R E G U L A T I O N S

FOR ADMISSION TO THE FELLOWSHIP OF THE GHANA COLLEGE OF PHYSICIANS AND SURGEONS -RADIOTHERAPY AND ONCOLOGY DIVISION

1.0 STRUCTURE

The examination comprises Part I, Part II and Part III: Part III must be passed within six years

PART 1

2.0 ADMISSION TO THE PART I EXAMINATION

2.1 For admission to Part I the candidate must

2.1.1 hold a post-internship qualification to practise medicine which has been registered or is registrable with the Medical and Dental Council of Ghana

2.1.2 have completed a year of internship or its equivalent

2.1.3 have trained in fulltime work in a recognised department of Radiotherapy and Oncology for a minimum period of one calendar year

2.1.4 prior to commencing his training and after completing his year of internship, have spent one year of acceptable clinical employment in an approved hospital, of which six months may be in general practise or pathology

2.2 The GCPS, through its Examinations and Credentials Committee, will review all applications for admission to the examination and may also review the ethical and professional standing of candidates

2.0 SYLLABUS FOR THE PART I EXAMINATION

See Annexure A

4.0 CONDUCT OF THE PART I EXAMINATION

The examination will consist of

4.1 Three written papers, as follows:

4.1.1 Paper 1 – Physics (3 hours)

4.1.2 Paper 2 – Radiobiology and Cancer Biology (3 hours)
4.1.3 Paper 3 – Applied anatomy (2 hours)

PART II

5.0 ADMISSION TO THE PART II EXAMINATION (MEMBERSHIP)

(to be read in conjunction with the Instructions)

For admission to Part II of the examination a candidate must

5.1 have completed Part I or have been exempted from it in terms of clause 2.2

5.2 have been qualified to practice medicine for five years (the year of internship or its equivalent may not be counted as one of these five years)

5.3 produce evidence of having completed three years instruction and training in fulltime posts in a recognised department of Radiotherapy and Oncology

5.4 submit a learning portfolio and log book

6.0 SYLLABUS FOR THE PART II EXAMINATION

See Annexure B

7.0 CONDUCT OF THE PART II EXAMINATION

The examination will consist of

7.1 Three written papers as follows:
7.1.1 Paper 1 – Tumour pathology and general oncology (3 hours)
7.1.2 Paper 2 and 3 – Radiation and medical oncology (3 hours each)

7.2 A viva voce examination

7.3 A clinical examination which will be concerned with proficiency in clinical examination as well as investigation and treatment of patients, 1½ hour practical Examination will be included in the clinical examination

7.4 A practical examination in the technical and practical aspects of radiation therapy.

PART III

8.0 ADMISSION TO PART III EXAMINATION (FELLOWSHIP)

(to be read in conjunction with instructions)

For admission to Part III examination a candidate must

8.1 have passed the Part II examination

8.2 have done at least five years of training

9.0 SYLLABUS FOR THE PART III EXAMINATION

See annexure C

10.0 CONDUCT OF PART III EXAMINATION

The examination will consist of two sections as follows:

10.1 A commentary

10.2 Statistical critique of a published article

A P P E N D I X A

Syllabus for Part I of the FGCPS –Radiotherapy and Oncology examination:

Physics curriculum

1.0 Atomic and nuclear structure

1.1 Structure of the atom
- 1.1.1 Nucleus, orbital shells, energy levels, binding energy
- 1.1.2 Particles - proton, electron, neutron, positron
- 1.1.3 Describe atomic number, atomic mass, isotopes

1.2 Wave and quantum models of radiation
- 1.2.1 Energy and wavelength, energy spectrum

1.3 Radioactivity
- 1.3.1 Decay processes
- 1.3.2 Activity, half life
- 1.3.3 Parent – daughter relationships and equilibrium
- 1.3.4 Nuclear reactions, bombardment and reactors

1.4 Production of photons and electrons

1.4.1 Physical concepts of beam production
- Bremsstrahling
- X-ray tube design
- Energy spectrum
- Characteristic radiation

1.4.2 Generation of beams
- Filters
- Gamma sources
- Linear accelerator
- Beam geometry

1.4.3 Attenuation of beams
- Half value layer
- Attenuation, energy transfer, and absorption
- Attenuation co-efficient

1.5 Interaction of x-rays and gamma rays with matter

1.5.1 Absorption and scatter of x-rays in matter
1.5.2 Photoelectric effect
1.5.3 Compton effect
1.5.4 Pair production

1.6 Interactions of particulate radiation

1.6.1 Direct and indirect ionisation
1.6.2 Elastic and inelastic collisions
1.6.3 Linear energy transfer
1.6.4 Heavy particles interactions
1.6.5 Interactions of Neutrons
1.6.6 Interactions of Electrons

