दिल्ली विश्वविद्यालय
University of Delhi

कुलसचिव | *Registrar*

No. Acad.-I/Ph.D./2025/467
03rd September, 2025

NOTIFICATION

Sub: Guidelines for Ph.D. Coursework

The departments of the University offer Ph.D. Programmes in their respective disciplines. As mandatory part of this programme, Ph.D. coursework is being conducted by every department. It has been noticed that there are variations in pattern of the course works which are being taught in various disciplines. Thus, to bring uniformity in the Ph.D. coursework across the disciplines, the following guidelines have been formulated to be made effective from the Academic Year 2025-26.

1 The total credit required for Ph.D. coursework ranges from 12 to 16 credits. The distribution of minimum 12 credits is as follows:

a. Research Methodology
Or
Advanced Research methodology (for students who have already studied Research Methodology) — **4 Credit**

b. Research Publication Ethics — **2 Credits**
c. Research Tools — **2 Credits**
d. Discipline Specific Elective Course (Relevant to the research areas) — **4 Credits**

Additional 4 credits may be obtained from a DSE, if required. This will be applicable in specialised area and such course(s) should not have been offered at PG studies

2 Teaching hours of the Ph.D. coursework are included in the workload of faculty.

3 The courses offered in the Ph.D coursework should be of higher level than those offered in the post-graduate programmes

3/9/25

REGISTRAR

FACULTY OF MEDICAL SCIENCES
UNIVERSITY OF DELHI

16.07.2026

PhD COURSE WORK

Ph.D. Course Work Requirements

All candidates enrolled in the Ph.D. Programme of the Faculty of Medical Sciences, University of Delhi, are required to complete the prescribed coursework for the requisite credits in accordance with the applicable regulations.

Each Ph.D. scholar shall maintain a **Course Work Log Book** documenting attendance and completion of the prescribed coursework.

Candidates are required to complete a **minimum of 320 hours** of coursework, equivalent to **12–16 credits**, during the **first two semesters** of the Ph.D. programme.

The coursework shall comprise the following **Compulsory and Optional Courses**:

Note:

1. **Course Content – Topics 1 to 9** are **compulsory** for all Ph.D. scholars.
2. In addition, each candidate shall complete **a minimum of four topics** from the optional topics.
3. Individual Departments may prescribe additional subject-specific coursework or topics, as deemed appropriate for candidates registered in their respective Ph.D. disciplines.
4. The coursework is aligned with the **end-of-second-semester Ph.D. Course Work Examination**, which shall comprise the following papers. The syllabus for each paper shall be as specified in the **Course Work Syllabus**:

   Paper I: Course Content listed under **Serial Nos. 1–3**

   Paper II: Course Content listed under **Serial Nos. 4–6**

   Paper III: Course Content listed under **Serial Nos. 7–9**

   Paper IV: Subject-specific topics and/or optional topics, including any additional department-prescribed coursework, as applicable.

Coursework Syllabus

S. No.	Compulsory Topic		Hours	Methods
1.	**Research Methodology**	i. Framing a Research Question ii. Epidemiological methods in Research	35	Lectures, Seminar, Workshop
		iii. Qualitative Research Methods iv. Quantitative Research Methods		
2.	**Ethics in biomedical Research**	i. Theories and Principles of Ethics.	35	Lectures, Seminar, Workshop
		ii. Concepts in research ethics - confidentiality and privacy, informed consent, vulnerable subjects arid special treatment, standards of care - principles, review processes etc. iii Involving human subjects		
		iv. Involving animals		
		v. Involving living tissues		
		vi. Guidelines ICMR, CPCSEA, GCP, etc		
3	**Intellectual Property Rights (IPR)**	Definition and objectives	10	Lectures, Seminar, Workshop.
		Application of IPR in research & development and disadvantages		
		Benefits and critics associated with IPR implementation		
		Patent application		
4.	**Biostatistics**	i. Hypothesis testing	40	Lectures, Seminar, Exercise, Workshop
		ii. Estimating sample size for a cross-sectional survey and case control study		
		iii. Standard measures		
		iv. Confidence interval		
		v. Parametric & Non Parametric methods		
		vi. General methodology in Biostatistics		
		Vii. Metanalysis/systematic review		
		Viii. Introduction to data analysis – introduction to various data analysis software such as SPSS etc.		

