THE AMERICAN BOARD OF RADIOLOGY

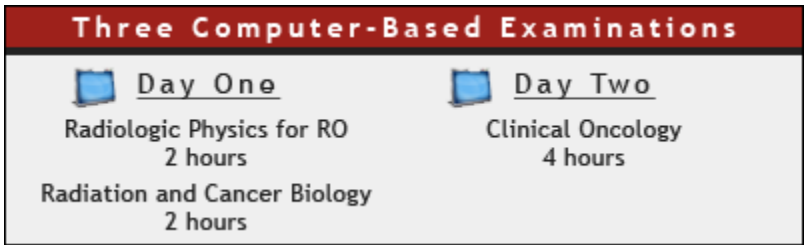
Radiation Oncology

Study Guide

The computer-based and oral exams include clinical oncology and radiation treatment planning and technique, physics, and cancer and radiation biology, as these subjects relate to the clinical practice of radiation oncology.

The three computer-based examinations

are administered over two days. The radiologic physics for radiation oncology exam is two hours long. The combined radiation and cancer biology exam is also two hours long. The clinical oncology exam, administered on the second day, is four hours long.



The oral exam

is administered separately. It is case-based; that is, candidates are shown images and asked questions about the depicted patients and diseases.

See the following areas for detailed study guides for each of the exams.

Clinical Oncology

Radiologic Physics for Radiation Oncology

Radiation and Cancer Biology

Oral Examination

Study Guide: Clinical Oncology

- This examination assesses your understanding of oncology and radiation therapy. Included are questions related to cancers of every type, including:
  - the epidemiology and pathology
  - the requirements for their diagnosis, staging, treatment (including the utilization of modalities other than radiation therapy) and follow-up
  - understanding of how radiation therapy affects normal tissues
  - complications resulting from radiation
  - ethics
  - statistics
  - anatomy
  - optimum beams and radiation sources for various clinical situations
  - tumor localization
  - dose distribution
  - selection of optimum volume, dose and fractionation
  - precision and errors in treatment planning
  - techniques involved in the treatment of the various anatomic and organ sites

- Questions in any category may relate to:
  - anatomy
  - epidemiology/etiologic agents
  - natural history
  - pathology
  - tumor markers
  - initial clinical evaluation
  - staging
  - routes of local, regional and distant spread
  - selection of a treatment modality
  - radiation therapy techniques (including external beam, brachytherapy and treating with unsealed radioactive agents)
  - treatment results (e.g., with surgery, radiation therapy, or chemotherapy)
  - patterns of failure
  - complications
  - normal tissue effects

Categories for Clinical Oncology

- **Pediatrics**
  - Retinoblastoma
  - Wilms tumor
  - Neuroblastoma
  - Rhabdomyosarcoma and other soft tissue sarcomas
  - Lymphomas
  - Leukemias
  - Histocytosis X
  - Ewing ’s sarcoma and other bone tumors
  - Pediatric solid tumors
  - Soft-tissue sarcoma

- Germ cell tumor
- Hepatic tumor
- Osteosarcoma
- Hodgkin's disease

- **Pediatric CNS Tumors**
  - Medullooblastoma
  - Astrocytoma (glioma) low grade
  - Astrocytoma, high grade
  - Brain stem glioma
  - Ependymoma
  - Pineal/Germ cell
  - Craniopharyngioma
  - Optic tract
  - Other

- **Gastrointestinal (GI) Tract**
  - Esophagus
  - Stomach
  - Small bowel
  - Colon/rectum
  - Anus
  - Pancreas
  - Biliary tract
  - Liver
  - Other

- **Gynecology**
  - Cervix
  - Endometrium/uterus
  - Ovaries & fallopian tubes
  - Vagina
  - Vulva
  - Other

- **Genitourinary (GU) Tract**
  - Prostate
  - Bladder
  - Testes/seminoma
  - Testes/nonseminoma
  - Kidneys
  - Ureter
  - Urethra
  - Penis
  - Other

- **Lymphomas and Leukemias**
  - Hodgkin disease
  - Non-Hodgkin lymphoma
  - Leukemia
  - Multiple myeloma/plasmacytoma
  - Total body irradiation
  - Total skin irradiation
  - Radioimmunotherapy
  - Other