1.7 Radiotherapy equipment

1.7.1 Linear accelerator

- Construction of radiotherapy machines
- Principles of beam production
- Beam collimation and modifiers

1.7.2 Cobalt units
1.7.3 Simulators

- Operation
- Fluoroscopy and Intensifiers
- CT simulation

1.7.4 Other imagers

- Principles of ultrasound, CT, MRI, PET
- Applications and limitations of above imaging to radiotherapy

1.7.5 Brachytherapy

- Sources used
- Calibration of sources
- Radioprotection

1.7.6 Equipment selection and specifications

1.8 Radiation beam quality and dose

1.8.1 Mono energetic and heteroenergetic beams

1.8.2 Dose quantities and units

- Kerma
- Exposure
- Absorbed dose
- Dose equivalent
- RBE dose
- Calculation of absorbed dose from exposure
- Relationship between kerma, exposure and absorbed dose

1.9 Radiation measurement and calibration

1.9.1 Ionisation chambers

1.9.2 Principles of beam calibration

1.9.3 Other methods of measuring absorbed dose

- Calorimetry
- Chemical dosimetry
- Solid state detectors
- Film dosimetry

1.10 Photon beam treatment

1.10.1 External beam planning principles

- Inverse square law
- Backscatter factor
- Electron build-up
- Percentage depth dose
- Equivalent squares
- Tissue-air ratio

1.10.2 Dose calculations

- Monitor unit calculations
  - Output factor
  - Field size correction factors
  - Collimator and phantom scatter factor
  - Beam modifier factors
  - Patient attenuation factors

- Calculations in practice
  - SSD technique
  - SAD technique

1.10.3 Translation of planning to calculations
- Beam parameters
- Beam weighting
- Arc rotation therapy
- Irregular fields

1.10.4 Computerised treatment planning
- Isodose curves (beam characteristics)
- Surface dose
- Parallel opposed beams
- Wedge techniques, isodose curves, angles
- Beam combinations

1.10.5 Surface corrections and heterogeneities
- Surface obliquity
- Inhomogeneity correction

1.10.6 Adjoining fields and special dosimetry problems
- Two-fields
- Three-fields
- Craniospinal gapping
- Pacemaker
- Gonadal dose
- Pregnant patient

1.11 Electron beam treatment

1.11.1 Basic characteristics
- Depth-dose curves
- Interactions
- Obliquity

1.11.2 Treatment planning principles
- Selection of energy, field size
- Skin dose
- Bolus
- Field shaping
- Field-matching
- Inhomogeneities

1.12 External beam quality assurance

1.12.1 Goals

1.12.2 Roles and duties

1.12.3 Staffing

1.12.4 Linac QA

- Commissioning linear accelerators (principles)

1.12.5 Routine Quality assurance requirements

- Daily, monthly, annually

1.13 Radiation protection and shielding

1.13.1 Definitions and standard

1.13.2 Dose equivalent and effective dose equivalent

1.13.3 Types of radiation exposure

- Background
- Man-made
- National recommendations on exposure limits

1.13.4 Protection regulations

1.13.5 Administrative requirements

- Safety programme
- Staff monitoring

1.13.6 Radiation shielding principles

- Treatment room design
- Types of barriers
- Neutron shielding for high energy beams
- Sealed source storage
- Protection equipment and surveys
- Monitoring equipment

1.14 Imaging in radiation oncology

1.14.1 Routine diagnostic imaging principles

1.14.2 Port films

1.14.3 Processors

1.14.4 Other imaging

- Electronic portal imaging devices

1.15 3D conformal therapy

1.15.1 Concepts and goals vs traditional RT

- Technology and methods for planning
- Multiple volume images
- Image processing
- Virtual simulation
- DRR's
- Multiple beams and non-coplanar beams

1.15.2 Optimisation methods

- Uniform vs non-uniform delivery
- Margins
- DVH's

1.15.3 Implications of treatment variabilities

- Set-up
- Patient factors
- ICRU 50 and 62 prescribing recording and reporting

1.16 Assessment of patient setup and verification

1.16.1 Immobilisation devices and methods

1.16.2 Positioning devices and methods

1.16.3 In-room treatment imaging

- Cone-beam CT
- Ultrasound
- Fiducials
- On-line correction of set-up errors
- Adaptive planning concepts