5.	**Good Clinical laboratory practices (GCLP)**	Introduction, objectives and key requirements	20	Lectures, Seminar, Workshop, Field visits
		History of GCLP and Relation to other regulations		
		Role of GCLP in basic research and drug discovery		
		Principle, procedure and applications of 'accreditation' as per guidelines of Accreditation bodies like ISO, NABH, NABL, IPHS, WHO etc.		
6	**Bio-safety/Waste Management**	Rationale, definition and classification of bio-hazardous/Biomedical waste	20	Lectures, Seminar, Workshop, Field visits
		Impact of different types of waste generated in a healthcare facility		
		Legislative-regulatory policy aspects		
		Standard procedures for proper handling storage and transportation of medical waste		
		Bio-safety issues with:- Chemical, Radiation, Microbiological waste etc.		
7.	**Protocol preparation**	Choosing a research topic for the Ph.D. thesis, framing research questions and formulating a hypothesis	50	Lectures, Seminar, Workshop.
		Literature Search. Identifying Aims & Objectives of Research Methodology		
		Various study designs including cross-sectional, case control and cohort etc.		
		Sample selection procedure and inclusion / exclusion criteria.		
		Translational value		
8.	**Scientific communication**	• Conference presentations • Scientific communication. • How to write a scientific paper. • Indexing of Journals • Bibliography • Preparing a Research Grant proposal. • Critical Review of Scientific articles	30	Lectures, Seminar, Workshop.

9.	**Computer Skills**	• MS Excel • Power Point • MS Words • Photoshop etc.	10	Lecture, Seminar, Course work at computer centre.

Optional Topics:

Note: The Candidate may select four topics from here.

In addition, the department may specify other topics as relevant for the candidate's work.

S. No	Optional Topics		Hours	Methods
10.	**Bioinformatics**	• Introduction to Bioinformatics • Primer designing • Analysis of DNA sequences and their interpretation • ORF finder	20	Lecture, Seminar, Demonstration Lab Work.
11.	**Assays**	• Principles and uses of spectrophotometer, luminescence assay • ELISA and its principles • Flow cytometry its methodology & use • HPLC: Procedure and analysis • FISH: Methods and applications • Other analytical methods	20	Lecture, Seminar, workshop laboratory work whenever applicable field visits
12.	**Molecular Biology Techniques**	• Immunohistochemistry methods – manual & automated • Electrophoresis of DNA/RNA • Quantitative Real Time polymerase chain reactor • Sequencing technique – sangers, NGS • Cell/Tissue Culture methods • Electron Microscopy/confocal microscopy	20	Lecture, Seminar, workshop laboratory work whenever applicable field visits
13	**Drug development & discovery**	• Process of drug discovery & development • Pharmacokinetic/Pharmacodynamic • Methods of preparing plant extracts. • Standardization & Characterization of drug from plants	20	Lecture, Seminar, workshop laboratory work whenever applicable
14	**Clinical trials**	Definition, type & conduct of clinical trials guidelines GCP guidelines Pharmacovigilance	16	Lecture, Seminar, workshop laboratory work whenever applicable

15.	**Immunology basic Issues**	Molecular concepts of Immunology, innate and adaptive immunity.	16	Lecture, Seminar, workshop laboratory work whenever applicable
		Use of hematopoietic stem cells: extraction, Culture Techniques & guidelines		
		Transplantation: Acute & Chronic rejection and their mechanism		
		Immune dysfunction: Autoimmune and hypersensitivity diseases		
		Vaccines: development and recent advances		
		Applications of immunological principles in immunotherapy of cancer and immune diagnostics of diseases.		
16.	**Nutrition**	Principles of Nutrition	8	Lecture Seminar
17.	**National Health Programs**	National Health Program Disease prevention and control	16	Lecture Seminar
18	**Other topics**	**As decided by the individual departments**		

Dean (Medical)

FACULTY OF MEDICAL SCIENCES
UNIVERSITY OF DELHI

10.08.2026

PhD COURSE WORK

Paper IV: The course specific topics and/or optional topics of the department of Anatomy prescribed coursework for Ph.D.

Unit	Title	Topics	Credit Score	Hours	Methods
I	**Advances in Gross, Regional and Applied Anatomy**	• Regional anatomy of head and neck, thorax, abdomen, pelvis and limbs• Anatomical variations and their clinical significance• Three-dimensional anatomical relationships• Surface and applied anatomy• Anatomical basis of clinical and surgical procedures• Contemporary approaches to dissection and prosection• Anatomical reconstruction and morphometry	**01**	**15**	Interactive lectures; dissection/prosection demonstrations; case-based discussions; seminars; journal clubs
II	**Advances in Neuroanatomy and Neuroscience**	• Functional and clinical neuroanatomy• Central, peripheral and autonomic nervous systems• Neural connectivity and functional networks• Brainstem, cerebellum and basal ganglia• Higher cortical and limbic systems• Neurovascular anatomy• Spinal cord pathways• Neuroanatomical basis of neurological disorders• Advanced neuroimaging and tractography	**01**	**15**	Interactive lectures; neuroanatomical demonstrations; imaging-based learning; case conferences; journal clubs
III	**Advances in Histology, Cell Biology and Tissue Biology**	• Microscopic organization of tissues• Cellular architecture and tissue specialization• Histogenesis and tissue renewal• Cell–cell and cell–matrix interactions• Extracellular matrix biology• Immunohistochemistry and molecular histology• Digital histology and image analysis• Tissue response to injury, ageing and disease	**01**	15	Microscopy/digital slide sessions; laboratory demonstrations; seminars; journal clubs; research workshops
IV	**Developmental Anatomy, Embryology and Craniofacial Biology**	• Molecular regulation of embryonic development• Organogenesis and morphogenesis• Developmental signalling pathways• Congenital anomalies• Craniofacial development and neural crest	**01**	15	Interactive lectures; embryology demonstrations; developmental case discussions; seminars; journal clubs