- **Head, Neck and Skin**
  - Larynx
  - Oral cavity
  - Oropharynx
  - Hypopharynx
  - Nasopharynx
  - Salivary glands
  - Orbits
  - Temporal bone
  - Skin
  - Thyroid gland
  - Other

- **Lung/Mediastinum**
  - Non-small cell cancer
  - Small cell cancer
  - Superior sulcus tumor
  - Thymomas and/or other mediastinum tumors
  - Other

- **Breast**
  - Early-stage breast cancer
  - Locally advanced breast cancer
  - Inflammatory breast cancer
  - Carcinoma in situ, ductal and lobular
  - Locally recurrent breast cancer
  - Metastatic breast cancer
  - Other

- **Soft Tissue**
  - Osteosarcoma and/or chondrosarcoma
  - Ewing ’s sarcoma
  - Other bone tumors
  - Soft tissue sarcomas
  - Desmoid tumor
  - Kaposi’s sarcoma
  - Other

- **Central Nervous System (CNS)**
  - Astrocytoma, low grade
  - Astrocytoma, high grade
  - Medulloblastoma
  - Brainstem glioma
  - Ependymoma
  - Pineal
  - Brain
  - Lymphoma
  - Meningioma
  - Pituitary
  - Spinal cord
  - Craniopharyngioma
  - Arteriovenous malformation (AVM)
  - Optic tract
  - Oligodendroglioma
  - Other

- **Palliation**
  - Skeletal metastases
  - Brain metastases
  - Cord compression
  - Vena cava syndrome
  - Hemostases
  - Relief of obstruction
  - Other

- **Biostatistics**
  - Study design
  - Definitions of statistical terms
  - General interpretation & analysis
  - Survival curves
  - Specificity/sensitivity
  - Tests of significance
  - Phase III studies (randomized)
  - Retrospective trials/historical controls
  - Phase I & II studies (nonrandomized case control studies)
  - Multiple trials/metaanalysis
  - Lab tests/x-ray studies
  - Other

- **Miscellaneous**
  - Ethics
  - Intravascular brachytherapy
  - Questions that do not relate to specific anatomical sites as listed above
  - Other applications of irradiation

Study Guide: Radiologic Physics for Radiation Oncology

This exam tests your knowledge of the principles of physics underlying the practice of radiation oncology. Included are questions on:

- basic physics
- instruments and measurements
- dosimetry
- radioactivity (radionuclides and physics of therapeutically employed radionuclides)
- protection and safety

Categories for Radiologic Physics for Radiation Oncology

- **Atomic and Nuclear Structure**
  - Bohr model of the atom
    - Coulombic force and electron binding energy
    - Electron orbits (energy levels)
    - Electron transitions—absorption and emission of energy
    - Characteristic radiation and the Auger effect
  - Nuclear structure
    - Nucleons —protons and neutrons
    - Nuclear force
    - $E = mc^2$ and nuclear binding energy
  - Factors affecting nuclear stability
    - Neutron-to-proton ratio
    - Average binding energy per nucleon
    - Pairing of similar nucleons in the nucleus
  - Nuclear nomenclature
    - The four isos (isotopes, isotones, isobars, isomers)
    - Shorthand representation of isotopes

- **Radioactive Decay**
  - Modes of radioactive decay
    - Beta (ß)
      - ß- (negative beta, negatron)
      - ß+ (positive beta, positron)
      - Electron capture
    - Alpha (α)
  - Other decay processes
    - Gamma rays
    - Internal conversion
  - Decay schemes
    - Construction and interpretation
    - Examples for each decay mode
  - Mathematics of radioactive decay
    - Units (SI Units)
    - Exponential decay equation
      - Half-life
      - Decay constant

        - Mean life, average life, and effective half life
        - Simple dose calculation for implants
    - Radioactive equilibrium
        - Secular equilibrium
            - Radium needles
            - ^{90}Sr applicators
        - Transient equilibrium
            - Nuclear medicine generators
    - Counting statistics
- Naturally occurring radioisotopes
- Manmade radioisotopes
    - Fission
    - Nuclear bombardment
- Decay schemes and properties for therapeutic isotopes