1.17 Brachytherapy planning

1.17.1 Calculation of dose distribution

- Calculation of dose from a point source/line source

1.17.2 Systems of implant dosimetry

1.17.3 Implantation techniques

- Surface
- Interstitial
- Intracavitary

1.17.4 Gynaecological implants
- Manchester system
- Bladder and rectal dose
- ICRU

1.18 IMRT
1.18.1 Delivery systems
1.18.2 Principles of dose prescription and inverse planning
1.18.3 QA

1.19 Special procedures
1.19.1 Stereotactic radiosurgery
- Delivery systems
- Principles of planning and delivery
- QA

1.19.2 Total body irradiation
- Principles of planning and delivery

1.20 Particle therapy
1.20.1 Protons
- Energy deposition
- Equipment
- Beam dosimetry
- Principles of production and delivery

1.20.2 Neutrons
- Basic interactions
- Principles of production and delivery

2.0 Radiobiology and Cancer Biology

2.1 **Basic Principles of radiobiology**
2.1.1 Interaction of radiation with matter
2.1.2 DNA damage by radiation
2.1.3 Cell survival curves
2.1.4 Cell radiosensitivity and radiocurability
2.1.5 Cell cycle
2.1.6 Lethal, potentially lethal, sublethal damage and repair
2.1.7 Dose rate effects
2.1.8 The basis of fractionation: 4 R's of radiobiology
2.1.9 Factors that modify clinical radiation response and methods to overcome limitations. The oxygen effect, radiosensitisers, radioprotectors, hypoxic cell sensitisers, hyperthermia, linear energy transfer.

2.1.10 Biological equivalent dose and linear quadratic equation (including practical clinical calculations)

2.1.11. Other radiation modalities (neutrons, protons), relative biological effectiveness

2.1.12 Tumour growth kinetics (Tpot, growth fraction, cell loss).

2.2 Effect of radiation on normal tissue

2.2.1 Normal tissue tolerance – organ and volume specific

2.2.2 Acute and late effects of radiation on normal tissues, including the eye and gonads (also hereditary effects, carcinogenesis)

2.2.3 Total body radiation

2.2.4 Effect of irradiation on the embryo and fetus

2.3 Cancer biology

2.3.1 Terminology of molecular biology of cancer

2.3.2 Carcinogenesis

2.3.3 Oncogenes

2.3.3 Tumour suppressor genes

2.3.4 Growth factors and signal transduction pathways

2.3.5 Apoptosis

2.3.6 Angiogenesis

2.3.7 Invasion and metastasis.

3.0 Applied Anatomy

3.1 Keeping the goal of treating the oncology patient in mind:

3.1.1 The structure, boundaries, vascular and lymphatic pathways, and neurological supply of: head and neck, the central nervous system, thoracic and abdominal organs and upper limbs proximal to mid humerus and lower limbs proximal to and including the femoral triangle

3.1.2 Landmark localisation:

- On surface anatomy
- Imaging

3.1.3 The relation of organs to one another and their movement

3.1.4 Radiological anatomy on relevant imaging techniques

3.1.5 Routes of potential cancer spread.

A P P E N D I X B

Syllabus for Part II examination:

1.0 Tumour pathology and general oncology

1.1 Tumour Pathology.

For each tumour site and type, the following aspects should be studied:

1.1.1 Epidemiology and aetiology

- Natural history
- Clinical presentation
- Characteristic imaging findings
- Laboratory diagnosis of disease:
  - Macroscopic and microscopic appearance of tumour compared withnormal tissue of origin and differential diagnosis.
  - Grading and staging systems in use
  - Immunohistochemistry
  - Tumour markers
  - Molecular techniques available (brief overview)
  -

The candidate should be able to interpret a pathological report including pathologic prognostic and predictive factors

1.2 General Oncology

The candidate should be familiar with all aspects of oncological disease:

1.2.1 Physiology of oncologic symptoms and syndromes

- Pain
- Nausea and vomiting
- Tumour lysis syndrome
- Hypercalcemia

1.2.2 Symptoms, signs, differential diagnoses, work up and staging of patients with tumours seen in oncological practice should be known. The candidate should be able to adequately interpret X-rays, scans, pathology and other laboratory results.

1.2.3 Physiology which is relevant to therapy

- Endocrine systems – particularly the thyroid and Pituitary Adrenal gonadal axis
- The immune system as (applied to Oncology – especially HIV infection)
- Haematoposiesis

1.2.4 The candidate should know and be able to plan and describe oncological treatment options for all patients including those routinely treated by other specialities e.g. Medicine, Surgery and Gynaecology. Principles as well as complications of curative and palliative cancer surgery should be known.

