge and understanding on the topics referred to in Appendix B, Syllabus for Part II Advanced Health Physics
2 A detailed understanding of the Radiation Ordinance and Code of Practice on Radiation Safety in HA Hospitals together with a knowledge of Department of Health guidance on radiation health issues
3 Knowledge of operational radiation protection methods, especially
   (a) Interpretation and application of radiation protection data
   (b) Work supervision and radiological measurements
   (c) Control procedures for work involving the potential for significant radiation exposure
4 The ability to give adequate and competent advice to all stakeholders, including employers, workers, patients and any other affected members of public on radiation protection and safety, especially regarding compliance with the Radiation Ordinance, HA's Code of Practice on Radiation Safety, Department of Health guidance on radiation health issues and international standards and guidelines on radiation protection

Appendix B

Syllabus for Part I and Part II Certification Examination

PART I (To be taken by all candidates)

Common Core

1 Basic Physics
1.1 Classical and relativistic mechanics
1.2 Electricity and magnetism
1.3 Optics
1.4 Physics of fluids and gases
1.5 Quantum mechanics
1.6 Solid states physics
1.7 Thermodynamics
1.8 Statistical physics

2 Atomic and nuclear physics
2.1 Radioactivity
2.2 Radioactive decay modes
2.3 Half life, mean life and biological half life
2.4 Nuclear reactions
2.5 Radionuclides production by activation

3 Production of X-rays
3.1 Principles of X-ray production
3.2 Bremsstrahlung spectra and characteristic X-rays
3.3 Quality of X-rays
3.4 Measurement of half value layer ("HVL")

4 Interaction of ionizing radiation with matter
4.1 Excitation and ionization
4.2 Interaction cross-sections and interaction coefficients
4.3 Rayleigh scattering, photoelectric effect, Compton scattering and pair production
4.4 Relative importance of interaction types
4.5 Multiple scattering of electrons
4.6 Stopping power and linear energy transfer ("LET")
4.7 Bragg peak of proton and other heavy charged particles
4.8 Neutrons

5 Radiation detectors and instrumentation
5.1 Principles of radiation detection
5.2 Counting statistics
5.3 Basic electronics design of detector circuits
5.4 Principles and modes of operation of common practical dosimeters (e.g. Geiger counter, proportional counter, scintillation counter, TLD, diode detector etc.)
5.5 Introduction to multi-channel analysers

6 Measurement of ionizing radiation
6.1 Exposure, air kerma and dose
6.2 Bragg-Gray principle
6.3 Ion chamber theory, designs and operation

6.4 Absorbed dose standards
6.5 Introduction to dosimetry protocols (e.g. IAEA 398, TG 51, MIRD etc.)
6.6 Patient dose measurements in radiation therapy
6.7 Dose area product and patient dose reduction in diagnostic radiology

7 Introduction to Human Anatomy and Physiology

8 Statistics

Radiotherapy Physics and Systems

1 Principles and characteristics of major radiotherapy equipment
1.1 Superficial X-ray unit, Orthovoltage X-ray unit and Co-60 unit
1.2 Linear accelerators
1.3 Conventional and CT-simulators
1.4 Afterloading units

2 Superficial X-ray and megavoltage photon and electron beams characteristics
2.1 Buildup, skin dose, beam flatness and penumbra
2.2 Equivalent square field
2.3 Wedge field and asymmetric field of photon beams
2.4 Field-size dependence of percentage depth dose, output factors etc.
2.5 Beam energy dependence of percentage depth dose, output factors etc.
2.6 SSD dependence and inverse square law correction
2.7 Effect of inhomogeneities and obliquity
2.8 Electron contamination in photon beams
2.9 Neutron production and activation in high-energy photon beams
2.10 Derivation of electron beam energies from depth dose measurement
2.11 Photon contamination in electron beams

3 Principles of radiotherapy
3.1 Role of radiotherapy in cancer treatment
3.2 Dose responses of healthy and tumorous tissues
3.3 Requirements for dose uniformity and conformity
3.4 Sparing of critical structures and organs
3.5 Patient positioning and immobilisation techniques
3.6 Radiobiological effects of treatment fractionations
3.7 Principles of Brachytherapy

