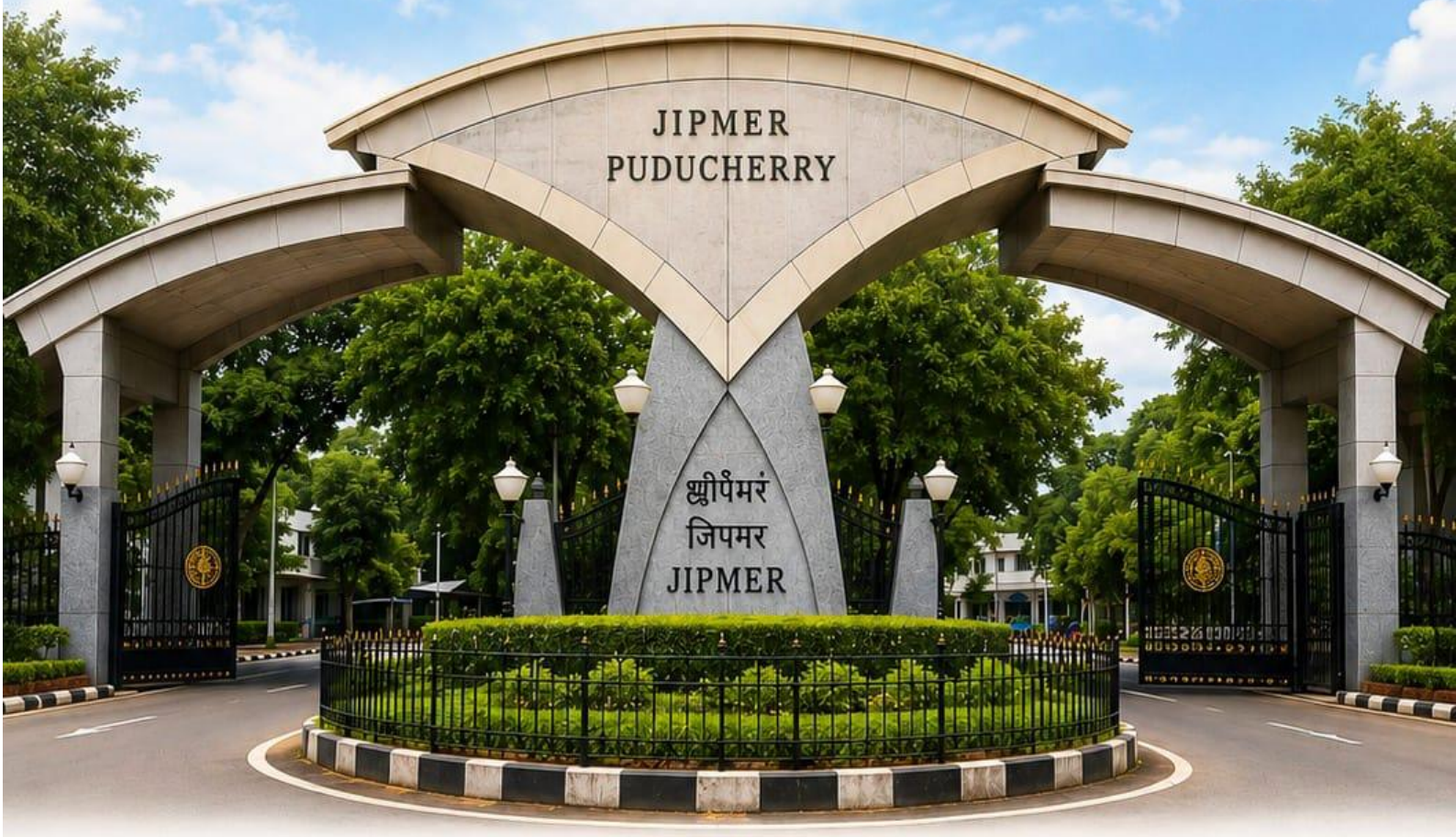
# CURRICULUM

# POSTGRADUATE

## MD Radiodiagnosis

From July 2026 session




JAWAHARLAL INSTITUTE OF POSTGRADUATE MEDICAL EDUCATION AND RESEARCH (JIPMER),
PUDUCHERRY – 605 006.