1.2.5 The expected benefits, complications and limitations of all treatment options should be known.

1.2.6 Knowledge of diseases that are non-malignant, but are treated in the practice of radiotherapy and/or chemotherapy is required. (Eg. Pituitary adenoma, acoustic neuroma, arterio-venous malformation, keloid, heterotopic ossification, thyroid eye disease, etc)

1.2.7 Candidate should have knowledge of cancer prevention techniques, screening, early detection and education of the public.

1.2.8 Some knowledge of effective communication techniques used to adequately and accurately inform cancer patients and family about disease and treatment is required.

1.2.9 Management of common psychological reactions in oncology patients.

1.2.10 The candidate should be able to discuss supportive care/symptomatic treatment in oncology and terminal care.

1.2.11 Knowledge of the practice of medicine in accordance with medical ethics is expected.

1.2.12 Knowledge of quality of life assessment is required.

2.0 Radiation and Medical Oncology

These 2 papers will contain at least 2 questions from each of the following sections:

2.1 Radiotherapy:

An in depth knowledge of the use and applications of radiotherapy and chemotherapy as well as biological and hormonal therapy applicable to tumours isessential. The candidate must be able to contrast this with other forms of treatment available and justify its use.

The candidate should be able to:

2.1.1 Justify the intent of radiation treatment and explain the rationale of sequencing in relation to other treatment modalities.

2.1.2 Describe the treatment planning process with respect to:

- Positioning and immobilization
- Simulation/scanning

- Delineation of tumour/treatment volumes and critical structures

2.1.3 Describe and justify the likely beam arrangement for a given tumour

2.1.4 Prescribe a course of treatment and describe:
- Dose, fractionation schedules, and treatment length.
- Normal tissue tolerances and limitations

2.1.5 Discuss plan assessment/appraisal

2.1.6 Discuss treatment supervision including:
- Verification
- Diagnosis, grading and treatment of acute toxicities of treatment and assessment of the impact of treatment on quality of life.

2.1.7 Discuss clinical applications, rationale and techniques of:
- brachytherapy
- Radio-isotope therapy
- Other specialised radiation techniques

2.2 **Systemic therapy (Chemotherapy, hormonal therapy, biological therapy)**
The candidate should have an in depth knowledge of the principles and indications for systemic therapies used in the curative and palliative setting and be able to describe:-

2.2.1 Classification and mechanism of action of cytotoxics.
2.2.2 Side effects and toxicities, as well as management of these
2.2.3 Commonly used therapeutic regimens and schedules
2.2.4 Rationale of sequencing in relation to other treatment modalities
2.2.5 Interactions with radiotherapy
2.2.6 Biological therapies
2.2.7 Indications for radiosensitisers
2.2.8 Knowledge of recent literature pertaining to oncologic diseases is expected

3.0 Learning Portfolio

The Learning Portfolio documents the trainees experience. It includes a guideline to a list of procedures.

It includes templates for the completion of case reports in Radiation Oncology and Medical Oncology.

In addition, trainees will be encouraged to use the Learning Portfolio to learn

Applied basic sciences and the associated roles of an Oncologist in Health Care Practice ie Collaborator, Communicator, Health Advocate, Manager, an ethically based Professional and Scholar.

The Learning Portfolio is to be signed off by the Head of Department prior to the trainee sitting the Part II examinations and needs to be presented to the examiners at the time of the Part II oral examination

A P P E N D I X C

SYLLABUS FOR PART III EXAMINATION

1.0 Commentary

1.1 The aim of the commentary is:

1.1.1 To establish an understanding of research methodology and to ensure participation in research as intergral components of radiation oncology training and subsequent specialist practice.

1.1.2. To encourage trainees to contribute to the oncology literature.

1.2 Content:

The commentary can consist of any subject in Oncology but should include some original data. It may consist of a retrospective review of a series of cases, a particularly unusual case study which illustrates aspects of the Basic Science of Oncology, an analysis and modelling of different treatment techniques or a Basic Science Study. A critical and substantial literature review as relevant to practice in Ghana may be considered on special motivation but this option is not encouraged.

1.3 Conduct of the commentary and presentation:

It is anticipated that the commentary will be done after the Part II examination. It should be managed during the trainees after hours study time and completed at least 6 months prior to the Part III examination. Trainees will be suitably supervised in the conduct of the study. The findings of the Commentary should be presented in publishable form that is under the Headings of Introduction, Patient and Methods, Results, Discussion (with a review of related literature) and References.