4 Principles of external beam treatment planning and dose calculations
4.1 ICRU definitions of CTV, GTV, PTV etc.
4.2 Use of CT for contouring
4.3 Choice of beam arrangements and beam weightings
4.4 Use of beam modifiers (shield, wedge, compensator and bolus)
4.5 Field shaping (MLC, lead and alloy blocks)
4.6 Use of dynamic wedge, virtual wedge, auto wedge etc.
4.7 SSD, extended SSD, isocentric and rotation techniques
4.8 Dose prescription, calculation and normalisation
4.9 Examples in 3-D conformal treatment

5 Radiation therapy simulation, delivery and verification
5.1 Conventional X-ray simulation
5.2 CT simulation
5.3 Treatment setup
5.4 Patient motion
5.5 Portal imaging

6 Quality assurance of radiotherapy equipment

6.1 Rationale of quality assurance
6.2 Core specifications of major radiotherapy equipment
6.3 Measurement of performance tolerances (electrical, mechanical and radiation)
6.4 Record keeping and report writing

7 Radiation protection in radiotherapy
7.1 General concepts of radiation protection
7.2 Designation of areas and classification of workers
7.3 Dose limits and risk estimation of radiation exposure
7.4 Personnel monitoring and area survey
7.5 Use of practical dosimeters in radiation protection
7.6 Protective design in radiotherapy suites
7.7 Introduction to Local Rules and Code of Practice
7.8 Overview of the Radiation Ordinance of Hong Kong

8 Introduction to Radiobiology

Medical Imaging Physics and Systems

1 X-ray systems
1.1 X-ray tube design
1.2 X-ray spectrum
1.3 X-ray tube rating
1.4 Power supply generator
1.5 Control circuits
1.6 Factors influencing X-ray output

2 Film-screen radiography and film processing
2.1 Radiographic principles
2.2 Film screen combination
2.3 Film processing and management
2.4 Image quality - contrast, resolution and MTF
2.5 Factors influencing image quality
2.6 Radiography image artifacts.

3 Fluoroscopic imaging systems
3.1 Basic principles
3.2 Fluoroscopy systems design
3.3 Automatic brightness control
3.4 Factors influencing image quality
3.5 Radiation dose and modes of operation
3.6 Artifacts
3.7 Hard copy recording

4 Digital imaging
4.1 Image receptors and conversion
4.2 Data sampling and aliasing
4.3 Image matrix, spatial resolution and volume averaging
4.4 Image processing
4.5 Display and analysis
4.6 Picture archiving and communication systems
4.7 Digital radiography system
4.8 Computed radiography
4.9 Tomosynthesis

5 Basic principles and clinical applications of other imaging modalities
5.1 Computed tomography

5.2 Magnetic resonance imaging
5.3 Ultrasound
5.4 Nuclear medicine

Radiation Safety and Protection

1. Radiations effects on human
1.1 Natural background radiation
1.2 Hazards of low levels of radiation
1.3 Types of radiation exposure and hazards in hospital environment
1.4 Biological and health effects
1.5 Radiobiological effectiveness (“RBE”)
1.6 Radiation weighting factor
1.7 Radiation effects on embryo and fetus

2. Protection quantity and units
2.1 Equivalent dose
2.2 Effective dose
2.3 Risk factors and collective doses
2.4 Radiation risk estimate

3. Radiation protection principles
3.1 ICRP recommendations
3.2 Dose limit
3.3 Time and distance
3.4 Use of shielding in radiation protection
3.5 Control and containment of radioactive substances
3.6 ALARA

4. Radiation survey and measurement
4.1 Common radiation detection and monitoring instruments
4.2 Instrument calibrations
4.3 Radiation survey and monitoring
4.4 Personnel dose monitoring

5. Practical radiation protection in hospital environment
5.1 Laboratory procedures of radionuclide therapy and imaging
5.2 Wipe test
5.3 Decontamination
5.4 Radioactive source transport
5.5 Safe custody and inventory of radioactive sources
5.6 Safe custody of sealed and unsealed radioactive sources
5.7 Storage and disposal of radioactive wastes
5.8 Practical methods of radiation protection in hospital
5.9 Classification of radiation working areas and radiation workers

6. Administrative measures and legislative control
6.1 Administration and organization for radiation protection in HA Code of Practice on radiation safety & protection in HA hospitals 2011 or equivalent.
6.2 Local radiological protection rules
6.3 Legislative control- Hong Kong Radiation Ordinance

Basic Engineering Physics

A. Engineering Physics Principles

1 Basic Electrical Principles

1.1 Power supply circuits including single phase, three phases and A.C. to D.C. conversion

1.2 High voltage power supply including auto-transformer, high frequency generator, modulator

1.3 Characteristics of electrical components including inductor, capacitor, resistor, diode, transistor, silicon controlled rectifier ("SCR"), operational amplifier, relay, sensor devices, Analog to Digital Converter ("ADC"), Digital to Analog Converter ("DAC"), DC motor, induction motor, AC motor, AC generator and motors control. etc.