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This curriculum was approved at the 19th meeting of the Standing Academic Committee held on 28th January 2026 and ratified at the 22nd meeting of the Governing Body and will be applicable for students joining MD Radiodiagnosis from the July 2026 session.

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## GOAL OF THE COURSE

To train a postgraduate to possess knowledge, skills, attitudes, values and responsiveness to meet the following needs in the society

Performance of imaging and imaging-related preventive, diagnostic, therapeutic and rehabilitative work in healthcare; using modalities that work with x-ray radiation (computer radiography, digital radiography, mammogram, fluoroscopy systems, computed tomography etc.), ultrasound and nuclear magnetic resonance (Magnetic resonance imaging).

Scholarship in imaging (life-long learner, teacher, researcher)

# TERMINOLOGY

## Key-capabilities

They refer to the practices carried out by the specialists as part of their professional services. They represent the services required from them, by patients, students, other medical/paramedical staff or the society in general.
Thus, they refer to the specific tasks that the postgraduate will be expected to do after he completes the course.
For the purpose of training, the tasks are broken down into units that have distinct cognitive concepts, unless they are predominantly procedural or attitude based.

## Core ideas in practice of Key-capabilities

They refer to the ideas that underly the practice of the specialists. They include ideas and concepts about structure and functioning of organs and organ systems in health and diseases, classification of diseases, equipment, tests, drugs etc.

# COURSE CONTENT

1. Key-capabilities (outline below, details in Annexure 1 (Part A))
2. Core ideas in the practice of key-capabilities (outline below, details in Annexure 1 (Part B))
3. Peripheral postings (details in Annexure 1 (Part C) and under 'Educational strategy)

(Please refer Annexure 1 for details)

**OUTLINE**

| **KEY-CAPABILITIES** | |
|---|---|
| 1 | Modality Procedures with Diagnostic Interpretation |
| 2 | Pre-Procedure evaluation |
| 3 | Image-Guided Interventions |
| 4 | Formulation of imaging strategy for clinical scenarios |
| 5 | Generation of Patient Reports for Unfamiliar Imaging Patterns/Findings |
| 6 | Management of emergency in radiology suite |
| 7 | Communication skills |
| 8 | Research |
| 9 | Teaching-learning |
| **Learning objectives for key-capabilities in practice of radiology** | |

| **CORE IDEAS IN THE PRACTICE OF KEY-CAPABILITIES** | |
|---|---|
| 1 | Normal imaging anatomy - to be identified |
| 2 | Embryology relevant to congenital diseases seen in imaging |
| 3 | Principles of functioning of imaging equipment |
| 4 | Image acquisition techniques and views in radiographs, ultrasound |
| 5 | Variant anatomy in clinically normal people - to be recognised |
| 6 | Modality specific artifacts and appearances - to be recognised |
| 7 | Clinically useful patterns - Display logical approach and differential diagnosis |
| 8 | Peripheral speciality (Nuclear Medicine) - To optimise imaging strategy |
| 9 | Guidelines, Regulations and Classifications |
| 10 | Diseases to be diagnosed |
| 11 | Artificial intelligence in medical imaging |

# LEARNING RESOURCES

**Recommended learning resources/books**

First year

1. Christensen's Physics of Diagnostic Radiology
2. Farr's physics for medical imaging
3. Manual of Diagnostic Ultrasound - WHO
4. Sanders' Clinical Sonography – A Practical Guide
5. Burgener, Francis A._ Kormano, Martti_ Pudas, Tomi - Bone and joint disorders_ Differential diagnosis in conventional radiology-Thieme
6. Yochum And Rowes - Essentials Of Skeletal Radiology
7. The Chest X-Ray: A Survival Guide

