C) Radiation Oncology Physics *(25hrs)*

• Describe the structure of an atom	Historical concept changes from Dalton to Thomson to Rutherford to Bohr; Atomic Structure;
• Describe in detail the processes that generate photons	Electron Interactions; Characteristic radiation; Bremsstrahlung radiation; angular distribution of photons; Dependence on Z;
• Describe the basic principles of the linear accelerator used in producing accelerated particles	Coherent discussion of: Thermionic Emission Microwave Production & Use as an energy source Particle acceleration in a vacuum in accelerating waveguide
• List with brief explanation the structure and components of one of your department's linear accelerators	Lists and describes gantry, stand, modulator cabinet, control console, injection system (electron gun), radiofrequency power generation (klystron/magnetron, thyratron), beam transport system (wave guide, vacuum), auxiliary systems. Report should include photographs of the components of one of the centre's linacs
• Physics has several basic laws of conservation involving energy, mass, momentum and charge. Using the process of Pair Production, describe how these four laws apply	Explanation covers Conservation of Energy (should include consideration of Mass/Energy Conversion, and interchangeability of various forms of energy (eV, KE, PD), Momentum, Charge, Atomic number, [Atomic mass number – needs to invoke $E=mc^2$]
• Describe the rationale and use of the red button in the bunker	Description of a Radiation Incident; Description with photographs of all safety devices in the linac and control room.
• Describe the rationale and use of the personal radiation monitor	Description of Personal Radiation Protection, ALARA, Justification of Dose, Dose Limits for Workers (and by inference General Public)
• Name and describe in detail the processes of interaction between photons and matter	Ionising radiation (direct, indirect) Detailed description of Photoelectric Effect, absorption edges, Compton scattering, Pair Production, Triplet Production, Photodisintegration, Predominance of Effects with Energy
• [Planning case] Using a non-clinical case, apply a single radiation beam to a patient's chest wall. Provide isodose plots for the following situations: o single 6MV photon beam entering perpendicular to the skin with inhomogeneity correction “OFF” o same beam with inhomogeneity correction “ON”. Describe the changes and give an explanation for how these arise o a single 6MV photon beam similar to the normal “medial tangent” with inhomogeneity correction “OFF”. Describe the changes in relation to Part a, and give an explanation for how these arise o Provide an image of your patient’s tangential treatment plan. Describe the rationale for the number of beams, their arrangement and beam modifying devices	Must use the Treatment Planning System to generate the required isodose curves. The images should include isodose lines at 10% increments. The first two should use a beam is a simple anterior beam that partially covers the mediastinum to display the difference in dose penetration with homogeneity ON/OFF. For the third, this single beam is then rotated to the “medial tangent” position and recalculated to display the effect of an oblique surface on isodose profiles. For the fourth, the actual treatment plan is to be reproduced and explained. The physics of wedges is to be explained here.

• Describe in detail the interactions that occur between electrons and matter	Detailed discussion of Coulombic Interactions, energy loss mechanisms, scattering; ionisation/excitation; Bremsstrahlung production; rate of energy loss; angular and spatial spread of pencil beam
• Describe the attenuation processes of electrons in detail	stopping power (overall, total linear, total mass collision/angular/radiation stopping power); elastic/inelastic collisions; energy loss
• [Practical] A patient requires an electron breast boost field the same shape as a normal size kidney. Use the resources of your department to construct the field definer. List and explain the steps in detail. Provide an image of your device. Describe how the device is used within the bunker	The candidate must produce a kidney shape first and then a fashion an electron cut-out to match the shape. Use of the device should include detailed instructions including distance from the patient, interlocking of applicator, use of cut-out, air gap, set up instructions etc. Description of alloy used & safety precautions.
• Describe the changes in dose deposition profile occurring for different electron beams. Compare different energies (6MeV vs. >/=15MeV), different field sizes (5cm vs. 10 cm), different thickness bolus (0cm vs. 1cm)	Detailed and accurate description of isodose changes – different penetration in relation to energy (requires simple calculation algorithm for choosing correct e- energy, dmax position (+/- bolus) and distal health tissue sparing, penumbra, lateral constriction of isodoses; practical range, maximum range, therapeutic range, buildup region, surface dose (effect of energy, effect of field size), bremsstrahlung contamination, PPD for electron beams (field size effect), output factor, dose profile, beam flatness & symmetry, There is no requirement to use the TPS for this portion, but it may enable candidates to see the differences.