Syllabus for Entrance Examination

Master in Medical Physics (MMP)

2025

Medical Education Commission

Sanothimi, Bhaktapur

Introduction:

Nepal has made significant strides in advancing postgraduate medical education across various specialties, with the aim of producing competent professionals who can deliver evidence-based, high-quality healthcare within the country. The fields of diagnostic radiology and radiation oncology have witnessed tremendous development since the introduction of ionizing radiation for medical use in Nepal in 1923. Today, with a rising global and national incidence of cancer, there has been a corresponding surge in institutions offering advanced radiation therapy, diagnostic radiation and nuclear medicine services. Despite this long history and growing infrastructure, Nepal lacks a formal educational program to produce Clinically Qualified Medical Physicists (CQMPs), as defined and recommended by the International Atomic Energy Agency (IAEA). Medical physicists are essential professionals who ensure the safe, accurate, and effective use of radiation in diagnosis and treatment.

Currently, the medical physics workforce in diagnostic radiology, nuclear medicine, and radiation therapy centers in Nepal relies on professionals who have been educated or trained abroad. This group remains limited in number and is insufficient to meet the rapidly growing national demand. Such dependence is unsustainable and represents a significant long-term challenge for the country's healthcare system. To address this urgent national need, National Academy of Medical Sciences (NAMS) is taking a pioneering initiative to start a Master in Medical Physics (MMP). This MMP program aims to provide students with the foundational knowledge required to enter a formal clinical residency, systematically produce IAEA aligned CQMPs to support and lead radiation-based healthcare services and enhance the safety, quality, and self-reliance of Nepal's cancer care and diagnostic imaging infrastructure.

Eligibility:

a. BSc Physics or equivalent
b. Candidate should score minimum of 50^{th} percentile in the entrance examination conducted by Medical Education Commission for being eligible to be in the merit list

Examination Format:

a. Question type: Single best response type of multiple-choice questions
b. Option: Four options (A, B, C, D)
c. Number of questions: 200
d. Full marks: 200 with negative marking of 0.25 for each wrong answer
e. Cognitive ratio: Recall: Understanding: Application - 50:30:20
f. Duration: 3 hours

Subjects Grouping and Weightage:

S.N.	Subject Grouping	Marks (Weightage)	Total Marks
Group A			
1	Nuclear Physics	15	45
2	Modern Physics	15	
3	Solid State Physics	15	
Group B			
4	Quantum Mechanics	20	60
5	Mathematical Physics	15	
6	Research Methodology and Statistics	10	
7	Thermodynamics	10	
8	Statistical Physics	5	
Group C			
9	Wave and Optics	10	30
10	Electronics	10	
11	Electricity and Magnetism	10	
Group D			
12	Mechanics	10	45
13	Classical Mechanics	10	
14	Material Science	10	
15	Space Science and Applied Mathematics	10	
16	Econophysics	5	
Group E			
17	Physics of Imaging	5	20
18	Physics of Radiation Therapy	5	
19	Radiation Protection	5	
20	Radiobiology	5	

Subject Contents:

1. **Nuclear Physics**: Nuclear forces, Nuclear reactions, Nuclear models, Nuclear reactors, Cosmic rays, Elementary particles, Interaction of radiation with matter
2. **Modern Physics**: Atomic structure, Many electron system, Atomic spectra, Particle properties of waves, X-ray spectrum, Nuclear structure, Nuclear transformations, Particle detectors and accelerators
3. **Solid State Physics**: Types and structure of crystals, Crystal structure from diffraction, Bonding in crystals, Defects in crystals, Lattice dynamics, Free electron theory, Band structure of crystals, Semiconductors, Superconductivity, Dielectric properties, Magnetism
4. **Quantum Mechanics**: Introductory wave mechanics, Quantum mechanical wave propagation, Operator formalism in quantum mechanics, Postulates of quantum mechanics,

One dimensional quantum mechanical problems, Harmonic oscillator and applications, Quantum mechanical problems and solutions, Central potential problems

5. **Mathematical Physics:** Vector analysis, Tensor analysis, Linear vector spaces, Fourier series and transforms, Differential equations, Partial differential equations.
6. **Research Methodology and Statistics:** Introduction to research, Research methods, Tools and methods of data collection, Sampling, Data analysis and synthesis, Measurement and scaling, Task of writing research, Basic concept of statistics, Generation of hypothesis, Application of statistical analysis in hypothesis testing
7. **Thermodynamics:** Thermodynamic fundamental concepts, Laws of thermodynamics and their application, Thermodynamic relations, Concept of ideal and real gases, Production of low temperature, Transport phenomenon, Black body radiation.
8. **Statistical Physics:** Classical statistical physics, Introduction to quantum statistical physics
9. **Wave and Optics:** Wave nature of light, Aberration at spherical surfaces, Interference, Diffraction, Polarization, Dispersion and scattering, Lasers, Holography
10. **Electronics:** Network theorems, Semiconductor and diodes, Bipolar junction transistors, Amplifiers, Operational amplifiers, Feedback amplifier, Oscillators, FET and UJT, Digital electronics and logic gates
11. **Electricity and Magnetism:** Elementary vector analysis, Electrostatic potential and field, Electric fields in dielectrics, Magnetic fields of moving charges, Magnetic properties and fields, Electromagnetic inductions, Varying currents, Alternating current circuit, Maxwell's electromagnetic equations
12. **Mechanics:** Laws of motion, Linear and angular momentum, Gravitational potentials and fields, Dynamics of rigid bodies, Harmonic oscillator, Wave motion, Elasticity, Fluid mechanics
13. **Classical Mechanics:** Motion in central field, Elastic and inelastic collision, Constraints, Variational principles and Lagrange’s equations, Inertial frames, Motion of rigid bodies, Relativity
14. **Material Science:** Synthesis of materials, Atomic structures and bonding, Structure of crystalline solids, Imperfections in solids, Phase diagrams, Mechanical properties of metals, Failure of metals, Mechanical properties of ceramics and polymers, Electrical properties of materials, Magnetic properties of materials, Thermal properties of materials, Optical properties of materials, Science of nanomaterials, Processing of materials, Economic, environmental and societal issues in material science

15. **Space Science and Applied Mathematics:** Space systems, Physics of remote sensing, Earth system, Astronomy, Space dynamics, Plasma in space, Applications of differential equation, Electric circuit theory, Particle dynamics, Rigid dynamics, Applications of Fourier series, Applications of partial differential equations
16. **Econophysics:** Efficient market hypothesis, Random walk, Levy stochastic processes and limit theorems, Scales in financial data, Stationery and time correlation
17. **Physics of Imaging:** X-ray, USG, Fluoroscopy, CT, MRI, PET-CT, SPECT, Mammogram
18. **Physics of Radiation Therapy:** Radioisotopes, Linear accelerator, Cobalt-60, Brachytherapy
19. **Radiation Protection:** Principles of radiation protection
20. **Radiobiology:** DNA, RNA, Cell cycle and cell death, Oxygen enhancement ratio, Relative biological effectiveness, Dose rate and fractionation