Unit	Title	Topics	Credit Score	Hours	Methods
		biology• Development of cardiovascular, gastrointestinal and urogenital systems• Developmental genetics and epigenetics• Fetal and neonatal anatomy			
V	**Clinical, Surgical and Radiological Anatomy**	• Clinical and surgical anatomy• Anatomical basis of minimally invasive and robotic procedures• CT, MRI and ultrasound anatomy• Endoscopic anatomy• Interventional and procedural anatomy• Anatomical variations and procedural safety• 3D reconstruction and virtual anatomy• Image-guided anatomy• Anatomy of complex clinical conditions	**01**	**15**	Imaging workshops; surgical demonstrations; case-based learning; multidisciplinary conferences; 3D visualization
VI	**Molecular, Regenerative and Translational Anatomy**	• Molecular basis of tissue organization• Cell signalling and tissue differentiation• Stem cells and tissue regeneration• Tissue engineering and biomaterials• Molecular anatomy and spatial biology• Genomics, transcriptomics and proteomics• Organoids and advanced cellular models• Tissue remodelling and ageing• Translational applications of anatomical research	**01**	**15**	Advanced seminars; laboratory demonstrations; journal clubs; experimental workshops; critical appraisal of research
VII	**Digital, Computational and Integrative Anatomical Sciences**	• Digital anatomy and virtual dissection• 3D anatomical modelling and reconstruction• Computational anatomy and morphometry• AI and machine learning in anatomical research• Image segmentation and quantitative imaging• 3D printing and anatomical models• Virtual and augmented reality• Anatomical databases and digital repositories• Integration of structural, functional and imaging data	**01**	**15**	Technology demonstrations; hands-on workshops; computer-based projects; seminars; journal clubs
VIII	**Research Methodology, Biostatistics and Emerging Approaches in Anatomical Sciences**	• Research design in anatomical sciences• Cadaveric, dissection-based and morphometric research• Histological and molecular research methods• Imaging-based research• Experimental and translational models• Biostatistics and quantitative analysis• Systematic reviews	**01**	**30**	Research methodology workshops; hands-on practical sessions; statistical/data-analysis exercises; journal clubs; proposal development;

Unit	Title	Topics	Credit Score	Hours	Methods
		and meta-analysis• Research ethics, including cadaveric research ethics•			laboratory demonstrations

19/8/2026

Prof. Anita Mahajan,
Head of the Department, Anatomy
Delhi University, Chairperson

19/8/26.

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19/8/2026

FACULTY OF MEDICAL SCIENCES
UNIVERSITY OF DELHI

13.08.2026

PhD COURSE WORK

Paper IV: The Course specific topics and/or optional topics of the Department of Biochemistry prescribed coursework for Ph.D.

S. No.	Topic	Credit Score	Hours	Instruction Strategy
1	pH, buffers and indicators; Basic Chemistry of carbohydrates, lipids and proteins; DNA and RNA chemistry; Principles of molecular biology – replication, transcription and translation; Radio – isotopes in research – Scintillation, autoradiography; centrifugation	01	15Hrs.	Group discussion/Lecture
2	Molecular Biology Techniques – Nucleic acid extraction, PCR; Electrophoresis	01	30Hrs.	Discussion followed by practical exercise
3	Optical techniques – spectrophotometry, luminescence, fluorescence, phosphorescence; proteomics – Polyacrylamide gel electrophoresis	01	30Hrs.	Discussion followed by practical exercise
4	Immunological Techniques – ELISA; Proteomics – Chromatography – paper chromatography/HPLC/GC – MS/LC – MS	01	30Hrs.	Discussion followed by practical exercise

1. The Ph.D. candidates should not be involved in clinical work.
2. The degree as well as the advertisement should preferably carry a disclaimer that the Ph.D degree is based on the successful completion of the thesis work and the degree doesn't not provide any clinical acumen for patient management in the aforementioned broad specialty in which the Ph.D degree has been awarded.

Binita 13/8/26.

Prof. Binita Goswami,
Head of the Department, Biochemistry
DU, Chairperson

FACULTY OF MEDICAL SCIENCES
UNIVERSITY OF DELHI

PhD COURSE WORK

02.09.2026

Paper IV: The course specific topics and/or optional topics of the department of Dental Science prescribed coursework for Ph.D.