2 Engineering Physics Principles

2.1 Units of measurement for electrical, physical and radiological quantities

2.2 Applied radiation physics to the operation of radiological equipment* and imaging equipment using non-ionizing radiation

2.3 Magnetic field fundamentals and its application to equipment and devices operation

2.4 Vacuum theory and its application to equipment and devices operation

B. Radiological Equipment* Safety

1. Electrical, Mechanical and Radiation Hazards

1.1 Safety devices and requirements to protect against electrical hazards

1.2 Safety devices and requirements to protect against mechanical hazards

1.3 Safety devices and requirements to protect against hazards from excessive radiation

1.4 Adverse incidents and safety reports

2. Radiological Equipment Safety Tests

2.1 General tests for operational safety

2.2 Electrical safety tests

2.3 Mechanical safety tests

2.4 Radiation safety tests

C. Principles of Radiological Equipment Management

1. Radiological Equipment Procurement and Specifications

1.1 Performance standards, functions and special treatment features

1.2 Performance tolerances and limits

1.3 Ancillary equipment to support radiological equipment functioning

2. Installation and Commissioning

2.1 System installation requirements and site planning

2.2 Radiation protection requirements

2.3 Clinical treatment data measurement requirements

2.4 Licensing requirements for radiological equipment in Hong Kong

3. Building Design and Building Services Requirements

3.1 Radiation protection requirements

3.2 Electrical requirements include supply mains, isolation, lighting, emergency switches, etc.

3.3 Environmental requirements include ventilation, water supply, fire protection, magnetic field, etc.

3.4 Safety devices or facilities for administrative and engineering controls of radiation protection

4. Acceptance Testing

4.1 Acceptance testing in accordance with tender specifications

4.2 Acceptance testing in compliance with relevant IEC standards

4.3 Acceptance testing in compliance with manufacturer's standards

5. Quality Assurance

5.1 Basic quality assurance concepts on radiological equipment

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* Radiological Equipment include, but not limited to, linear accelerators, brachytherapy afterloading equipment, Cobalt-60 teletherapy machines, radiotherapy simulators, therapeutic irradiating apparatus, radiotherapy treatment planning systems, diagnostic X-ray equipment, Gamma cameras, CT scanners, etc.

5.2 Quality assurance standards and procedures
5.3 Operation of quality assurance tools and equipment

PART II

Advanced Radiation Protection (To be taken by all candidates)

1 Shielding techniques for radiological facilities
1.1 What is WUT?
1.2 Treatment room design (primary, scatter and leakage radiation)
1.3 Neutron production from linear accelerator emanating high-energy photons
1.4 Structural shielding design for teletherapy and brachytherapy
1.5 Structural shielding design for diagnostic imaging facilities
1.6 Special considerations for sealed radioactive sources
1.7 Special considerations for unsealed radioactive sources

2 Planning of radiological equipment for radiation protection
2.1 Site planning
2.2 Machine commissioning
2.3 Accident procedures and emergency planning
2.4 Local rules
2.5 Licensing requirement in Hong Kong

3 Risk of radiological procedures
3.1 Patient protection and patient doses
3.2 Effective doses and risks in radiology
3.3 Risks from radiological examinations
3.4 Risk from ingested or injected activity
3.5 Special high-risk situations – irradiation of children or in-utero
3.6 Risk associated with an abdominal examination for pregnant patient

Advanced Radiotherapy Physics and Systems (To be taken by all candidates sitting for the Certification Examination in Radiotherapy Physics)

1 High-energy photon and electron beams dosimetry and calibrations
1.1 Overview of current high-energy X-ray and electron dosimetry protocols
1.2 Dose calculation formalisms
1.3 Machine output calibrations
1.4 IAEA TLD dose audit for high-energy X-rays

2 Superficial X-ray dosimetry and calibration
2.1 Overview of current low-energy X-ray dosimetry protocol
2.2 Dose calculation formalism
2.3 Machine output calibration