Second Year

1. Grainger & Allison's Diagnostic Radiology
2. Webb, Müller and Naidich's High-Resolution CT of the Lung
3. CT and MRI of the Whole Body – John Haaga
4. Diagnostic Ultrasound 5th Edition, Carol M. Rumack Deborah Levine
5. Orthopaedic Imaging: A Practical Approach 4th Edition; by Adam Greenspan
6. Callen's Ultrasonography in Obstetrics and Gynaecology Edition; Author Mary Norton

Third Year

1. Osborn's Brain: Imaging, Pathology, and Anatomy
2. Pediatric Neuroimaging – James Barkovich
3. Catherine Westbrook, Carolyn Kaut Roth, John Talbot-MRI in Practice-Wiley-Blackwell
4. Caffey's Pediatric Diagnostic Imaging, 2-Volume Set, 13th Edition; Author: Brian D. Coley

# EDUCATIONAL STRATEGY

Image-based discussion (case presentation) - every day in the morning for 45 minutes (8.15 am to 9 am)

Participation in multi-disciplinary team meetings - once or twice every week

Seminars - every day in the evening for 45 minutes (4.15 to 5 pm)

Every week, 2 cases are worked up and entered in an online logbook by each student

Journal clubs to discuss recent advances

*Formative assessment is done for each of the above activities and feedback is given

**Postings within department (in months)**

| Semester | US | EMS US | DOP | FL | HN&T CT | AC&V CT | MG | Br MRI | Bd MRI | INT | PP |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I | 1 | 1 | 1 | 1 | 1 | | | | | | |
| II | 1 | 1 | 1 | 1 | | 1 | 1 | | | | |
| III | 1 | 1 | | 1 | 1 | 1 | 1 | | | | |
| IV | 2 | 1 | 1 | | 1 | 1 | | | | | |
| V | 1 | | | | 1 | 1 | | 1 | 1 | 1 | |
| VI | | | | | | | | 2 | 2 | 0.5 | 0.5 |

- **US** – Ultrasound
- **EMS US** – Emergency Ultrasound
- **DOP** – Doppler
- **FL** – Fluoroscopy
- **HN&T CT** – Head, Neck & Thorax CT
- **AC&V CT** – Abdomen, Cardiac & Vascular CT
- **MG** – Mammography
- **Br MRI** – Brain MRI
- **Bd MRI** – Body MRI
- **INT** – Interventions
- **PP** – Peripheral Posting

**Peripheral posting**

(Please refer Annexure 1C (Part C) for details)

List of Departments

1. Nuclear Medicine

The student will be assessed in the nuclear medicine department. Attendance and feedback will be sent to the Department of Radiodiagnosis.

**Dissertation**

- A research project should be undertaken and dissertation must be submitted as per Postgraduate Research Monitoring Committee (PGRMC) guidelines of JIPMER.
- Two hard copies of the dissertation, prepared from the research project, should be submitted to the Dean (Academics) JIPMER, at two and half years of the course to become eligible to appear for the final examination at the end of the course, as per the guidelines of JIPMER.
- Six monthly interim presentations of the dissertations will be done to monitor the progress of the research work and take corrective measures when faced with difficulties.
- **Please refer to Postgraduate Dissertation Regulations and Postgraduate Examination Regulations document for further details**

# WORKPLACE OBSERVATION

## Logbook

(Please refer Annexure 2 for sample forms)

1. A consolidated record of the number of cases, done independently and with assistance, of each procedure type, is entered as per the format in **Annexure 2**. Each entry is made with date and certified by faculty.

2. Detailed workup of selected cases (2 cases, selected every month from the posting in different places ) will be maintained by the student and entered in the logbook.