- **Properties and Production of Particulate and Electromagnetic Radiation**
    - Particulate radiation
        - Mass, charge
        - Relativistic energy equation
    - Electromagnetic radiation
        - Wave-particle duality
        - Wave equations
        - Electromagnetic spectrum
    - Production of radiation
        - Principles
        - Radioactive decay
        - X-ray tube
    - Linear accelerators
        - Operational theory of wave guides
            - Standing wave guides
            - Traveling wave guides
        - Bending magnet systems
        - Flattening filters
        - Electron scattering foils
        - Electron cones
        - Targets
        - Factors affecting
            - Beam energy
            - Entrance dose
            - Depth of maximum dose
            - Beam uniformity
            - Dose rate
        - Monitor chamber
        - Collimation systems
            - Primary and secondary collimators
            - Coupled and independent jaws (including virtual wedges)
            - Multileaf collimators
            - Other collimation systems (e.g., stereotactic systems)
            - Radiation and light fields (including field size definition)
        - Mechanical and operational features

- Cyclotron
- Microtron
- Cobalt units
- Therapeutic x-ray (<300 kVp)

- **Interactions of Electromagnetic Radiation with Matter**
  - Coherent scatter
  - Photoelectric effect
  - Compton effect
  - Pair production
  - Photonuclear disintegration
  - Relative probabilities of interactions in human tissues
    - Energy dependence
    - Atomic number dependence
    - Electron density dependence

- **Interactions of Particulate Radiation with Matter**
  - Formalism
    - W value
    - Specific ionization
    - Linear energy transfer
    - Range
    - Stopping power
  - Types of interactions
    - Heavy vs light particles
    - Charged vs uncharged particles
    - Elastic collisions
    - Inelastic collisions
  - Heavy charged particles
    - Inelastic collisions with electrons
    - Depth dose characteristics (Bragg peak)
  - Light charged particles
    - Elastic and inelastic collisions with electrons
    - Inelastic collisions with nuclei
  - Neutrons
    - Elastic collisions with hydrogen nuclei
    - Depth dose characteristics vs charged particles and photons
  - Biological implications of particle therapy

- **Quantification and Measurement of Dose (including SI units)**
  - Exposure (air kerma)
  - Absorbed dose (kerma)
  - Dose equivalent
  - RBE dose
  - Calculation of absorbed dose from exposure (e.g., f factor)
  - Bragg-Gray cavity theory
  - Gas-filled detectors
    - Principles of operation
    - Uses

- Ion chambers
    - Types
    - Exposure measurement
    - As a Bragg-Gray cavity
    - Correction factors (e.g., temperature and pressure)
    - Calibration of photon and electron beams (e.g., TG 21 and TG 25)
- Thermoluminescent dosimetry
- Calorimetry
- Film
- Chemical dosimetry
- Solid state diodes
- Scintillation detectors
- Measurement techniques

- **Characteristics of Photon Beams**
    - Mathematics of exponential attenuation
        - Half-value thickness
        - Attenuation coefficients (linear, mass, partial, total)
        - Narrow beam vs broad beam geometry
        - Monoenergetic vs heteroenergetic
        - Parallel vs diverging beams
    - Beam quality for heteroenergetic beams
        - Energy distribution of accelerated electron beam
        - Filtration
        - Geometry
        - Effective energy
        - Energy spectra

- **Dosimetry of Photon Beams in a Homogeneous Water Phantom**
    - Dose distributions
        - Central axis percent depth dose
        - Isodose curves
        - Factors affecting dose distributions and penumbra
            - Beam energy or quality (including patient dose from neutrons)
            - Source size
            - SSD and SAD
            - Mayneord F factor
            - Inverse square law
            - Field size and shape
            - Equivalent square
            - Scatter effects
            - Flattening filters
            - Depth
            - Surface dose
            - Other
        - Dose distributions for multiple unshaped beams
            - Open beams
            - Wedged beams
        - Tissue-air ratio and backscatter factor