S. No.	Topic	Content / Details	Credit Score	Hours	Teaching-Learning Methods
I	**Advances in Conservative Dentistry and Endodontics**	• Contemporary concepts in dental caries and minimally invasive dentistry • Adhesive and biomimetic restorative dentistry • Pulp biology and mechanisms of pulpal disease • Advances in endodontic diagnosis and treatment • Regenerative endodontics and pulp regeneration • Endodontic biomaterials and tissue engineering • Digital technologies and emerging approaches in restorative dentistry	1	15	Interactive lectures; seminars; case-based discussions; journal clubs; hands-on demonstrations
II	**Advances in Oral Medicine and Radiology**	• Contemporary concepts in diagnosis of oral mucosal diseases • Potentially malignant oral disorders and oral cancer • Oral manifestations of systemic diseases • Advanced dental imaging and digital radiology • CBCT and three-dimensional imaging • MRI and ultrasonography in oral diseases • AI-assisted diagnosis and image analysis • Salivary and point-of-care diagnostics	1	15	Case-based learning; image interpretation; seminars; journal clubs; imaging demonstrations
III	**Advances in Oral and Maxillofacial Surgery**	• Contemporary approaches to oral and maxillofacial surgery • Management of maxillofacial trauma • Oral and maxillofacial infections • Cysts and benign/malignant lesions • Reconstructive and regenerative approaches • Implant and pre-implant surgery • Computer-assisted surgery and navigation • 3D planning and emerging surgical technologies	1	15	Case-based learning; seminars; surgical demonstrations; multidisciplinary discussions; journal clubs

Kanwaljeet Kaur

IV	**Advances in Oral and Maxillofacial Pathology and Oral Microbiology**	• Molecular basis of oral diseases • Oral pathology and clinicopathological correlation • Oral potentially malignant disorders and neoplasia • Oral microbiome and microbial dysbiosis • Host–microbiome interactions • Molecular pathology and biomarkers • Immunohistochemistry and molecular diagnostic techniques • Genomics and epigenetics in oral diseases	I	15	Seminars; clinicopathological conferences; microscopy/digital pathology demonstrations; journal clubs; laboratory demonstrations
V	**Advances in Orthodontics and Dentofacial Orthopedics**	• Craniofacial growth and development • Molecular and cellular basis of orthodontic tooth movement • Contemporary concepts in malocclusion • Skeletal and dentoalveolar growth modification • Digital orthodontics and 3D imaging • Clear aligner therapy and emerging technologies • AI and digital treatment planning • Orthodontic biomaterials and tissue response	I	15	Interactive lectures; seminars; case discussions; digital technology demonstrations; journal clubs
VI	**Advances in Pediatric and Preventive Dentistry**	• Developmental biology of the dentition • Early childhood caries and risk assessment • Preventive and minimally invasive dentistry • Pediatric oral health and systemic interactions • Behavioural approaches to pediatric dental care • Special-care dentistry • Developmental anomalies and genetic disorders • Emerging preventive and regenerative approaches	I	15	Case-based learning; seminars; problem-based discussions; community/clinical demonstrations; journal clubs
VII	**Advances in Periodontology**	• • Pathogenesis of periodontal diseases • Periodontal inflammation and systemic diseases • Oral microbiome and host response • Periodontal regeneration and tissue engineering • Biomarkers of periodontal disease • • Regenerative and precision approaches in periodontology	I	15	Seminars; case-based discussions; journal clubs; laboratory demonstrations; research paper appraisal
VIII	**Advances in Prosthodontics and Oral Rehabilitation**	• Contemporary fixed and removable prosthodontics • Implant-supported rehabilitation • Maxillofacial prosthodontics • Dental biomaterials and biocompatibility • CAD/CAM and digital prosthodontics • 3D printing and additive manufacturing • Digital smile design and aesthetic rehabilitation • Functional and patient-reported outcomes	I	15	Interactive lectures; technology demonstrations; case presentations; hands-on workshops; journal clubs

IX	**Advances in Public Health Dentistry and Population Oral Health**	• Epidemiology of oral diseases • Oral health inequalities and social determinants • Community-based oral health programmes • Oral health promotion and behavioural interventions • Preventive dentistry at population level • Geriatric and special-needs oral healthcare • Dental health policy and health economics • Teledentistry and digital population health	I	15	Interactive lectures; field visits; community-based projects; data interpretation; seminars; group discussions

Head of the Department, Dental Science
DU, Chairperson

FACULTY OF MEDICAL SCIENCES
UNIVERSITY OF DELHI

22.09.2026

PhD COURSE WORK

Paper IV: The course specific topics and/or optional topics of the department of Medical Microbiology prescribed coursework for Ph.D.

S. No.	Topic	Credit Score	Hours	Methods
1	Collection, transport & storage of samples for Microbiology	01	15 Hrs.	
2	Bacterial Culture	01	15 Hrs.	
3	Methods of AST	01	15 Hrs.	
4	Bacterial genetics & mechanism of AMR	01	15 Hrs.	
5	Staining methods in Microbiology	01	15 Hrs.	
6	Automated blood culture systems	01	15 Hrs.	
7	Biosafety levels & containments	01	15 Hrs.	