3. Record of academic activities (at department, institute or outside institute level) to be entered in the logbook are as follows

i. Presentation in department seminars
ii. Presentation in journal clubs along with Title, Journal and Issue presented
iii. Conferences attended - National/International
iv. Papers presented at conferences with title, name and issue of the journal, certified by faculty.
v. Papers published with title, name and issue of the journal, certified by the faculty
vi. Peripheral postings - Feedback forms obtained for academic presentations in other departments and during peripheral postings will be attached as annexure.

4. Record of co-scholastic activities, if any

## Workplace observation scheme (submitted along with internal assessment marks)

(Please refer Annexure 3 for sample forms)

The day to day activities in practice and learning of the student will be observed and recorded in the "workplace observation form" at the end of every posting or monthly
Assessment of logbook is to be done at the same time instances, and entry made in the "workplace observation form" by the faculty.
Feedback, as part of formative assessment is given to students, by faculty, during these time instances.

## ASSESSMENT

### Marks

| Exam | Marks | Description |
|---|---|---|
| Theory exit examination | 400 marks | This is the written exam at the end of the course. Four theory examination papers as given in the curriculum document of the course. |
| Practical exit exam | 400 marks | This is the practical examination at the end of the course. The detailed scheme is given in the curriculum document of the course. |
| Internal Assessment | Internal assessment Theory: 50 marks | Two exams should be conducted - one at the end of first year and the other at the end of second year.<br><br>Portions for the examination and pattern of the examination must be notified to the students at least one month in advance.<br>The pattern of the internal assessment test will be similar to one paper of the theory exit examination.<br><br>Two faculty members will evaluate the paper of each candidate in a blinded manner and the average of the 2 scores will be taken as the final score for the internal assessment. If a resident misses one of the tests due to medical reasons (medical certificate from a faculty member of the treating department and duly forwarded by the HoD to the Dean (Academic)), he/she can be permitted to appear in the test that is held for the next batch 6 months later. This can be permitted only once in the course period. If a resident does not attend an internal assessment test, or if he/she fails to attend the rescheduled test due to medical reasons, the score will be considered as 0 for the test. No retests or re-evaluation will be permitted under any circumstances.<br><br>The internal assessment marks should be communicated to the students within two months of conducting the exams.<br><br>Internal assessment test marks will be added to the final aggregate to the tune of 100 marks (theory and practical). There is no cut off of internal assessment test scores for determining eligibility to appear in the exit examination or to decide pass/fail solely based on the internal assessment test scores.<br><br>However, when a student secures less than 50% |

| | | |
|---|---|---|
| | | marks in the internal assessment or when any concern is formally raised by the student with the Dean office, a review board with at least 3 faculty members should be constituted to review the student's performance with the student, recommend appropriate remedial measures, document the remedial plan, and submit a signed copy of the document to the Dean's Office.<br><br>Additional periodic assessments can be held as part of formative assessment. Scores of these tests will not be considered for internal assessment and will not be considered for replacing scores of any of the internal assessment tests.<br><br>Information to be provided to the Dean Office, before the final examination.<br>1. Dates of internal assessment examinations conducted<br>2. Names of faculty members involved in assessment against each date<br>3. Marks obtained by students in theory, practical and workplace-based observation in each exam session<br>4. Internal assessment marks for each student for Theory, Practical and Workplace based assessment. An average of the two theory and practical tests will be used to calculate scores for 50 and 25 marks respectively. Cumulative workplace-based assessment scores will be determined for 25 marks.<br>5. Copy of review documentations for periods of low performance of a student, if any, with remedial measures suggested by the departmental committee. |
| Internal Assessment (Practical and Workplace-based assessment) | Internal assessment Practical: 25 marks<br><br>Internal assessment Workplace-based | For practical examinations, all members of the faculty of the department, from Assistant Professor to the senior-most faculty, shall participate in internal assessment on a rotating basis. The assessment shall be planned such that multiple faculty members are engaged for each student and different faculty members are engaged for the two assessments, wherever feasible. The pattern prescribed in the curriculum document shall be followed for practical assessments and the score shall be adjusted for 25 marks.<br><br>Workplace-based assessment marks are given based on practice of the profession and affective domain attributes in the workplace and in the learning environment. |