    - Tissue-maximum ratio
    - Tissue-phantom ratio
    - Relationships between PDD, TAR, TMR, TPR
    - Point dose and treatment time calculation methods for single unshaped fields
        - Machine output factors (e.g., absolute and relative output, head scatter, patient scatter factors)
        - Equivalent squares
        - SSD vs SAD setups
        - Beam modifier factors (e.g., wedge and tray factors)
    - Dose calculation at the isocenter of a rotating beam
    - Point dose and treatment time calculations for single shaped fields
        - Separation and recombination of primary and scatter radiation (e.g., Clarkson techniques)
        - Off-axis factors
        - Dose under blocks
        - Equivalent squares for shaped fields
    - Isodose distributions for multiple fields, including arc therapy
    - Measurement of photon dose distributions

- **Dosimetry of Photon Beams in a Patient**
    - Dose specification (eg, ICRU 50)
    - Corrections for patient contour
        - Effective SSD method
        - TAR ratio method
        - Isodose shift method
    - Corrections for tissue inhomogeneities
        - TAR ratio method
        - Power law method
        - Isodose shift method
        - Equivalent TAR
    - Dose within and around an inhomogeneity
    - Matching of adjacent fields
    - Using multiple wedged fields
    - Parallel opposed beams
        - Point of maximum dose
        - Uniformity, dependence upon
            - Energy
            - Separation
            - SSD
    - Entrance dose and exit dose, including beam modifying devices
    - Isodose distributions for multiple beams, including mixed modality and arc therapy
    - Compensation
        - Missing tissue
        - Dose compensation
        - Bolus
    - Off-axis factors
    - Practical/simple calculation of dose
    - Practical/simple 2D treatment planning

- 3D conformal treatment planning 3D conformal treatment planning *Advanced Treatment Planning for EBRT*, Letter G)
- Dose delivery accuracy and precision

- **Dosimetry of Electron Beams**
  - Dose distributions
    - Central axis percent depth dose
    - Isodose curves
  - Factors affecting dose distributions
    - Beam quality
    - Beam spreading systems
    - SSD and SDD
      - Effective SSD techniques
      - Inverse square
    - Field size and shape
    - X-ray contamination
    - Depth
    - Surface dose
    - Inhomogeneities (e.g., CET)
    - Other
  - Energy specification
    - Most probable energy
    - Mean energy
    - Energy at depth
    - Ranges (extrapolated, practical, R50)
  - Choice of energy and field size
  - Air gaps and oblique incidence
  - Tissue inhomogeneities
  - Bolus, absorbers, and spoilers
  - Matching adjacent fields
  - Point dose and treatment time calculations
  - Field shaping techniques
  - Electron arc
  - Total skin electron therapy

- **Brachytherapy**
  - Historical review—role of radium
  - Calculation of dose from a point source
  - Calculation of dose from a line source
  - Physical and dosimetric properties of commercial sealed sources and applicators
  - Implant instrumentation and techniques
    - Low dose rate
    - High dose rate (including PDR)
    - Biological considerations of dose, dose rate, and fractionation
  - Calibration and specification of sources
  - Disseminated (unsealed sources)
  - Acceptance testing and quality assurance
  - Dose specification, implantation dosimetry, and dosimetry systems
    - Patterson-Parker

        - Quimby
        - Paris
        - Other
    - Dose specification and dosimetry systems of intracavitary implants

- **Advanced Treatment Planning for EBRT**
    - Plane radiography and fluoroscopy for simulation
    - Portal imaging
        - Film-based
        - Electronic
    - Imaging for radiation therapy planning
        - CT
        - MRI
        - Ultrasound
        - Isotope imaging
    - Image processing
        - Image enhancement
        - 2D and 3D visualization of volumetric data (DRRs, volume rendering)
        - Image registration
    - Virtual simulation (including BEV techniques)
    - Treatment planning systems
    - 3D conformal treatment planning
        - Plan evaluation (DVH, NTCP, TCP, etc)
        - Dose optimization techniques
        - Noncoplanar beams
        - IMRT
    - Radiosurgery
    - Patient setup and alignment

- **Quality Assurance**
    - Equipment-related
        - Regulations and recommendations
        - Measurement techniques
    - Patient related
        - Misadministration
            - External beam
            - Brachytherapy
    - Brachytherapy source inventory