Prof. Rumpa Saha,
Head of the Department, Medical Microbiology
DU, Chairperson

FACULTY OF MEDICAL SCIENCES
UNIVERSITY OF DELHI

Dated : 16.09.2026

PhD COURSE WORK

Paper IV: The course specific topics and/or optional topics of the department of Pathology prescribed coursework for Ph.D.*

S. No.	Topic		Credit Score	Hours	Methods
1	**Hematology Principles & Techniques**	• Microscopy & Staining (Giemsa and Special stains) • Principles and uses of spectrophotometer, luminescence assay, Mass spectrometry. • ELISA and its principles • Flow cytometry its methodology & use • HPLC/Capillary zone electrophoresis: Procedure and analysis • FISH and its applications • Other related techniques in Hematology	01	15	Lecture, Seminar, laboratory work
2	**Molecular Biology Techniques**	• Electrophoresis of DNA/RNA/protein • PCR and its types : Techniques and Applications • Sequencing technique – Sangers, NGS • Cell/Tissue Culture methods /HSC • Electron Microscopy/Confocal Microscopy	01	15	Lecture, Seminar, laboratory work
3	**Basics of Pathology : General Pathology, Immunology and Cytopathology (Principles & Techniques)**	• Basic Principles of general pathology • Concepts of Immunology. • Immune dysfunction: Autoimmune and hypersensitivity diseases • Microscopy & Staining in Cytopathology • Fluid processing • Cell Block, LBC and other Cyto techniques	01	15	Lecture, Seminar, laboratory work
4	**Histopathology Techniques**	• Microscopy & Staining (H & E and Special stains) • Gross and frozen Techniques • Tissue processing and Slide making • Immunohistochemistry methods – manual & automated • FISH & Cytogenetics	01	15	Lecture, Seminar, laboratory work

***It is a responsible of Supervisor that there is no duplicacy in selecting the optional credits.**

16/9/26 16/9/26 16/9/26. 16/9/26

Head of the Department, Pathology
DU, Chairperson

PhD Coursework in Physiology

Paper IV: Optional Topics

Unit	Title	Topics	Hours	Methods
I	**Molecular and Cellular Advances in Physiology**	• Ion channels, transporters, and membrane physiology • Cellular signalling pathways and signal transduction	20	Lectures, Seminars
II	**Cognitive, Sleep and Neurophysiology**	• Neurophysiology of cognition and executive functions Evoked and event-related potentials. • Sleep physiology and circadian rhythm regulation	20	Lectures, Seminars, Practicals/ Demonstrations
III	**Integrative Autonomic and Cardiovascular Physiology**	• Electrocardiography Autonomic regulation of cardiovascular function • Heart rate variability and autonomic balance Autonomic function testing	30	Lectures, Seminars, Practicals/ Demonstrations
IV	**Exercise, Environmental and Respiratory Physiology**	• Integrative physiology of exercise and physical training • Adaptation to extreme environments (altitude, heat, cold) • Occupational and environmental physiology Lung function tests	20	Lectures, Seminars, Practicals/ Demonstrations
V	**Lifestyle, Mind–Body and Ageing Physiology**	• Yoga, meditation, and mind–body physiology • Ageing and physiological adaptations	20	Lectures, Seminars, Practicals/ Demonstrations
VI	**Modern Tools and Translational Approaches in Physiological Research**	• Biomarkers in physiological research • Wearable devices and digital physiology • Electrophysiological techniques (EEG, EMG, evoked potentials)	30	Lectures, Seminars, Practicals/ Demonstrations

Farah Khaliq

Dr. Farah Khaliq
Head of the Department, Physiology
FMSc, University of Delhi.

FACULTY OF MEDICAL SCIENCES
UNIVERSITY OF DELHI

24.07.2026

PhD COURSE WORK

Paper IV: The course specific topics and/or optional topics of the department of Radiology prescribed coursework for Ph.D.

S. No.	Topic	Credit Score	Hours (106 Hrs.)	Methods
1.	Advanced Imaging Physics, equipment, techniques, image formation, image quality optimization in USG, CT, MRI and hybrid imaging.	01	(26.50 Hrs.)	Lecture Seminar workshop
2.	Radiation Biology & Radiation Safety.	01	(26.50 Hrs.)	Lecture Seminar workshop
3.	Subspecialty Radiology (any one):	01	(26.50 Hrs.)	Lecture Seminar workshop
4.	Artificial Intelligence & Informatics in Radiology	01	(26.50 Hrs.)	Lecture Seminar workshop

Prof. R. S. Solanki,
Head of the Department, Radiology
Delhi University, Chairperson

1. Advanced Imaging Physics, equipment, techniques, image formation, image quality optimization in USG, CT, MRI and hybrid imaging. Contrast media.