| | | |
|---|---|---|
| | assessment: 25 marks | Workplace observation proforma should be provided to students at the time of joining the department.<br>The method of workplace observation should be explained to the students at the beginning of the course. |
| Dissertation | 100 marks | Dissertation marks will be calculated by the average of the scores provided by 2 external examiners.<br>Approval of the dissertation with more than 50% scores awarded by the external examiners will be one of the eligibility criteria for appearing for the exit examination of the discipline. |
| Total | 1000 marks | **Criteria for PASS:**<br>1. (a) A candidate will need to pass the final Theory Exit Exam and Practical Exit Exam independently. (b) A minimum of 50% marks in 'Theory Exit exam' (a minimum of 40% in each of the four papers) and 50% in 'Practical Exit exam' separately shall be mandatory<br>2. A candidate should also score 50% or above in the final aggregate marks (500 out of 1000) to pass in the degree course.<br>If a student secures a pass score in theory and practical examination but fails in the aggregate score, he/she can re-appear in the exit examination of the subsequent session. There is no provision to improve internal assessment or dissertation scores. |
| **Please refer to Postgraduate Examination Regulations document for further details** | | |

**Syllabus for Exams**

**The Internal Examination syllabus may be subject to revision based on academic requirements.**

**Theory Exit Exam**

Written exam is conducted in the form of four papers as described below:

Paper – I

Imaging anatomy and Imaging physics
Imaging related Physiology/Pathology/Pharmacology/Biochemistry

Paper-II
Principles and interpretation of Radiography, USG, CT & MRI in the diagnosis of diseases of the: Musculoskeletal System
Respiratory System

Cardiovascular
System Breast
Pediatric, oncoimaging, emergency radiology, and interventional procedures related to above.

Paper - III

Principles and interpretation of Radiography, USG, CT & MRI in the diagnosis of diseases of the:

Gastrointestinal
System Genito-
urinary System
Obstetrics
Radiology
Gynaecology
Pediatric, oncoimaging, emergency radiology, and interventional procedures related to above

Paper - IV

Principles and interpretation of radiography, USG, CT & MRI in the diagnosis of diseases of the:

Central Nervous System
Ent/Orbit/Teeth
Endocrine Radiology
Modern Imaging/Recent Advances
Pediatric, oncoimaging, emergency radiology, and interventional procedures related to above

**Practical Exit Exam**

| | **Marks** |
|---|---|
| Long case ( 1 item * 80 ) | 80 |
| Short case (2 items * 40) | 80 |
| Spotters (40 items * 2) | 80 |
| Viva voce | 80 |

Viva-voce will include:

- Radiation Physics and regulations
- Radiographic techniques, Radiological procedures
- Imaging equipment and quality assurance
- Interventional Procedures, instruments used in intervention
- Contrast
- Nuclear medicine

# MODEL THEORY QUESTION PAPERS

## M.D. DEGREE EXAMINATION – RADIODIAGNOSIS

### PAPER - I - Imaging anatomy, Imaging physics, Imaging related Physiology/ Pharmacology/Pathology/Biochemistry

Time : 3 hours Maximum marks : 10 x 10 marks = 100 marks

1. a. Draw a diagram of the female pelvic floor and describe the components of each compartment
   b. Explain how the components are altered in different degrees of uterine prolapse
   c. Mention one most appropriate MRI sequence for imaging these patients with rationale for the same ( 4+4+2)

2. List 4 developmental abnormalities of the pancreas that can be visualized by imaging. Explain the embryologic basis of each and the clinical relevance of the abnormalities. (4X2.5 )

3. Define the following. What attributes of image quality are altered by these and why? Suggest measures to optimize image quality with respect to these effects.
   a. penumbra effect b. heel effect (5+5)