- **Radiation Protection and Safety**
    - Principles, biological effect models, personnel dose limits, rules, regulations
    - Structural shielding design for external beam therapy
        - Primary barriers
        - Secondary barriers
        - Machine shielding (beam stoppers and head shielding)
        - Neutrons
    - Radiation protection for brachytherapy procedures
        - Source storage and transport containers
        - Patient room

        - Special considerations for high dose rate brachytherapy
        - Special procedures and source prep rooms
        - Release of patients treated with temporary implants
    - Leak testing of sealed sources
    - Routine radiation surveys
    - Personnel monitoring
    - Protection against nonionizing radiation
    - Administrative requirements
        - Radiation Safety Officer
        - Radiation Safety Committee
    - Safety instructions and safety precautions
        - Sealed-source brachytherapy
        - Radiopharmaceutical therapy

- **Quality Management Program**
    - Written directive
    - Identification of patient
    - Plan and delivery in accordance with written directive
    - Unintended deviation
        - Recordable events
        - Misadministrations

- **Special Topics**
    - Hyperthermia
    - Computers

Study Guide: Radiation and Cancer Biology

This exam tests your knowledge of the principles of cancer and radiation biology underlying the practice of radiation oncology. Included are questions on:

- basic cancer biology and the molecular biology of cancer
- the response to radiation at the subcellular and cellular levels
- the radiation responses of normal and malignant tissues
- radiation carcinogenesis
- hereditary effects as they relate to radiation protection

Categories for Cancer and Radiation Biology

- **Interaction of Radiation with Matter**
  - Definition of ionizing radiation and types
  - Definition of LET and quality of radiation
  - Generation of free radicals
  - Direct and indirect action of radiation
  - Role of oxygen

- **Molecular Mechanisms of DNA Damage**
  - Assays for DNA damage
  - Neutral and alkaline elution, pulsed field electrophoresis, comet, plasmid-based assays
  - Types of DNA lesions and numbers per cell/Gy
  - Multiply damaged sites
  - Single lethal hits and accumulated damage (inter- and intratrack)

- **Molecular Mechanisms of DNA Repair**
  - Types of repair
  - Repair of base damage, single-strand and double-strand breaks
  - Homologous recombination
  - Nonhomologous end-joining

- **Chromosome and Chromatid Damage**
  - Assays
  - Conventional and FISH
  - Dose response relationships
  - Use of peripheral blood lymphocytes in *in vivo* dosimetry
  - Stable and unstable chromatid and chromosome aberrations
  - Human genetic diseases that affect DNA repair, fragility, and radiosensitivity

- **Mechanisms of Cell Death**
  - Apoptotic death
    - Developmental and stress induced
    - Morphological and biochemical features of apoptosis
    - Molecular pathways leading to apoptosis
    - Radiation-induced apoptosis in normal tissues and tumors
  - Necrotic death
    - Morphological, pathological, and biochemical features of necrosis
  - Mitotic death following irradiation

    - Catastrophic vs apoptotic death
    - Cell division postradiation and time of clonogen death
  - Radiation-induced senescence

- **Cell and Tissue Survival Assays**
  - In vitro clonogenic assays
    - Effects of dose, dose rate, cell type
  - In vivo clonogenic assays
    - Bone marrow stem cell assays, jejunal crypt stem cell assay, skin clones, kidney tubules

- **Models of Cell Survival**
  - Random nature of cell killing and Poisson statistics
  - Comparison of survival of viruses, bacteria, and eukaryotic cells after irradiation
  - Single-hit, multitarget models of cell survival
  - Two component models
  - Linear quadratic model
  - Calculations of cell survival with dose

- **Linear Energy Transfer**
  - RBE defined
  - RBE as a function of LET
  - Tissue type

- **Oxygen Effect**
  - Define OER
  - Dose and dose per fraction effects
  - OER vs LET
  - Impact of O2 concentration
  - Time scale of oxygen effect
  - Mechanisms of oxygen effect

- **Repair at the Cellular Level**
  - Sublethal damage repair
  - Potentially lethal damage repair
  - Half-time of repair
  - Dose rate effects and repair
  - Dose fractionation effects

- **Solid Tumor Assay Systems**
  - Experimental models
  - TD50 limiting dilution assay
  - Tumor regrowth assay
  - TCD50 tumor control assay
  - Lung colony assay
  - In vitro / in vivo assay
  - Spheroid systems