1.4 Assessment of the commentary:

The commentary will be examined by the Trainee's Head of Department or his designate and externally reviewed through the Council of College of Radiotherapy and Oncology. The commentary should be presented to the GCPS at least 6 months prior to the end of the fellowship period.

2.0 Statistics and Statistical Critique of a Published Article.

After completion of the Part II examination, a written report will be provided by the trainee to the Head of Department on the following.

- A statistical critique of a published article

AND

- A written answer (open book) to 2 or more questions set by the Head of the Department or designate and based on the syllabus below.

2.1 **Aim:**

The trainee is to become acquainted with Statistics as applied to Oncology at similar time as undertaking the commentary.

2.2 Presentation - sample outline of critique of a published article on a Phase III study (more than 2 pages in length)

2.2.1 Study aim and phase

2.2.2 Protocol.

- Similarity of prognostic factors in treatment arms
- Adequacy of treatment in control arm
- Endpoints – comment on their appropriateness and determination
- Other comments

2.2.3 Statistical design of study

- Hypothesis – the null and alternate hypothesis
- Alpha error and power of the study
- Determination of number of patients needed
- Other comments

2.2.4 Statistical evaluation

- Descriptive statistics used
- Statistical test used to evaluate endpoints - p value findings
- Findings in terms of odds ratio or Hazard ratio and confidence intervals
- Other comments

2.3 **Assessment:**

The critique will be examined by the Trainee's Head of Department or designate and reviewed by a Head of Department or his designate from another University.
The critique should be presented to the GCPS together with the Research project.

2.4 Syllabus in Statistics as Applied to Oncology

2.4.1 Scientific Knowledge

- Rationale of Clinical Trials
- Levels of Evidence in Medicine
- Sequenced Phases leading to Randomised Trials
    - Phase I Clinical Trials
    - Phase II Clinical Trials
    - Phase III Clinical Trials

2.4.2 The Study Protocol

- Study Patients
- Treatment
- Follow up of Patients
- Endpoints in Oncology studies

2.4.3 Statistics

- Descriptive Statistics
    - Mean, Median and standard deviation
    - Life table and Kaplan Meier survival plots
- Statistical planning of a Phase III study
    - Null hypothesis
    - Type 1 and Type II errors
    - Probability of Type I and type II errors in studies – alpha and beta.
    - Numbers of patients need in a study
    - Statements of probability and confidence intervals, P-values and their meanings. The normal distribution

- Types of Data and Statistical Tests
    - Binary Data and the chi square
    - Continuous Data and the t test or z score
    - Survival Analyses and the log rank test
    - Hazard Ratios and confidence intervals
    - Prognostic Factors - multivariate analysis
    - Correlation and regression

APPENDIX D

Recommended reading list

- Faiz M Khan. *The Physics of Radiation Therapy*. Lippincott, Williams Wilkins, 1997.
- CK Bomford, IH Kunkler, SB Sherriff, J Walter, H Miller. Walter and Miller's Testbook *Radiation Physics, Therapy and Oncology*. Churchill Livingstone 1993. *5th edition*
- Prof Hering's lecture notes on Medical Physics
- ICRU reports:
  No. 50- Prescribing, recording and reporting photon beam therapy
  No. 62- Prescribing, recording and reporting photon beam therapy (supplement to ICRU 50)
- Metcalfe P, Kron T & Hoban P: *The Physics of Radiotherapy X-rays Linear Accelerator.* 1997
- Eric J. Hall. *Radiobiology for the Radiologist.* Lippincott Williams & Wilkins Publishers. *6th edition*, 2006.
- G. Gordon Steel. *Basic Clinical Radiobiology.* (Editor) 3rd edition (4th edition coming out late in 2008 new editor)
- There are many suitable Anatomy textbooks that may be referenced. Examples include:
  - McMinn RMH: *Last's Anatomy – Regional and Applied*, Churchill Livingstone, New York, *10th edition* 1999.
  - Netter FH: *Atlas of Human Anatomy* 3rd edition.
  - Fleckenstein and Tranum-Jensen: *Anatomy in Diagnostic Imaging*, 2nd edition Saunders Co 2001
- Robbins Pathological Basis of Disease.
- De Vita V, Hellman S, Rosenberg SA: *Cancer: Principals and Practice of Oncology,* 7th edition. Lippincott Williams & Wilkins, 2008
- Perez CA, Brady LW, Halperin EC, Schmidt-Ullrich RK: *Principles and Practice of Radiation Oncology*, 5th edition. Lippincott Williams & Williams, 2007
- SA Leibel and TL Phillips (Editors) *Textbook of radiation oncology*, Publisher: WB Saunders. 2004