PH.D. PRE-COURSE WORK EXAMINATION SYLLABUS

Paper II: Recent Advances in Radiology & Imaging Technology

Sr. No.	Topic	Details	Hours
1	Advanced MRI Techniques	- Functional MRI (fMRI): principles, BOLD effect, resting-state fMRI - Diffusion Tensor Imaging (DTI): principles, tractography, applications in neuroimaging - Perfusion imaging: DSC, DCE, and ASL techniques - MR Spectroscopy: single-voxel and multi-voxel techniques, metabolite quantification	3
2	Molecular Imaging	- PET-CT: principles, radiotracers (FDG, PSMA, amyloid tracers), quantification methods - PET-MRI: technology, attenuation correction - SPECT-CT: principles, applications in cardiac and bone imaging - Radiomics and radiogenomics: machine learning integration, clinical applications	3
3	Artificial Intelligence in Radiology	- Machine learning algorithms: supervised, unsupervised, and reinforcement learning - Deep learning in image analysis: CNNs, GANs, transfer learning - Computer-aided detection and diagnosis (CAD): lung nodules, breast lesions, brain tumors - AI in workflow optimization and report generation	3
4	Interventional Radiology Advances	- Image-guided therapies: CT, MRI, and ultrasound technical guidelines - Embolization techniques - Tumor ablation: radiofrequency, microwave, cryoablation, irreversible electroporation - Vascular interventions: angioplasty, stenting, thrombectomy devices- applications	3
5	Dual-Energy CT and Spectral Imaging	- Principles of dual-energy CT: photoelectric effect, Compton scattering - Material decomposition techniques: basis material decomposition, virtual monoenergetic imaging - Clinical applications: vascular imaging, urinary stone characterization, gout imaging - Radiation dose considerations and optimization in dual-energy CT	3

Sr. No.	Topic	Details	Hours
6	Advanced Ultrasound Techniques	- Contrast-enhanced ultrasound: microbubble contrast agents, kinetic models - Elastography: strain and shear wave techniques in various organs - 3D/4D ultrasound: fetal imaging - High-frequency ultrasound and photoacoustic imaging	3
7	Radiation Dose Optimization	- Iterative reconstruction algorithms: statistical and model-based approaches - Low-dose protocols: pediatric imaging techniques - Dose monitoring and tracking systems: dose registries, decision support tools - Patient-specific dosimetry and risk assessment	3
8	Hybrid Imaging Systems	- PET-MRI: technical challenges, MR-based attenuation correction, clinical applications - SPECT-CT: principles, applications in oncology and infection imaging - PET-CT advancements: digital detectors, total-body PET - Clinical applications and comparative effectiveness of hybrid imaging	3
9	Quantitative Imaging Biomarkers	- Development of imaging biomarkers: identification, validation, qualification - Standardization efforts: QIBA, EIBALL initiatives - Biomarkers in oncology: tumor volume, ADC, SUV, radiomics features - Biomarkers in neurology: brain volumetry, white matter integrity, cerebral blood flow	3
10	Novel Contrast Agents	- Nanoparticle-based contrast agents: iron oxide nanoparticles, quantum dots and its uses. - Molecular probes for specific targeting: antibody-conjugated agents, activatable probes - Multimodal contrast agents: PET/MRI agents, theranostic agents - Safety considerations and regulatory aspects of novel contrast agents	3
11	3D Printing in Radiology	- 3D printing technologies: FDM, SLA, material jetting - Image segmentation and 3D model creation from medical images - Applications in surgical planning: complex fractures, congenital heart defects - Patient-specific phantoms for quality assurance and training - Legal and ethical considerations in 3D printing of medical models	3

Sr. No.	Topic	Details	Hours
12	Teleradiology and Cloud-based PACS	- Advancements in image sharing: DICOM web, vendor-neutral archives - Remote diagnosis: workstation requirements, reporting systems - Collaborative platforms: second opinion networks, multidisciplinary team meetings - Security and privacy considerations in cloud-based imaging - Integration of AI tools in teleradiology workflows	3

Total Hours: 36

Dr. Purnachandra Lamghare
Professor and HoD
Department of Radiodiagnosis, DYPMC

Dr. Abhay Saraf
Director
Dr. D.Y. Patil School of Allied Health Sciences