Syllabus for medical physicist examination.

1.Basic Radiation Physics

Atomic Structure, atomic number, mass number, isotopes, radioisotopes, radioactivity, specific activity, general properties of alpha, beta and gamma rays, laws of radioactivity and successive transformations, half-life, decay constant, mean life, natural radioactive series, radioactive equilibrium, artificial radioactivity, production of radioisotopes by neutron and charged particle bombardments, nuclear cross sections.

2. Basic X-ray Physics

Production and properties of X-rays, characteristics and continuous spectra, basic requirements of medical diagnostic and therapeutic tubes, safety devices in X-ray tubes, technology of modern X-ray tubes, insulation and cooling of X-ray tubes, filtration and beam quality, mobile and dental units, malfunctions of X-ray tubes, limitations on loading, control panels, image intensifiers; technology of electron accelerators.

3. Radiation Detection and Measurement

3.1 Principles of Radiation Detection

Basic principles of radiation detection, Gas Filled detectors: Ionisation chambers- Theory and design; Construction of condenser type chambers and thimble chambers; Gas multiplication, Proportional and GM Counters; Characteristics of organic and inorganic counters, dead time and recovery time, solid state detectors (scintillation detectors, semiconductor detectors), Chemical systems: Radiographic and Radiochromic films; Thermoluminescent Dosimeters (TLD), Optically stimulated Luminescence dosimeters (OSLD), radiophotoluminescent dosimeters, neutron detectors, nuclear track emulsions for fast neutrons, solid state nuclear track (SSNTD) detectors, calorimeters.

3.2 Radiation Measuring & Monitoring Instruments

Dosimeters based on condenser chambers, pocket chambers, dosimeters based on current measurement, different types of electrometers- MOSFET, Vibrating condenser and Varactor bridge types; secondary standard therapy level dosimeters, farmer dosimeters, radiation field analyzer (RFA), radioisotope calibrator, multipurpose dosimeter, water phantom dosimetry systems, brachytherapy dosimeters, Thermoluminescent dosimeter readers for medical applications, calibration and maintenance of dosimeters.

Instruments for personnel monitoring, TLD badge readers, glass dosimeter readers, digital pocket dosimeters using solid state devices and GM counters, teletector, industrial gamma radiography survey meter, gamma area (zone) alarm monitors, contamination monitors for alpha, beta and gamma radiation, hand and foot monitors, laundry and portal monitors, scintillation monitors for X-ray and gamma radiations, neutron monitors, tissue equivalent survey meters, flux meter and dose equivalent monitors, pocket neutron monitors, teledose systems.

Instruments for counting and spectrometry, portable counting systems for alpha and beta radiation, gamma ray spectrometers, multichannel analyzers, liquid scintillation counting system, RIA counters,

whole body counters, air monitors for radioactive particulates and gases.

4. Radiation Biology

Interaction of radiation with cells, chomosome aberrations, mutations, potentially lethal and sub-lethal damages, modification of radiation damage, LET, RBE, dose rate, dose fractionation, stochastic and deterministic effects of radiation, acute radiation sickness, LD50/60, effects of radiation on skin, blood forming organs, digestive tract and reproductive system; effects of chronic and acute exposure to radiation, induction of leukemia and radiation carcinogenesis, genetic effects of radiation, physical and biological factors affecting cell survival, chemical and hyperthermic sensitizers, radio-protectors, tumour biology, non-conventional fractionation schemes, high LET radiation therapy, radiobiological basis of radiotherapy, time dose fractionation (TDF) and gap correction, linear quadratic model.

5. Radiotherapy

Benign and malignant tumours, palliative and curative therapy, beam therapy equipments- kV X-ray machine, telecobalt units, medical electron linear accelerators; output calibration procedures for photon and electron beams, dosimetry parameters, patient dose calculations, neutron capture therapy, proton and heavy ion therapy, radioisotopes used in brachytherapy, LDR, MDR, HDR and PDR brachytherapy, remote afterloading brachytherapy units, source strength measurement, integrity checks for 4 sources, treatment planning system (TPS) used in radiotherapy, IMRT/IGRT, recent advances in radiotherapy, patient and occupational safety measures, performance standards and acceptance criteria for radiotherapy equipment, quality assurance (QA) in radiotherapy.