3 Brachytherapy dosimetry and source calibration
3.1 TG-43 definitions of source strength, anisotropy, radial dose distribution etc.
3.2 Dose calculations using TG-43 formalism
3.3 Calibration of high dose rate ("HDR") sources
3.4 Calibration of intravascular brachytherapy sources
3.5 Calibration of manual implant sources
3.6 Calibration of unsealed radioisotope sources
3.7 Use of radionuclides dose calibrator

4 Principles of external beam treatment planning
4.1 Choice of treatment modality and beam energy
4.2 Choice of localization and immobilization techniques

4.3 Use of CT images and MR fusion in contouring
4.4 Beam's eye view and digital reconstructed radiographs ("DRR")
4.5 Beam alignment (including non-coplanar) and shaping
4.6 Beam weightings and use of beam modifiers
4.7 Field matching and splitting
4.8 Plan evaluation with isodose curves and dose volume histograms ("DVH")
4.9 Fractionation schemes and radiobiological modeling

5 Computerised treatment planning
5.1 Dose computation algorithms
5.2 3-D conformal planning
5.3 Stereotactic planning
5.4 Intensity modulated radiation therapy ("IMRT") planning
5.5 Afterloading planning
5.6 Treatment planning evaluation

6 Methodology of dose calculations in treatment planning
6.1 Percentage depth dose and isodose curves
6.2 Output factors (collimator scatter factor, phantom scatter factor and peak scatter factor)
6.3 Wedge factor, tray factor, inverse square factor and Mayneord factor
6.4 Tissue air ratio ("TAR"), tissue maximum ratio ("TMR") and tissue phantom ratio ("TPR")
6.5 Backscatter factor, Scatter air ratio and scatter maximum ratio
6.6 Patient homogeneities and contour corrections
6.7 MU calculations

7 External beam radiotherapy techniques
7.1 Conventional SSD, extended SSD, isocentric and arc techniques
7.2 Parallel opposing and box techniques
7.3 Use of asymmetric field and field-in-field
7.4 Coplanar and non-coplanar techniques
7.5 3-D conformal, stereotactic and IMRT techniques
7.6 Mixed modality and mixed energy techniques
7.7 Very large field techniques (total body irradiation ("TBI") and total skin irradiation)
7.8 Use of treatment aid and accessories

8 Brachytherapy techniques
8.1 Dosimetry of manual implants (Manchester and Paris systems)
8.2 Source localization and dose calculation
8.3 LDR, HDR and intravascular treatments
8.4 Radioisotopes treatment
8.5 Therapeutic nuclear medicine
8.6 Manual implants

9 Physical aspects of quality assurance, acceptance and commissioning of radiotherapy equipment
9.1 Measurement of machine performance tolerances
9.2 Rectification of performance deviations
9.3 Scheduling of QA procedures

10 Radiation safety and protection in radiotherapy
10.1 Shielding calculations and room design
10.2 Licensing procedures
10.3 Review of Local Rules and Code of Practice and radiation contingency plans
10.4 Roles of radiation protection supervisor ("RPS") and adviser ("RPA")
10.5 Incidence investigation and reporting

11 Statistical techniques in radiotherapy
11.1 Sampling techniques
11.2 Statistical inferences

11.3 Groups comparisons
11.4 Association between variables
11.5 Survival analysis
11.6 Clinical trials
11.7 Epidemiology

12 Radiobiology principles used in radiotherapy
12.1 Acute and late effects
12.2 Fractionation scheme

Advanced Medical Imaging Physics and Systems (To be taken by all candidates sitting for the Certification Examination in Imaging Physics)

1 Picture archiving and communication systems ("PACS")
1.1 Understanding of functions of PACS
1.2 Understanding of DICOM standards
1.3 Fundamental networking

2 Computed tomography
2.1 Detectors and detector arrays
2.2 Data acquisition and image reconstruction
2.3 Image quality and artifacts
2.4 Radiation dose
2.5 Quality assurance

3 Magnetic resonance imaging
3.1 Machine hardware and imaging coils
3.2 MR signals and spatial encoding
3.3 Image reconstruction
3.4 Common pulse sequences
3.5 Image quality and artifacts
3.6 Safety considerations
3.7 Quality assurance