- **Tumor Microenvironment**
  - Tumor vasculature
  - Angiogenesis
  - Hypoxia in tumors
    - Measurement of hypoxia
    - Transient and chronic hypoxia
  - Reoxygenation following irradiation
  - Relevance of hypoxia in radiation therapy
  - Hypoxia as a factor in tumor progression
  - Hypoxia-induced signal transduction
  - Cellular composition of tumors

- **Cell and Tissue Kinetics**
  - Cell cycle
  - Measurement of cell cycle parameters by 3H-thymidine
  - Measurement by flow cytometry, DNA staining and BrdU
  - Cell cycle synchronization techniques and uses
  - Effect of cell cycle phase on radiosensitivity
  - Cell cycle arrest and redistribution following irradiation
  - Cell cycle checkpoints, cyclins, cyclin dependent kinase inhibitors
  - Tissue kinetics
    - Growth fraction
    - Cell loss factor
    - Volume doubling times
    - Tpot
  - Growth kinetics of clinical and experimental tumors

- **Molecular Signaling**
  - Receptor/ligand interactions
  - Phosphorylation/dephosphorylation reactions
  - Transcriptional activation
  - Gene expression profiling and radiation-induced gene expression
  - Radiation-induced signals
    - DNA damage response
    - Non-DNA damage response
  - Cell survival and death pathways

- **Cancer**
  - Cancer as a genetic disease
  - Oncogenes
  - Tumor suppressor genes
  - Telomeric changes in cancer
  - Epigenetic changes in cancer (e.g., hypermethylation)
  - Multistep nature of carcinogenesis
  - Molecular profiling of cancer
  - Signaling abnormalities in carcinogenesis
  - Effects of signaling abnormalities on radiation responses
  - Prognostic and therapeutic significance of tumor characteristics

- **Total Body Irradiation**
  - Prodromal radiation syndrome
  - Cerebrovascular syndrome
  - Gastrointestinal syndrome
  - Hematopoietic syndrome
  - Mean lethal dose and dose/time responses
  - Immunological effects
  - Assessment and treatment of radiation accidents
  - Bone marrow transplantation

- **Clinically Relevant Normal Tissue Responses to Radiation**
  - Responses in skin, oral mucosa, oropharyngeal and esophageal mucous membranes, salivary glands, bone marrow, lymphoid tissue bone and cartilage, lung, kidney, testis, eye, central and peripheral nervous tissues

- **Mechanisms of Normal Tissue Radiation Responses**
  - Molecular and cellular responses in slowly and rapidly proliferating tissues
    - Cytokines and growth factors
    - Regeneration
    - Remembered dose
    - Functional subunits
  - Mechanisms underlying clinical symptoms
    - Latency
    - Inflammatory changes
    - Cell killing
    - Radiation fibrosis
    - Volume effects
  - Scoring systems for tissue injury
    - LENT and SOMA

- **Therapeutic Ratio**
  - Tumor control probability (TCP) curves
    - Calculation of TCP
    - Factors affecting shape and slope of TCP curves
    - Influence of tumor repopulation/regeneration on TCP
  - Normal tissue complication probability (NTCP) curves
    - Influence of normal tissue regeneration on responses
    - Response of subclinical disease
    - Causes of treatment failure
    - Factors determining tissue tolerance
    - Normal tissue volume effects
    - Dose-volume histogram analysis
  - Effect of adjuvant or combined treatments on therapeutic rationals

- **Time, Dose, Fractionation**
  - The 4 R's of fractionation
  - The radiobiological rationalc behind dose fractionation
  - The effect of tissue type on the response to dose fractionation
  - Effect of tissue/tumor types on a/b ratios

- Quantitation of multifraction survival cures
- BED and isoeffect dose calculations

- **Brachytherapy**
  - Dose rate effects (HDR and LDR)
  - Choice of isotopes
  - Interstitial and intracavitary use
  - Radiolabeled antibodies

- **Radiobiological aspects of alternative dose delivery systems**
  - Protons, high LET sources, BNCT
  - Stereotactic radiosurgery/radiotherapy, IMRT, IORT
  - Dose distributions and dose heterogeneity