1. Fundamentals of Medical Imaging Physics

- Electromagnetic radiation and wave physics, X-ray production and beam characteristics, Photon interactions with matter, Attenuation mechanisms, Radiation quantities and units, Signal generation and detection, Image formation principles across imaging modality, Digital image acquisition, Detector technologies, Noise sources in medical imaging, Spatial, contrast and temporal resolution, Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR), Detective Quantum Efficiency (DQE), Modulation Transfer Function (MTF), Noise Power Spectrum (NPS), Figure of Merit (FOM)

2. Ultrasound Imaging Physics and Technology

Physics

Piezoelectric effect, Ultrasound wave propagation, Acoustic impedance, Reflection, refraction, scattering, Attenuation mechanisms, Beam formation, Beam steering and focusing, Harmonic imaging, Tissue harmonic imaging, Pulse inversion imaging, Spatial compounding

Equipment

Transducer design, Linear, convex, phased array, matrix probes, Beamformer architecture, Front-end electronics, Digital signal processing, Doppler hardware, Elastography hardware, High-frequency ultrasound systems

Advanced Imaging Techniques

B-mode optimization, Color Doppler, Power Doppler, Spectral Doppler, Vector flow imaging, Superb Microvascular Imaging (SMI), Contrast-enhanced ultrasound (CEUS), Elastography (Strain, Shear wave), 3D/4D ultrasound, Fusion imaging, Navigation-guided ultrasound, AI-assisted ultrasound

Image Quality Optimization

Frequency selection, gain optimization, Dynamic range, Time gain compensation, Focus placement, Depth optimization, Doppler angle correction, PRF optimization, Wall filter adjustment, Aliasing reduction, Artifact recognition and correction, Quality assurance and phantom testing

3. Computed Tomography (CT)

Physics

X-ray tube technology, Detector physics, Data acquisition geometry, Slip-ring technology, Helical scanning, Pitch, Multi-detector CT, Cone beam geometry, Spectral imaging, Photon counting CT, Reconstruction mathematics

Equipment

Gantry components, Tube design, High-frequency generators, Detector arrays, Data acquisition systems, Automatic exposure control, ECG gating, Injector systems, Iterative reconstruction hardware, AI reconstruction platforms

Advanced Techniques

Dual-energy CT, Spectral CT, Photon-counting CT, Dynamic perfusion CT, Cardiac CT, CT angiography, Low-dose CT, Organ dose modulation, Metal artifact reduction, Quantitative CT, Radiomics-enabled CT

Image Quality Optimization

kVp selection, mAs optimization, Automatic tube current modulation, Pitch optimization,

Slice thickness selection, Reconstruction kernel selection, Iterative reconstruction, Deep-learning reconstruction, Motion correction, Beam hardening correction, Partial volume reduction, Image quality metrics, CT dose optimization, DRLs, CTDIvol, DLP, SSDE

4. Magnetic Resonance Imaging (MRI)

Physics

Nuclear magnetic resonance, Spin physics, Relaxation mechanisms, T1, T2, T2*, Proton density, K-space, Fourier transformation, Gradient systems, RF coils, Signal generation, Pulse sequences

Equipment

Magnet systems, Superconducting magnets, Shim systems, RF transmit-receive systems, Gradient hardware, Coil technology, Cryogenics, MRI safety systems

Advanced Imaging Techniques

Parallel imaging, Compressed sensing, Diffusion MRI, Diffusion tensor imaging, Diffusion kurtosis imaging, IVIM, Perfusion MRI, Functional MRI, MR spectroscopy, Susceptibility imaging, Quantitative MRI, Cardiac MRI, Whole-body MRI, MR elastography, Synthetic MRI, AI reconstruction

Image Quality Optimization

Parameter optimization, TR, TE, Flip angle, Bandwidth, Matrix, FOV, Slice thickness, Coil selection, Parallel imaging optimization, Motion reduction, Artifact suppression, SAR optimization, SNR optimization

5. Hybrid Imaging

PET/CT

Coincidence detection, Scintillation detectors, TOF PET, Digital PET, Attenuation correction, Scatter correction, Reconstruction algorithms, SUV quantification, Respiratory gating, Dose optimization

PET/MRI

MRI-based attenuation correction, Motion correction, Quantitative PET, Simultaneous acquisition, Clinical applications

SPECT/CT

Gamma camera physics, CZT detectors, Collimator selection, Reconstruction, Quantitative SPECT

Emerging Hybrid Systems

Total-body PET, Digital PET, PET photon-counting CT, AI-enabled hybrid imaging

6. Digital Image Processing

Digital image representation, Sampling, Quantization, Histogram analysis, Window width and level, Spatial filtering, Frequency filtering, Image enhancement, Edge detection, Segmentation, Registration, Fusion, Texture analysis, Quantitative imaging biomarkers, Radiomics preprocessing

7. Image Quality Assessment

Objective Metrics

SNR, CNR, MTF, NPS, DQE, Uniformity, Geometric accuracy, Spatial resolution, Contrast resolution, Artifact quantification

Subjective Assessment

Visual grading analysis, Visual grading characteristics, Observer performance studies, ROC analysis, Interobserver agreement, ICC and kappa statistics

Contrast Media:

X-ray and CT Contrast Agents

- Iodinated contrast media
- Ionic and non-ionic agents

- High-, low-, and iso-osmolar contrast media
- Monomeric and dimeric compounds
- High-concentration contrast agents
- Blood-pool contrast agents

