



Appendix 1 - Part 1 Blueprint for Foundational Sciences

PART 1A - Radiation Physics and Imaging Technology (RPIT)

<i>Subject</i>	<i>Domain</i>	<i>Area</i>	<i>Topic</i>
Radiation Physics	General physical properties of electromagnetism	Electromagnetic spectrum	<ul style="list-style-type: none"> • Electric and magnetic fields • Ionizing radiation vs non-ionizing radiation (e.g., radiofrequency [MRI], visible light) • Properties of X-radiation
		Properties of ionizing radiation	<ul style="list-style-type: none"> • Principles of radioactivity and radionuclides • Alpha, beta, neutron, and gamma radiation • Principles of exponential decay, half-life, specific activity
		Properties of photons	<ul style="list-style-type: none"> • Energy, frequency, wavelength, speed
	X-ray production	Characteristics of photons	<ul style="list-style-type: none"> • Wave and particle properties
		Components of an x-ray machine and component function(s)	<ul style="list-style-type: none"> • X-ray tube • Control panel. • High/Low voltage components, transformers • Tube rating, duty cycle, waveform, rectification. • Collimation
		X-ray generation	<ul style="list-style-type: none"> • Electron-target interactions • X-ray emission spectrum • Factors affecting x-ray beam intensity and quality. • Beam restriction and scatter reduction
Imaging Technology	Imaging techniques	Intraoral	<ul style="list-style-type: none"> • Bisecting angle and paralleling techniques
		Extraoral	<ul style="list-style-type: none"> • Panoramic, lateral cephalometric, skull projections
	Radiographic film	Components and component function(s)	<ul style="list-style-type: none"> • Film package structure, film structure, mechanism of



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		Film processing	<ul style="list-style-type: none"> conversion of x-ray photons to displayed image • Chemistry of developer and fixer
		Factors affecting film image quality	<ul style="list-style-type: none"> • Temperature, time, humidity, safe light, speed
	Digital imaging	Components and function(s)	<ul style="list-style-type: none"> • CCD/CMOS PSP (also referred to as CR)
		Image acquisition	<ul style="list-style-type: none"> • Mechanism of conversion of x-ray photons to displayed image
		Image characteristics	<ul style="list-style-type: none"> • Spatial and contrast resolution
		Digital image quality assurance metrics	<ul style="list-style-type: none"> • ADA/ANSI standard 1094 - Quality Assurance for Digital Intra-oral Radiographic Systems
Computed tomography		Cone beam computed tomography (CBCT)	<ul style="list-style-type: none"> • Basic principles • Components and component function(s) • Operational modes • Image characteristics • Factors affecting image quality
		Conventional or multiple detectors computed tomography (MDCT)	<ul style="list-style-type: none"> • Basic principles • Components and component function(s) • Operational Modes • Image characteristics • Factors affecting image quality
Magnetic resonance imaging		Basic principles	<ul style="list-style-type: none"> • Magnetic Moment Interaction with an External Field (B_0)
		Components and component function(s)	<ul style="list-style-type: none"> • Static Magnetic field and gradient file subsystems, RF transmitter and receiver, RF coils
		Image characteristics	<ul style="list-style-type: none"> • Pulse Sequence Parameters (TR, TE, Flip Angle, Inversion Time)
		MR signal properties	<ul style="list-style-type: none"> • Proton Density (Spin Density), Transverse) Relaxation, T_2^* Relaxation, T_1 (Longitudinal) Relaxation
		Basics of pulse sequences	<ul style="list-style-type: none"> • Comparison of T_1, T_2, proton density, and T_2^* tissue contrast and use in OMR
		Factors affecting image quality	<ul style="list-style-type: none"> • Spatial resolution, signal-to-noise ratio, contrast, artifacts



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		Safety and bioeffects	<ul style="list-style-type: none"> • Projectile Hazards, effects on Implanted Devices • RF (e.g., Tissue Heating and Other) and gradient field (e.g., peripheral nerve stimulation, sound pressure) biological effects
		Applications in OMR	<ul style="list-style-type: none"> • Malignancy, osteomyelitis, benign tumor differentiation, TMJ, soft tissue
	Ultrasound imaging	Basic principles	<ul style="list-style-type: none"> • Sound wave properties, power and intensity. • Interactions of sound waves with matter • Doppler imaging
		Components and component function(s)	<ul style="list-style-type: none"> • Transducer components and arrays • Display modes
		Factors affecting image quality	<ul style="list-style-type: none"> • Spatial and temporal resolution • Contrast noise
		Applications in OMR	<ul style="list-style-type: none"> • Salivary gland disease
	Nuclear medicine imaging	Properties of radiopharmaceuticals	<ul style="list-style-type: none"> • Radionuclide decay • Radioactivity • Uptake and distribution • Types in dentistry (technetium-99m, Gallium-67, FDG PET/CT radiotracer)
		Basic principles of imaging	<ul style="list-style-type: none"> • Planar imaging • Scintillation (gamma) camera • Single photon emission computed tomography (SPECT) and SPECT/CT • Positron emission tomography (PET)
		Applications in OMR	<ul style="list-style-type: none"> • TMJ, salivary gland disease
	Contrast used in head and neck imaging	Indications and basic techniques	<ul style="list-style-type: none"> • Types of compounds • Selection of ionic vs. non-ionic agents • CT vs. MRI contrast agents
		Properties of contrast agents	<ul style="list-style-type: none"> • Radiopacity, osmolarity, viscosity, distribution, excretion
		Complications or adverse reactions to procedures	<ul style="list-style-type: none"> • Hypersensitivity reactions, thyroid dysfunction, and