6. Radiation Protection Standards

Radiation dose to individuals from natural radioactivity in the environment and man-made sources, basic concepts of radiation protection standards, International Commission on Radiological Protection (ICRP) and its recommendations, categories of exposures, risk factors, international/national radiation protection standards- ICRP, BSS and AERB, overview of UNSCEAR recommendations, factors governing internal exposures, radionuclide concentrations in air and water and contamination levels, dose limits for occupational workers, general public, comforters and trainees.

7. Radiation Hazard Evaluation and Control

Internal and external radiation hazards, evaluation and control of external radiation hazards, individual and workplace monitoring, application of time, distance and shielding; shielding calculations, planning of medical radiation installations, shielding calculation parameters- workload (W), use factor (U), occupancy factor (T); primary and secondary protective barriers, design and shielding requirements for diagnostic Xray facilities, telecobalt, medical accelerator, brachytherapy installations and medical radioisotope laboratories.

Radiation monitoring instruments, calibration check of monitoring instruments, radiation monitoring procedures for radiation generating equipment and installations, protective measures to reduce radiation exposures to patients and occupational workers, radiation hazards in radioisotope laboratories, protective equipment.

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9. Disposal of Radioactive Waste

Radioactive wastes, sources of radioactive waste, classification of waste, treatment techniques for solid, liquid and gaseous effluents, permissible limits for disposal of waste, sampling techniques for air, water and solid; geological, hydrological, media meteorological and ecological considerations for waste disposal, decontamination procedures.

Disposal of radioactive wastes, general methods of disposal, management of radioactive waste in medical, industrial, agricultural and research facilities.

10. Transport of Radioactive Material

Regulatory aspects of transport of radioactive material (RAM), introduction, terms used (e.g. Competent Authority, A1& A2 values, unilateral & multilateral approvals, special form radioactive material, special arrangement, transport index (TI) etc.), transport scenarios (routine, normal and accidental), variety of packages covered under the transport regulations (including designing, testing, transport and storage); general requirements of all packaging, requirements for transport by air mode, test requirements, preparation, marking, labeling of packages, preparation of transport documents (consignors declaration, TREM Card, instructions to the carrier & emergency preparedness in writing), responsibilities of consignor, general instructions and response to off-normal situations during transport.

11. Regulatory Aspects for Medical Radiation Facilities

National legislation, regulatory framework, relevant regulatory documents such as Act, Rules, applicable safety codes, standards, guides and manuals, radiation surveillance procedures, regulatory controllicensing, inspection and enforcement; responsibilities of employer, licensee, Radiological Safety Officer (RSO), technologist, radiation workers and radioisotope supplier.

Physical protection of sources, safety and security of sources during storage, use, transport and disposal, regulatory requirements for import/export, procurement, use, handling, transfer and disposal of radioisotopes, inventory control, security provisions: administrative and technical measures, security threat and graded approach in security provision, Radiation Protection Programme (RPP).

Radiation Emergencies and Medical Management

Radiation accidents and emergencies in the use of radiation sources and equipment in radiotherapy, nuclear medicine and diagnostic radiology, radiation safety during source transfer operations, source stuck and handling procedures, loss of radiation sources, their tracing and recovery, case studies and lessons learned, Radiation injuries and medical management.

13. Emergency Response Plans and Preparedness

Normal and potential exposures, accident situations involving radioisotopes, elements of emergency planning and preparedness including procedures for notification and line of communication, administrative and technical procedures, emergency response accessories, responsibilities of employer, licensee, RSO, technologist, radiation workers and radioisotope/ equipment supplier in case of emergency.

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