Hong Kong Association of Medical Physics

Resident Physicist Examinations

Part I and Part II

Guide to Candidates

and

Application Form

Contents

Chapter 1

Examination System and Format

Background

The Resident Physicist examination is conducted by the Examination Committee of the Hong Kong Association of Medical Physics ("HKAMP") on request by the Hospital Authority ("HA") for its Resident Physicists under residency training in HA hospitals.

Format of Examination

The examination consists of two parts: Part I multiple-choice questions ("MCQ") written examination and Part II (written and viva examination). A candidate must pass both parts of the examination in order to pass the Resident Physicist 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 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

Part I Examination

The Part I written examination shall be conducted by 4 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 25 MCQ questions from a bank of questions in one of the four medical physics specialties, namely radiotherapy physics, imaging physics, engineering physics and clinical aspect of health physics. 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 made by the moderator. The duration of the Part I examination is 3 hours.

The MCQ questions shall approximately be distributed as follow:

Radiotherapy physics:	25
Imaging physics:	25
Engineering physics:	25
Health physics:	25

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 10 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% (10 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 Resident Physicist Examination

The Syllabus
The syllabus for the Resident Physicist Examination is based on the curriculum of the Resident Physicist Training Programme of the HA and is given in Appendix A. The summary of scope of the examinations is tabulated as follows:

Summary of Examination Scope

Part I Resident Physicist Examination

Compulsory Modules To be taken by all Resident Physicists	**Coverage**
Basic radiation physics	Atomic and nuclear physics, production of X-ray, interaction of ionizing radiation with matter, radiation detectors and instrumentation, measurement of ionizing radiation, 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 human anatomy and physiology, 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 Resident Physicist Examination

Compulsory Modules	Coverage
Advanced radiation protection To be taken by all Resident Physicists.	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 Resident Physicist 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 Resident Physicist 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 Resident Physicist 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.

Chapter 3

Guidance Notes for Candidates Taking Part I & Part II Resident Physicist Examination

Part I Resident Physicist Examination

Multiple-choice Papers

1 The examination paper will consist of 100 MCQs, which will be based on the syllabus for the HA Resident Physicist Training Programme. 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 complete 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:

Radiotherapy physics:	25
Imaging physics:	25
Engineering physics:	25
Health physics:	25

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 10 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% (10 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 6 mSv 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 15 MV 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.

6. English shall be used during the examination.

Chapter 4

Examination Application Procedures and Requirements

The Examinations

The Resident Physicist Examinations are to qualify the successful candidates in the following specialties:

(i) Examination for Resident Physicist (Radiotherapy Physics)
(ii) Examination for Resident Physicist (Imaging Physics)
(iii) Examination for Resident Physicist (Engineering Physics)

General Requirements

(i) Candidates applying for sitting in the Resident Physicist Examination shall be a Resident Physicist practicing in the Hospital Authority.
(ii) Candidates applying for sitting in Part I or II of the Resident Physicist Examination shall be a member (Full or Associate Member) of HKAMP.
(iii) Candidates applying for Part I Examination shall, on the day of examination, have at least one year of recognized full-time equivalent working experience as a Resident 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.
(iv) Candidates applying for Part II Examination shall, on the day of examination, have at least two years of recognized full-time equivalent working experience as a Resident Physicist. 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.

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 Resident Physicist 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 Full Member of the 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 Resident Physicist 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:

Dr. Thomas Ng
Oncology Centre,
Basement 3, Main Block,
St. Teresa's Hospital
Kowloon

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

Syllabus for Part I and Part II Examination

PART I (To be taken by all candidates)

Basic Radiation Physics

1 Atomic and nuclear physics
1.1 Radioactivity
1.2 Radioactive decay modes
1.3 Half life, mean life and biological half life
1.4 Nuclear reactions
1.5 Radionuclides production by activation

2 Production of X-rays
2.1 Principles of X-ray production
2.2 Bremsstrahlung spectra and characteristic X-rays
2.3 Quality of X-rays
2.4 Measurement of half value layer (“HVL”)

3 Interaction of ionizing radiation with matter
3.1 Excitation and ionization
3.2 Interaction cross-sections and interaction coefficients
3.3 Rayleigh scattering, photoelectric effect, Compton scattering and pair production
3.4 Relative importance of interaction types
3.5 Multiple scattering of electrons
3.6 Stopping power and linear energy transfer (“LET”)
3.7 Bragg peak of proton and other heavy charged particles
3.8 Neutrons

4 Radiation detectors and instrumentation
4.1 Principles of radiation detection
4.2 Counting statistics
4.3 Basic electronics design of detector circuits
4.4 Principles and modes of operation of common practical dosimeters (e.g. Geiger counter, proportional counter, scintillation counter, TLD, diode detector etc.)
4.5 Introduction to multi-channel analysers

5 Measurement of ionizing radiation
5.1 Exposure, air kerma and dose
5.2 Bragg-Gray principle
5.3 Ion chamber theory, designs and operation
5.4 Absorbed dose standards
5.5 Introduction to dosimetry protocols (e.g. IAEA 398, TG 51, MIRD etc.)
5.6 Patient dose measurements in radiation therapy
5.7 Dose area product and patient dose reduction in diagnostic radiology

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 Human Anatomy and Physiology

9 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 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
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

*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.

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 Resident Physicists sitting for the Resident Physicist 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 Resident Physicists sitting for the Resident Physicist 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 Resident Physicists sitting for the Resident Physicist 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

Hong Kong Association of Medical Physics

Application for Part I and Part II Resident Physicist 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 Resident Physicist Examination only:

☐ Radiotherapy Physics

☐ Imaging Physics

☐ Engineering Physics

A. Personal Information

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. __________

B. Academic Qualification

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. Present Employment

Information on Current Employment

Employer

Postal Address

Job Title

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

D. Previous Relevant Employment

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. Professional Referees

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 ________________________

F. Declaration

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*

G. Office Use Only

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