MRI Contrast Agents

- Gadolinium-based contrast agents (GBCAs)
- Linear and macrocyclic GBCAs
- Extracellular agents
- Hepatobiliary-specific agents
- Blood-pool agents
- Organ-specific agents
- Iron oxide nanoparticles
- Manganese-based agents
- Emerging non-gadolinium agents

Ultrasound Contrast Agents

- Microbubble contrast agents
- Second-generation microbubbles
- Targeted microbubbles
- Phase-change nanodroplets
- Contrast-enhanced ultrasound (CEUS)

Nuclear Medicine Contrast/Radiotracers

- PET radiotracers
- SPECT radiopharmaceuticals
- Hybrid imaging contrast principles
- Theranostic agents

2. Radiation Biology & Radiation Safety.

- Molecular mechanisms of radiation-induced DNA damage and repair.
- Cellular responses to radiation (apoptosis, senescence, genomic instability, bystander effects).
- Deterministic and stochastic radiation effects, including fetal and pediatric considerations.
- Radiation dosimetry, including CTDI, DLP, SSDE, effective dose, and organ dose estimation.
- Optimization principles (ALARA/ALADA/ALADAIP) and Diagnostic Reference Levels (DRLs).
- Radiation protection strategies for patients, healthcare workers, and the public.
- Occupational radiation monitoring and shielding design for diagnostic and interventional imaging facilities.
- MRI and ultrasound safety, including SAR, implant safety, and ultrasound bioeffects.
- International and Indian regulatory frameworks (ICRP, IAEA, ICRU, UNSCEAR, AERB).
- Quality assurance, radiation safety audits, and emergency preparedness.
- Biological dosimetry, radiation biomarkers, and radiogenomics.
- Emerging research areas such as low-dose radiation biology, AI-enabled dose optimization, and precision radiobiology.

3.Subspecialty Radiology (any one):

Neuroradiology, Cardiothoracic imaging, Musculoskeletal imaging, Breast imaging, Fetal imaging, Pediatric radiology, Abdominal imaging, Genitourinary imaging, Emergency imaging, Interventional Radiology, oncology Imaging.

- **Neuroradiology:** DWI, DTI, perfusion MRI, fMRI, SWI, MR spectroscopy, ASL, vessel wall imaging, stroke imaging, neuro-oncology.
- **Cardiothoracic Imaging:** Cardiac CT/MRI, coronary CTA, FFR-CT, HRCT, ILD, pulmonary embolism, quantitative lung imaging.
- **Musculoskeletal Imaging:** Advanced MRI, cartilage imaging, bone marrow disorders, sarcopenia, musculoskeletal ultrasound, elastography.
- **Breast Imaging:** Digital breast tomosynthesis, contrast-enhanced mammography, breast MRI, BI-RADS, image-guided biopsy, AI applications.
- **Fetal Imaging:** High-resolution obstetric ultrasound, fetal neurosonography, fetal MRI, placental imaging, Doppler assessment.
- **Pediatric Radiology:** Pediatric protocol optimization, congenital anomalies, low-dose imaging, whole-body MRI, pediatric oncology imaging.

- **Abdominal Imaging:** Multiparametric liver MRI, MRCP, elastography, CT/MR enterography, quantitative liver imaging.
- **Genitourinary Imaging:** Multiparametric prostate MRI (PI-RADS), CT/MR urography, female pelvic MRI, pelvic floor imaging.
- **Emergency Imaging:** Polytrauma CT, FAST/eFAST, acute stroke imaging, vascular emergencies, AI-assisted emergency triage.
- **Interventional Radiology:** Image-guided biopsy, embolization, vascular interventions, tumor ablation, fusion imaging, navigation systems.
- **Oncologic Imaging:** RECIST/iRECIST/PERCIST, whole-body MRI, PET/CT, PET/MRI, radiomics, theranostics, and precision oncology imaging.

4. Artificial Intelligence & Informatics in Radiology

- Fundamentals of machine learning, deep learning, and foundation AI models.
- Medical image analysis, including classification, segmentation, detection, registration, and quantitative image analysis.
- Radiomics, radiogenomics, and quantitative imaging biomarker development.
- AI-assisted image reconstruction, denoising, artifact reduction, and low-dose imaging.
- Radiology informatics, including RIS, PACS, HIS/EHR integration, and DICOM, HL7, FHIR, and RadLex standards.
- Clinical validation of AI systems, performance metrics, bias assessment, calibration, and external validation.
- Explainable AI (XAI), trustworthy AI, and human–AI collaboration.
- AI ethics, privacy, cybersecurity, and regulatory frameworks for medical AI.
- Big data analytics, federated learning, cloud computing, and imaging data management.
- Emerging technologies, including generative AI, vision-language models, multimodal AI, digital twins, and intelligent imaging ecosystems.
- Teleradiology
- Robotics in imaging
- AI research methodology, dataset curation, benchmarking, reporting guidelines (CLAIM, TRIPOD-AI, CONSORT-AI, STARD-AI), and MLOps. Machine learning, deep learning, radiomics, PACS, RIS, DICOM, AI validation, ethics of AI.