Subject	Domain	Area	Topic contrast-induced nephropathy
Measures of Diagnostic Performance Analysis	Precision and reproducibility	Indices of inter- and intra-rater agreement	• Kappa / weighted Kappa
	Accuracy	Indices	• Sensitivity, specificity, positive predictive value, negative predictive value, likelihood ratios, confidence intervals, ROC (Az)
Computer Technology	Components and component function(s)	Associations	• Correlation, regression
		Hardware	• Display characteristics and viewing conditions. • Terminology (e.g., GPU, CPU, pixel, RAM) • Limitations of the human visual system • Grayscale Standard Display Function and Just Noticeable Differences • PACS, RIS, EMR, Worklist
	Information processing	Reconstruction	• Filter back projection vs iterative reconstruction • Advantages and disadvantages of each
		Image processing	• Look up tables (window, level, linear and nonlinear), • Histogram and equalization • Frequency processing (edge and smoothing) • Computer-Aided detection and diagnosis, machine learning, and deep learning (Artificial Intelligence)
		Image archiving	• DICOM • File types, compression algorithms and ratios
		Image transmission Networking technology	• Networks and data exchange • Terminology (e.g., LAN, WAN, WWW, thin client, cloud-based, server, VPN)



PART 1B - Radiation Biology, Safety and Protection (RBP)

Subject	Domain	Area	Topic
Radiation Biology	Molecular and cellular radiobiology	Principles	<ul style="list-style-type: none"> • Linear energy transfer, Relative biologic effectiveness, Fractionation, Lethal Doses
		Effects of radiation on macromolecules	<ul style="list-style-type: none"> • Direct vs. indirect effects, effects of radiation on water, target theory
		Chromosomal damage and repair	<ul style="list-style-type: none"> • DNA repair mechanisms
		Cellular effects of radiation	<ul style="list-style-type: none"> • Law of Bergonié and Tribondeau • Radiosensitivity of Different Cell Types • Cell Cycle Radiosensitivity • Cell Damage, Survival, Repair, and Death
		Systemic effects of radiation	<ul style="list-style-type: none"> • Tissues and organs, whole body, population (gender and age) • Stochastic and non-stochastic effects
		Tissue reactions (Deterministic)	<ul style="list-style-type: none"> • Acute radiation syndrome (Prodromal syndrome, hematological effects/hematopoietic syndrome, gastrointestinal syndrome, central nervous system effects/cerebrovascular syndrome) • Reproductive effects e.g., germ cells, cytogenetic effects) • Therapeutic high dose effects on oral tissues (e.g., mucosa, taste buds, salivary glands, bone)
		Stochastic effects	<ul style="list-style-type: none"> • Carcinogenesis, mutagenesis
		Teratogenic effects	<ul style="list-style-type: none"> • Growth and development, leukemia
		Factors affecting radiosensitivity	<ul style="list-style-type: none"> • Physical factors (e.g., type of radiation used, the dose, temperature, fractionation, chemical factors,) • Biological factors (e.g., oxygen effect, cell cycle, type of cell)
		Radiation Risk	<ul style="list-style-type: none"> • Definition and communication of risk (e.g., relative, absolute, etc.) • Biological risk estimates for ionizing radiation. • Dose-response relationships
		Ionizing radiation	<ul style="list-style-type: none"> • Biological effects
		Ultrasound	<ul style="list-style-type: none"> • Biological effects
		Magnetic fields / radio waves	<ul style="list-style-type: none"> • Biological effects
Radiation Safety and Protection	Radiation detection and measurement	Basic terminology and dosimetry	<ul style="list-style-type: none"> • Radioactivity • Film, luminescence, radiochromic film and ionization chamber dosimetry.



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		Radiation metrics in OMR	<ul style="list-style-type: none"> • Exposures, KERMA, absorbed dose, Equivalent dose, Effective dose • CDTI, DAP, DLP, mAs • DRL and AD
	Exposure and dose in radiology	Risk assessment Patient doses and risks of oral and maxillofacial imaging procedures	<ul style="list-style-type: none"> • Occupational and Non-occupational dose limits • Comparison of doses in OMR and medical radiology procedures • Relative and absolute risk • Comparison to background radiation • Uncertainties in risk estimation • Addressing patient concerns
	Minimization of occupational and non-occupational exposure	Principles of radiation protection	<ul style="list-style-type: none"> • Time, distance, shielding (personal and structural) • ALARA, ALADA, ALADIP • Maximum permissible dose
	Minimization of patient exposure	Selection criteria and technical factors	<ul style="list-style-type: none"> • Current guidelines (e.g., NCRP, ICRP, IAEA, FDA/ADA, AAOMR, CDA, AAP, AAOMR/AAE, European Commission Directorate-General for Energy, British Orthodontic Society)
	Office/clinic design for safety	Statutory responsibilities Shielding plan parameters	<ul style="list-style-type: none"> • Federal and State • Isodose profiles, workload, occupancy, protective barriers, personal monitoring • Considerations for handheld dental x-ray units