4 Ultrasound
4.1 Transducers
4.2 Data acquisition and mode of operations
4.3 Doppler
4.4 Image quality and artifacts
4.5 Quality assurance
4.6 Bioeffects and safety

5 Nuclear medicine
5.1 Principle of radiochemistry, radionuclide imaging and radiopharmacy
5.2 Gamma camera and laboratory instruments design
5.3 Data acquisition and display
5.4 Emission computed tomography
5.5 Radiation measurement and counting statistics
5.6 Image quality and artifacts
5.7 Radiation dose
5.8 Quality assurance

6 Principles of special imaging systems
6.1 DSA cardiovascular imaging system
6.2 DSA angiography system
6.3 Bone densitometry
6.4 Mammography

7 Radiation safety and protection in diagnostic radiology

7.1 Radiation hazards in diagnostic radiology
7.2 Dosimetry measurement and assessment
7.3 Protection of patient and staff
7.4 Dose reduction techniques
7.5 Room design

Advanced Engineering Physics (To be taken by all candidates sitting for the Certification Examination in Engineering Physics)

A. Principles of radiological equipment and dosimetry instrument

1 <u>Concepts and features of medical linear accelerators</u>

1.1 Operational features and theory of accelerators
- 1.1.1 Energy designation in linear accelerators
- 1.1.2 Treatment beam production; transportation and stabilization
- 1.1.3 High voltage supply and pulse modulators principles
- 1.1.4 Microwave principles: microwave control systems and power sources; accelerator structures and microwave components
- 1.1.5 Beam optics and bending systems
- 1.1.6 Dose measurement and beam monitoring systems
- 1.1.7 Electrical and mechanical control principles of auxiliary systems: vacuum system, water cooling system, gas and pneumatic system
- 1.1.8 Accelerator safety and control interlocking systems

1.2 Operational features of beam shaping and collimation
- 1.2.1 Conventional beam collimation for photon and electron beams
- 1.2.2 Radiation and mechanical aspects of static and motion wedge beam collimation
- 1.2.3 Radiation and mechanical aspects of multi-leaf collimator for static and dynamic beam collimation
- 1.2.4 Dynamic arc therapy

1.3 Operational features of radiotherapy imaging
- 1.3.1 Electronics portal imaging device
- 1.3.2 Cone beam CT imaging
- 1.3.3 Image-guided radiation therapy
- 1.3.4 Principles of flat panel detector for digital imaging

1.4 Electro-mechanical features of auxiliary assemblies
- 1.4.1 Principles, positioning and alignments of isocentric rotations of gantry, collimators, and treatment couch
- 1.4.2 Mechanical alignments of radiation beam axis with respect to X-ray target/electron window, collimators / MLC, filters and optical projection

2 <u>Concepts and features of kilo-voltage X-ray equipment</u>

2.1 Operational features and theory of X-Ray generator
- 2.1.1 Principles of X-ray generation and its controls systems
- 2.1.2 High voltage conversion
- 2.1.3 Principles of X-ray tube
- 2.1.4 Automatic exposure control and automatic brightness control

2.2 Operational features and theory of diagnostic imaging
- 2.2.1 Principles of imaging system
- 2.2.2 Fluoroscopy
- 2.2.3 Image quality assessment

2.3 Operational features and theory of other imaging modalities
- 2.3.1 Radiotherapy simulator
- 2.3.2 X-ray computer tomography
- 2.3.3 Any other special imaging system (for particular candidates)

2.4 Operational features and theory of superficial therapy equipment
- 2.4.1 Treatment beam quality and specifications
- 2.4.2 Treatment control parameters: dose stability, kV/timer/mA control, filters & applicators

2.4.3 Safety and control interlocking systems

3 <u>Concepts and features of automatically-controlled brachytherapy afterloading equipment</u>