4. Describe the Nyquist theorem. What are its implications in doppler ultrasound? Give an example of a clinical situation in which it is applicable. (10 marks)

5. Describe the
   a) Underlying physics principle of elastography used in ultrasound with diagram
   b) Compare and contrast strain elastography from stress elastography.
   c) List 4 organs in which elastography is useful with their clinical application in it ( 6+2+2)

6. Describe the difference between deterministic and stochastic effects of radiation and give two examples for each effect. Describe radiation protection measures that must be adopted to reduce radiation dose at the level of a. population b. patients c. radiation employees. (4 + 6)

7. Describe the cause of and correction measures that can be done for the following CT artifacts
   a. ring artefact
   b. beam hardening - streaking artefact
   c. partial volume artefact d. Stair-step artefact (4X2.5)

8. a) List the differences between paramagnetic, diamagnetic, and ferromagnetic materials with one example for each.
   b) Compare and contrast T2 from the T2* sequence in terms of underlying physics and imaging appearance.
   c) Mention any 4 clinical conditions where SWI has a role. (4+4+2)

9. List hypersensitivity reactions to intravenous iodinated radiographic contrast media while classifying them as mild, moderate and severe. Describe the management of any three SEVERE hypersensitivity reactions to contrast media giving rationale for drugs used. (2.5 + 7.5)

10. a. Describe the rotator cuff muscles in terms of their origin, insertion and function.
    b. Describe the landmarks to identify Couinauds segmental anatomy of the liver in Computed Tomography with illustrative schematic drawing. (6+4 marks)

## M.D. DEGREE EXAMINATION – RADIODIAGNOSIS

### PAPER-II Imaging of the chest, cardiovascular system, musculoskeletal system and breast (including corresponding paediatric, emergency, interventional and onco imaging)

Time : 3 hour. Maximum marks : 10 x 10 marks = 100 marks

1. Classify cardiomyopathy (1995 WHO classification) and list the most common causes of each type. List the MRI sequences to evaluate the same. Construct a flowchart to make a diagnosis based on these sequences (3+2+5)

2. A 2- week old neonate presented with cyanosis and respiratory distress. List 4 differential diagnosis for this patient. Provide a diagnostic approach while describing imaging appearances to plan management of the patient for any two of the most likely differentials? (2+8)

3. a. Describe the patient preparation and procedure for performing CT coronary angiography b. Compare and contrast imaging findings of vulnerable plaques from stable plaques. Describe two life-threatening coronary artery variants that can be identified by CT. (4+4+2)

4. a. Classify interstitial lung diseases as per aetiology b. Compare and contrast the imaging findings of smoking-related interstitial lung diseases. (3+7)

5. A 45-year-old male patient is planned for trans catheter aortic valve replacement. How will you evaluate him before surgery using imaging? (10 marks)

6. A 27-year-old young basketball player presented with recurrent anterior dislocation of the shoulder. Describe his preoperative imaging evaluation with the possible imaging appearances. (10 marks)

7. A 8-year-old child presented with fever, pain, and swelling in the right lower thigh for 2 weeks. No history of trauma was present. List the differential diagnosis. List 4 subtypes of Osteosarcoma and compare and contrast their imaging appearances (2+8)

8. (i) Classify diffuse cystic diseases of the lung according to age.
(ii) Describe the computed tomography features and the pathophysiological/anatomic basis for the CT features of a. Congenital lobar emphysema b. Congenital cystic adenomatoid malformation of lungs (2 + 2*4 marks)

9. Describe and explain the imaging manifestations of sarcoidosis in the a. chest b. joints and bone (7 + 3 marks)

List indications for breast MRI. List sequences used in Breast MRI. Define in breast MRI A. non-mass enhancement B. Kinetic curve assessment and describe how it should be reported as per BIRADS. (1+ 3+ 6 marks)

