

Ph.D. in Medical Physics

Paper II: Recent Advances in Medical Physics

| Sr. No. | Topic | Details | Contact Hours |
|---------|--|--|---------------|
| 1 | Advanced Radiation Therapy Techniques | <ul style="list-style-type: none">- Intensity-modulated radiation therapy (IMRT) advancements- Volumetric modulated arc therapy (VMAT)- Stereotactic body radiation therapy (SBRT)- Stereotactic radio surgery (SRS)- Adaptive radiation therapy techniques | 3 |
| 2 | Particle Therapy Physics | <ul style="list-style-type: none">- Proton therapy beam delivery systems- Heavy ion therapy physics- Relative biological effectiveness modelling- Monte Carlo simulations in particle therapy | 3 |
| 3 | Image-Guided Radiation Therapy | <ul style="list-style-type: none">- Cone-beam CT image guidance- MRI-guided radiation therapy- PET Guided RT- Real-time tumor tracking systems & motion management- Fiducial and surface guidance technologies- Adaptive radiation therapy techniques | 3 |
| 4 | Advanced Medical Imaging Physics | <ul style="list-style-type: none">- Dual-energy CT physics and applications- Functional MRI techniques- PET CT/PET MRI hybrid systems | 3 |
| 5 | Radiation Dosimetry Advancements | <ul style="list-style-type: none">- 3D/4D dosimetry systems & phantoms- Small field dosimetry techniques (Active & passive)- Advance dosimetry protocols in Teletherapy & Brachytherapy | 3 |
| 6 | AI & Machine Learning in Medical Physics | <ul style="list-style-type: none">- AI applications in treatment planning- Deep learning for image segmentation & delineation- Predictive models for treatment outcomes- Automated quality assurance systems | 3 |
| 7 | Brachytherapy Physics | <ul style="list-style-type: none">- High dose rate (HDR) brachytherapy innovations- Electronic brachytherapy sources- 3D image-based brachytherapy planning- In vivo verification methods | 3 |
| 8 | Radiation Protection and Safety | <ul style="list-style-type: none">- Low-dose radiation effects- Novel radiation shielding materials- Personnel monitoring advancements- Radiation safety in new modalities | 3 |
| 9 | Clinical Perspectives | <ul style="list-style-type: none">- Radiation Biology- Fractionation and regimes- BED & EQD2 | 3 |
| 10 | Quality Assurance & audits in Radiotherapy | <ul style="list-style-type: none">- End-to-end QA for advanced techniques- Statistical process control in radiotherapy- Patient-specific QA methodologies | 3 |

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| | | - Automated QA tools and software - Audits | |
| 11 | Computational Medical Physics | - GPU-accelerated dose calculation algorithms - Deformable image registration techniques - Radiomics and texture analysis - Virtual and augmented reality applications | 3 |
| 12 | Emerging Technologies | - FLASH radiotherapy & physics - Nanotechnology in radiation oncology | 3 |

Total Contact Hours: 36