3.1 Radiation safety design of afterloading system

3.2 Principles of electrical, electronic and mechanical control of treatment delivery

3.3 Safety and control interlocking systems

4 <u>Concepts and features of dosimetry instruments</u>

4.1 Principles of dose measurement

4.2 Characteristics of dose measurement detectors

4.3 Tri-axial cables and instrument connection

4.4 Care, maintenance and quality assurance of dosimetry instruments

B. Equipment project management

1.1 Management of equipment replacement, disposal and evaluation

1.2 Management of tender procedure preparation and specifications (IEC standards requirements)

1.3 Management of equipment installation, facilities preparation and environmental requirements

1.4 Radiation protection requirement for shielding equipment rooms

1.5 Equipment acceptance testing

1.6 Equipment commissioning procedure

1.7 Establishment of quality assurance tests and preventive maintenance inspection program

C. Practical engineering maintenance

1 Fault finding techniques and problem solving hypothesis in equipment maintenance

2 Risk and safety assessment of equipment

3 Practical maintenance case review

D. Engineering physics and medical physics in practice

1 Applied engineering physics in equipment preparation

2 Applied medical physics in quality assurance of equipment

3 Applied principles of quality assurance tools

E. Health and safety

1 Management of patient safety: dose audit / calibration, pacemaker patients, etc.

2 Management of staff safety: Local Rules, health and safety at work

3 Management of equipment safety: protection against radiation, electrical, mechanical hazards

Advanced Health Physics (to be taken by all candidates sitting for the Certification Examination in Health Physics)

1 Operational Health Physics – Fundamentals

1.1 Atomic and nuclear physics

1.2 Interaction of radiation with matter

1.3 Biological effects of radiation

1.4 Radiation physics concepts, quantities and units

1.5 The basic principles of the International Commission on Radiological Protection
Justification
Optimization
Dose limits

1.6 Risk communication and risk reduction

1.7 The background to radiation protection standards
Epidemiology
The linear hypothesis for stochastic effects
Deterministic effects

1.8 Detection and measurement methods
Instruments: calibration and functional tests
Personal dosimetry
Check of contamination
Uncertainties and limits of detection

1.9 Different kinds of sources
Sealed sources
Unsealed sources
X-ray equipment
Particle accelerators
1.10 Organization of radiation protection
The role of the qualified expert
Safety consciousness and ability to instil safety culture into others
Recording and reporting (sources, doses, abnormal events)
Categorization of workers
Categorization of sources
Delimitation of workplaces
Quality assurance

2 Operational Health Physics – General
2.1 Risk assessment and impact on the environment
2.2 Minimization of risks
2.3 Limitation of releases to the environment
2.4 Monitoring
Area monitoring
Biological monitoring
Environmental monitoring
2.5 The concept of critical group
Dose assessments for critical group
2.6 Protective measures in emergency situations
2.7 Decontamination
2.8 Analysis of incidents and accidents in order to prevent recurrence
2.9 Management of radioactive waste
2.10 Transport of radioactive substances
2.11 Optimization and ALARA
2.12 Internal dosimetry – dose factors
2.13 Specific physiology of inhalation and ingestion
2.14 Containment and filtration
2.15 Potential exposure – accidents
2.16 Interventions in emergency situations
2.17 Decommissioning
2.18 Use of sealed sources
Limitation of access to areas
Transport of mobile devices containing radioactive sources
2.19 Unsealed sources
Hazards of isotopes production and use
Hazards of inhalation and contamination
Special waste management aspects
Special hazards associated with natural radiation

3 Operational Health Physics – Nuclear Medicine
3.1 Justification of exposure
3.2 Diagnostic reference levels
3.3 Choice of radiopharmaceutical
Clinical indications
Organ or tissue dose and effective dose
Economic considerations and availability
3.4 Organ and effective doses from different radiopharmaceutical examinations and effect of age
3.5 Risk as function of age
3.6 Identification of pregnant patients and limitations on nuclear medicine diagnostics in pregnancy
3.7 Modifications of administered activity related to body mass and age
3.8 Enhancing elimination of radiopharmaceuticals to reduce exposure
3.9 Special protection of the foetus

Indications and contraindications

3.10 Nuclear medicine diagnostics in breast feeding females
3.11 Actions to be taken following misadministration
3.12 Exposure of volunteers in medical research involving administration of radiopharmaceuticals
3.13 Quality management and control in optimization
3.14 Discharge of patients after nuclear medicine procedures (diagnostic and therapy)
3.15 Clinical consequences to pregnant patient or a patient becoming pregnant in the weeks following a radionuclide therapy
3.16 Considerations on conception following radionuclide therapy
3.17 General rules of work with unsealed sources
3.18 Special protection and monitoring of doses to hands and fingers of workers
3.19 Considerations for pregnant workers in controlled areas