- **Chemotherapeutic agents and radiation therapy**
  - Classes of agents
  - Mechanisms of action
  - The oxygen effect for chemotherapy
  - Multiple drug resistance
  - Interactions of chemotherapeutic agents with radiation therapy
  - Photodynamic therapy
  - Gene therapy

- **Radiosensitizers, Bioreductive Drugs, Radioprotectors**
  - Tumor radiosensensitization
    - Halogenated pyrimidines, nitroimidazoles
  - Hypoxic cell cytotoxins
    - Tirapazamine
  - Normal tissue radioprotection
    - Mechanisms of action, sulfhydryl compounds, WR series, dose reduction factor (DRF)
  - Biological response modifiers

- **Hyperthermia**
  - Cellular response to heat
  - Heat shock proteins
  - Thermotolerance
  - Response of tumors and normal tissues to heat
  - Combination with radiation therapy

- **Radiation Carcinogenesis**
  - Initiation, promotion, progression
  - Dose response for radiation-induced cancers
  - Importance of age at exposure and time since exposure
  - Malignancies in prenatally exposed children
  - Second tumors in radiation therapy patients
  - Effects of chemotherapy on incidence
  - Risk estimates in humans
  - Calculations based on risk estimates

- **Heritable Effects of Radiation**
  - Single gene mutation
  - Chromosome aberrations
  - Relative vs absolute mutation risk
  - Doubling dose
  - Heritable effects in humans
  - Risk estimates for hereditable effects

- **Radiation Effects in the Developing Embryo**
  - Intrauterine death
  - Congenital abnormalities and neonatal death
  - Microcephaly, mental retardation
  - Growth retardation
  - Dose, dose rate, and stage in gestation
  - Human experience of pregnant women exposed to therapeutic dose

- **Radiation Protection**
  - General philosophy
  - Stochastic and deterministic effects
  - Relative weighting factors
  - Equivalent dose-tissue weighting factor
  - Effective dose, committed dose
  - Collective exposure dose
  - Dose limits for occupational and public exposure
  - ICRP and NCRP

Study Guide: Oral Exam

You will be examined by eight examiners for a period of 30 minutes with each.

The subject matter is the clinical management of malignant and benign disease, and is usually presented according to the anatomical site of the primary tumor. Electronic display of images may be used in some categories of the examination.

Questions in any category may relate to:

- Anatomy
- Epidemiology
- Pathology
- Patterns of local, regional and distant involvement
- Clinical evaluation, including staging and tumor markers
- Selection of treatment modalities, including surgery, radiation therapy and systemic therapy, as applicable
- Radiation therapy planning and technique
- Results of treatments including patterns of failure and prognostic factors
- Complications of treatments with emphasis on the effects of radiation therapy on normal tissues, and how they should be managed

The anatomical sites are divided into the following eight categories:

- **Gastrointestinal Tract— includes malignancies of the :**
  - esophagus
  - stomach
  - small bowel
  - colon
  - rectum
  - anus
  - pancreas
  - adrenal gland
  - liver
  - gallbladder
  - bile ducts

- **Gynecologic Malignancies—includes malignant lesions of the:**
  - cervix
  - vagina
  - uterus
  - allopian tubes
  - ovaries
  - vulva

- **Genitourinary Tract—includes malignancies of the:**
  - prostate
  - kidney
  - ureter
  - urethra

- bladder
- penis
- testis

- **Lymphoma/Leukemia—includes:**
  - Hodgkin disease
  - non-Hodgkin lymphomas
  - leukemias
  - myeloma

- **Head, Neck, and Skin—includes malignancies of the:**
  - oral cavity
  - paranasal sinuses
  - salivary glands
  - nasopharynx
  - hypopharynx
  - thyroid
  - larynx
  - oropharynx
  - skin

- **Breast— includes:**
  - malignancies of the breast
  - in-situ carcinomas of the breast

- **Central Nervous System and Pediatric Malignancies—includes benign and malignant diseases of the:**
  - central nervous system
  - neoplasms of the pediatric age group
    - histiocytoses

- **Lung and Mediastinum, Soft Tissue and Bone—includes malignancies of the:**
  - lung and mediastinum
  - pleura
  - soft tissues
  - bone