Tamil Nadu Public Service Commission
Syllabus
Medical Physics and Physics
(PG Degree Standard)

Code: 601

UNIT I: Integrated Electronics (10 Questions)
Semiconductor diodes – Transistor – JFET – MOSFET – Thyristor – Rectifier – Operational Amplifier and its Mathematical operations. Active & Passive filters – Oscillators – Relaxation oscillators. Logic gates – Universal Logic gates – Encoder – Decoder – Flip Flops – Counters – A/D and D/A counters – Shift Registers – Multiplexer – Demultiplexer – Microprocessor 8085 – Applications – Voltage regulation using ICs.

UNIT II: Mathematical Physics and Statistics (10 Questions)
Gauss, Green and Stoke's theorem – Applications. Matrix – Eigen value – Eigen vector. Complex numbers – Cauchy Reimann conditions – Analytic function – Bilinear transformation – Conformal mapping – Taylor's series. Fourier series – Fourier transform and its applications.
Statistics: Mean – Median -Mode – Standard deviation – Moments – Skewness – Kurtosis. Binomial, Poisson, Gaussian, Exponential, Bivariate distribution – Correlation and Regression – Chi square, t-, F distribution – Randomness in Monte-Carlo simulation.

UNIT III: Fundamental Radiation Physics (20 Questions)
Atomic Structure – Radiation – Nuclear transformation – Radioactivity and Radioactive decay – Successive disintegration and Equilibrium conditions – Interaction of radiation with matter: Electromagnetic radiation, Charged particles and Neutrons – Radiation quantities and units – Radiation detectors and measurements: Gas filled detectors – Solid state detectors – Personnel and Area monitoring devices.

UNIT IV: Radiation Biology (25 Questions)
Action of radiation on living cells – Radiobiological models: Cell survival curves, Target theory, Linear Quadratic model, Nominal Standard Dose, Time Dose Fractionation, Local effect, Tumor control probability, Normal Tissue Complication Probability based, Extrapolated Response Dose and BED (Biological Effective Dose) model. Fractionation in radiation therapy – 5 R's of radiobiology – Dose rate effect – Oxygen Enhancement Ratio (OER) – Relative Biological Effectiveness (RBE) – Linear Energy Transfer (LET) – Molecular mechanism of DNA and Chromosomal damage and their repair mechanisms – Cell death – Radiosensitizers and Radioprotectors – Biological effects of radiation: Deterministic and Stochastic effects – Acute and Chronic effects – Somatic and Genetic effects – Effects of radiation on Embryo and Fetus.

UNIT V: Radiation Hazards Evaluation and Control (25 Questions)
Radiation protection standards and regulations – Atomic Energy Act – Radiation protection rules – Recommendation of ICRP (International Commission on Radiological Protection), AERB (Atomic Energy Regulatory Board), IAEA (International Atomic Energy Agency) and WHO (World Health Organization) – e-licensing of radiation applications – Key principles of radiation protection: Justification, optimization and dose limits (recommended by AERB & ICRP) – Evaluation of Internal and External radiation hazards – Site layout planning and shielding calculations - Derived Air Concentration (DAC) – Annual Limit of Intake (ALI) – Maximum Permissible Body Burden (MPBB) – Radioactive waste disposal – Radiation emergencies – Medical management, Legislation and Ethics.

UNIT VI: Physics of Radiation Therapy (30 Questions)
History – Physical principles – Components and working of telecobalt and linear accelerator machines – Physics of modern radiotherapy machines: gamma knife, cyber knife, tomotherapy and proton therapy - Planning techniques of 3D Conformal Radio Therapy (3D-CRT), Volumetric Modulated Arc Therapy (V-MAT), Intensity Modulated Radio Therapy (IMRT) - Stereotactic Radio Surgery (SRS) and Stereotactic Radio Therapy (SRT), Image Guided Radiotherapy (IGRT), Stereotactic Body Radio Therapy (SBRT), Total Body Irradiation (TBI), Total Skin Electron Therapy

(TSET) – Dosimetric concepts of photon and electron beam – Beam directing and modifying devices – Radiation dosimetric protocols – Calibration and quality assurance of radiotherapy equipments and treatment planning systems - Radiotherapy simulators - Patient positioning and immobilization devices.

UNIT VII: Physics of Brachytherapy (20 Questions)

Brachytherapy radionuclides and their properties – Classification based on dose rate, implant duration, loading and its applications – Reference exposure rate – Reference air kerma rate and air kerma strength – apparent activity – Brachytherapy dosimetric systems – Calibration and quality assurance of brachytherapy sources, equipment and treatment planning system – Source strength verification using in-air and well type ionization chamber.

UNIT VIII: Physics of Diagnostic Radiology (30 Questions)

X-ray, Production, X-ray tube, Generator Circuits - Accessories: Beam restrictors: Cones, Cylinders, Collimators, Beam filters and grids – Detectors: X-ray film, Intensifying screens – Digital radiography detectors: Computed and Direct Radiography – Diagnostic equipment and Imaging modalities: Physics, Component, Detector technology, Image quality and artifacts of Radiography, Fluoroscopy, Mamography. Computed Tomography: Principle, Generations, Components, Detectors, Reconstruction of images and Artifacts - Quality assurance of diagnostic equipments – PACS (Picture Archiving and Communication System)

Magnetic Resonance Imaging (MRI) – Nuclear Magnetic Resonance (NMR) – Basic principles of MRI – Larmor frequency – Resonance – Mechanisms of Relaxation (T1 & T2) – Signal localization contrast agents – Instrumentation of MRI – MRI safety – MRI sequences - Image quality and artefacts.

UltraSonoGraphy (USG) – Production and properties of ultrasound – Acoustic impedence – ultrasound beam characteristics – Interaction of ultrasound with tissue – Ultrasound display modes – Tissue harmonic imaging – Doppler ultrasound systems – Elastography – Bio effects of ultra sound – Image Quality & Artifacts.

UNIT IX: Physics of Nuclear Medicine (20 Questions)

Radionuclides and their properties – Scintillation counters – Different types of collimators – Gamma camera: Single head and dual head scanners – Emission tomography – Single Photon Emission Computed Tomography (SPECT) – Positron Emission Tomography (PET) – Production of radioisotopes for nuclear medicine procedure – Technetium generator – Radiopharmaceuticals and their clinical applications – Therapeutic applications of radiopharmaceuticals – Quality assurance and Radiation safety procedures in handling and disposing radionuclides.

UNIT X: Medical Lasers and Biomedical Instrumentation (10 Questions)

Theory and production of medical lasers – Optical properties of tissues – Laser tissue interaction mechanism – Applications of lasers in medicine – Hazards of lasers and their safety measures.

Electrocardiography (ECG) – Electroencephalography (EEG) – Electromyography (EMG) – Physiological assist devices – Pacemakers – Defibrillators – Heart Lung machine – Diathermy and Dialysis units: Hemo and Peritonial dialysis – Blood cell counter.

Dated: 17.11.2025