4 Operation Health Physics – PET/CT

4.1 PET/CT technology
Cyclotron
PET scanner
CT scanner
PET/CT scanner
4.2 Local and international requirements for medical exposure in PET/CT
4.3 Patient protection in PET/CT procedures
Considerations for paediatric patients
Considerations for female patients
4.4 Considerations in the design of PET/CT and cyclotron facility to minimize staff and public doses
4.5 Protective equipment for reduction of staff dose
4.6 Personal and workplace monitoring
4.7 Decontamination procedures
4.8 Protection of pregnant staff, visitors and friends and relatives of the patient
4.9 Logistic considerations
Transport of radionuclide
Accounting
Security of sources
Waste management
Discharge of patients
4.10 Organization of radiological protection program
Safety and risk assessment
Designation of areas
Written procedures
Local rules
Emergency procedures
4.11 Quality control on the production of radiopharmaceuticals

5 Operational Health Physics – Interventional Radiology (“IR”), interventional cardiology (“IC”) and Theatre Fluoroscopy (“TF”) Using Mobile Equipment

5.1 X-ray systems for IR, IC and TF
5.2 Dosimetric quantities specific for IR, IC and TF
Dose-area product or kerma-area product and effective dose
Entrance dose and entrance dose rate in fluoroscopy
5.3 Radiological risks in IR, IC and TF
5.4 Radiological protection of staff in IR, IC and TF
5.5 Radiological protection of patients in IR, IC and TF
5.6 Quality assurance in IR, IC and TF
5.7 Optimization of radiation dose in IR, IC and TF

6 Operational Health Physics – Paediatric Radiology

6.1 General, equipment and installation considerations
6.2 Reduction of exposure
6.3 Pregnancy considerations in abdominal examinations

6.4 Risk factors
6.5 Patient dosimetry and reference dose levels
6.6 Protection of staff, parents and carers

7 Infrastructure and practice of radiation protection in Hong Kong
7.1 International recommendations, conventions, standards and regulations
7.2 Regulations governing radiation protection in Mainland China
7.3 Radiation Ordinance, Cap 303, Laws of Hong Kong
7.4 Other relevant Hong Kong legislations and guidelines
7.5 Code of Practice on Radiation Safety in HA Hospitals

Hong Kong Association of Medical Physics

Application for Part I and Part II Certification Examination

General Information:

Please check examination: ☐ Part I is HK$2,000 ☐ Part II is HK$3,000 for each specialty
☐ Part IIA(retake) is HK$1500 ☐ Part IIB(retake) is HK$1500

An examination fee must be submitted with this application. Application for Part II for multiple specialties may be submitted in one form. Eligible candidates shall be notified of the time and venue of the examination by mail.

Please check the specialty of the Part II Certification Examination only:

☐ Radiotherapy Physics

☐ Imaging Physics

☐ Engineering Physics

☐ Health Physics

Surname ______ Prof /Dr /Mr /Mrs /Ms *

Other Names ______

Identity No. ______ HKID / Passport No. *

Postal Address ______

E-mail Address ______

Day Time Contact Tel. No. ______ Fax No. ______

Bach. Degree ______ Yr Awarded ______

Master's Degree ______ Yr Awarded ______

Doctoral Degree ______ Yr Awarded ______

University ______

Remarks: Copy of certificate(s) must be certified by a Certified Medical Physicist of HKAMP and submitted with the application.

** delete as appropriate*

Candidate's Surname & Initials

C.

Information on Current Employment

Employer

Postal Address

Job Title

Date of Employment [dd-mm-yy] - -

D.

List in chronological order. Please give details on a separate sheet when necessary.

Fm mm-yy	To mm-yy	Name and Address of Employer	Position Held (please indicate FT or PT) and Major Responsibilities

Documentation proof of previous employments shall be submitted with application.

Candidate's Surname & Initials

E.

Proposer | | Prof /Dr /Mr /Mrs /Ms *

Postal Address

Date [dd-mm-yy] ____________________ Proposer's Signature ________________________

Supporter | | Prof /Dr /Mr /Mrs /Ms *

Postal Address

Date [dd-mm-yy] ____________________ Supporter's Signature ________________________

I declare that the information given in this application form and any other documents attached are true, correct and complete.

Date [dd-mm-yy] ____________________ Candidate's Signature ________________________

* *delete as appropriate*

Date received	- -	e-Acknow. done	- -
Cert. included	[Yes / No]	Exam notified	- -
Fee included	[Yes / No]	Result sent	- -
Part I passed	[Yes / No / NA]	Remarks	____________________