FACULTY OF MEDICAL SCIENCES
UNIVERSITY OF DELHI

09.09.2026

PhD COURSE WORK

Paper IV: The course specific topics and/or optional topics of the department of Surgery prescribed coursework for Ph.D.

S. No.	Topic	Major Areas / Topics	Credit Score	Hours	Methods
1.	**Advances in Surgical Sciences, Anatomy and Pathophysiology**	• Applied surgical anatomy and anatomical variations • Surgical inflammation and immune response • Wound healing and tissue repair, Novel concepts. • Surgical stress response and metabolic changes • Ischemia–reperfusion injury • Infection and surgical sepsis • Surgical microbiome and host–microbiome interactions	**01**	15	Interactive lectures; seminars; case-based discussions; laboratory demonstrations; journal clubs
2.	**Advances in Breast, Endocrine and Soft-Tissue Surgery**	• Contemporary management of benign and malignant breast diseases • Molecular biology and genetics of breast cancer • Breast-conserving and reconstructive approaches • Thyroid and parathyroid disorders • Adrenal and neuroendocrine surgical disorders • Molecular and functional imaging in endocrine surgery • Soft-tissue tumours and sarcomas • Sentinel lymph-node techniques and image-guided surgery • Precision and personalized surgical approaches	**01**	15	Case-based learning; multidisciplinary tumour boards; imaging demonstrations; surgical videos; seminars; journal clubs
3.	**Advances in Gastrointestinal and Hepatobiliary Surgery**	• Esophageal, gastric and colorectal diseases • Inflammatory bowel disease • Gastrointestinal malignancies • Liver and biliary tract diseases	**01**	**15**	Case conferences; operative video analysis; imaging workshops; journal

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		• Pancreatic disorders and surgery • Portal hypertension • Bariatric and metabolic surgery • Organ-specific biomarkers and precision surgery			clubs
4.	**Advances in Trauma, Emergency and Acute Care Surgery**	• Principles of trauma systems and damage-control surgery •Point-of-care ultrasound and rapid diagnostics • Trauma systems, triage and disaster surgery • Polytrauma and major haemorrhage • Thoracic, abdominal and vascular trauma • Traumatic brain injury: surgical considerations • Burns and thermal injuries • Acute intestinal ischemia • peritonitis • Sepsis and septic shock • Diabetes / Diabetic foot • Novel Markers	**01**	15	Simulation-based learning; trauma case discussions; emergency surgical demonstrations; multidisciplinary simulations; journal clubs
5.	**Minimally Invasive, Robotic and Image-Guided Surgery**	• Principles of laparoscopic surgery • Advanced minimally invasive procedures • Robotic surgery and telesurgery • Image-guided and navigation-assisted surgery • Fluorescence-guided surgery • Intraoperative ultrasound • 3D reconstruction and virtual surgical planning • Surgical simulation and skills assessment • Artificial intelligence and computer-assisted surgery • Digital surgery and surgical ergonomics	**01**	15	Hands-on workshops; surgical simulation; operative video analysis; technology demonstrations; journal clubs
6.	**Surgical Oncology, Reconstruction and Regenerative Surgery**	• Neoadjuvant and multimodal cancer treatment • Oncoplastic and reconstructive surgery • Tissue engineering and regenerative surgery • Biomaterials and surgical implants • Organ preservation and transplantation principles	**01**	15	Multidisciplinary tumour boards; advanced seminars; laboratory demonstrations; journal clubs
7.	**Perioperative Medicine, Surgical Critical Care and Integrated Surgical Sciences**	• Preoperative risk assessment and optimisation • Perioperative nutrition and metabolic support • Fluid, electrolyte and acid–base management	**01**	15	Case-based learning; critical-care simulations;

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		• Postoperative pain and recovery • Surgical-site infection and antimicrobial stewardship • Anastomotic complications and wound complications • Enhanced Recovery After Surgery (ERAS) • Quality of life and patient-reported outcomes • Quality improvement and patient safety • Surgical outcomes			multidisciplinary conferences; data interpretation; seminars; journal clubs
8.	**Research Methodology, Biostatistics and Emerging Technologies in Surgery**	• Research design in surgical sciences: Randomized controlled trials, Cohort, case-control and registry-based research, epidemiological research • Comparative effectiveness and outcomes research • Systematic reviews and meta-analysis • Biostatistics: survival analysis, Surgical risk prediction and clinical decision models • AI and machine learning in surgical care • Surgical innovation and technology assessment • Health economics and cost-effectiveness of surgical interventions • Data management and research integrity • Scientific writing and publication ethics • Grant writing and research proposal development	**01**	15	Research methodology workshops; hands-on statistical/data-analysis sessions; journal clubs; research proposal development; seminars
9.	**Molecular biology**	• Molecular biology of surgical cancers •Tumour microenvironment and cancer progression • Precision surgical oncology • Immunotherapy and targeted therapy • Stem-cell-based approaches	**01**	15	Interactive lectures; seminars; laboratory demonstrations; journal clubs

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Head of the Department, Surgery
DU, Chairperson