## M.D. DEGREE EXAMINATION – RADIODIAGNOSIS

### PAPER – III Imaging of gastrointestinal tract and abdomen, urogenital tract, obstetrics & gynaecology ( (including corresponding paediatric, emergency, interventional and onco imaging)

Time : 3 hours Maximum marks : 10 x 10 marks = 100 marks

1. (i) Describe the 4 steps in assigning the LIRADS category as per ACR 2018 diagnostic CT/MRI LIRADS and treatment response CT/MRI LIRADS.
(ii) List the indications, contraindication, and the embolic agents used for TACE in hepatocellular carcinoma. (2*4 + 2 marks)

2. (i) Compare and contrast primary sclerosing cholangitis from bacterial cholangitis.
(ii) A 40-year-old male patient diagnosed with primary sclerosing cholangitis is planned for liver transplantation. Describe the steps in imaging evaluation before the surgery. (4+6 marks)

3. As per 2012 revised Atlanta classification (i) What are the morphological types of pancreatitis (ii) What are the types of fluid collection in pancreatitis (iii) How is the clinical severity of pancreatitis graded (iv) What are the types of collections for which image-guided drainage should be done and provide the rationale for same. (3+4+2+2)

4. List the differential diagnosis for mass lesions of the small bowel. Compare and contrast the imaging appearances of 4 of the most commonly encountered mass lesions of the small bowel. (2+8)

5. Describe the ultrasound/doppler methods and indices to evaluate foetal growth restriction. Provide a severity classification of foetal growth restriction based on imaging. (6+4)

6. Describe the (i) List 4 of the most common histological subtypes of renal cell carcinoma. Compare and contrast their imaging appearances in CT and MRI (ii) Describe the CT imaging appearance of Wilms tumour (6+4)

7. List renal cystic diseases in children and adults. What are the imaging appearances and the pathological basis for them in the following conditions? (4+6)
a) medullary sponge kidney
b) cystic dysplasia
c) polycystic kidney disease

8. A 30-year-old female patient presented with lower abdominal pain and bleeding per vagina. Mention the differential diagnosis for the given clinical scenario. Discuss the types and imaging findings in ectopic pregnancy. (3+7)

9. List the sequences used in multiparametric MRI of the prostate. Describe how assessment of prostate lesions is done in these sequences as per PIRADS 2019 (v 2.1). (1+9)

10. A 60-year-old female patient presented with bilateral complex ovarian masses. Discuss the USG and MR imaging approach in the evaluation of this patient. (10)

## M.D. DEGREE EXAMINATION – RADIODIAGNOSIS

**PAPER – IV Imaging of Central nervous system, orbit, ENT, dental, endocrine radiology, Recent advances (including corresponding paediatric, emergency, interventional and onco imaging)**

Time : 3 hours Maximum marks : 10 x10 marks = 100 marks

1. A 27-year-old male patient presented with progressive upper and lower weakness and paraesthesia. List the differential diagnosis for the given clinical scenarios and describe its imaging findings (3+7)

2. A 25-year-old male patient presented with pulsatile ophthalmoplegia. What will be the cause of this when a. history of trauma is present b. history of trauma is absent? How will you evaluate this patient? Mention the role of an interventional radiologist in one such condition. (2+4+4)

3. Describe an approach to perform response assessment in brain tumours using imaging? How do you differentiate radiation necrosis from tumour recurrence by imaging? (5+5)

4. A 5-year-old child presented with a solid cystic lesion in the posterior fossa of the brain. List the differential diagnosis and describe imaging findings in each of them. (4+6)

5. A 8-year-old child presented with a midline cystic lesion in the neck. List the causes and describe the imaging appearances of cystic lesions of the neck in a child. (3+7)

6. What are the types of hyperparathyroidism? Describe how imaging can be used to differentiate primary from secondary hyperparathyroidism? Compare the role of US and SPECT in the localization of parathyroid lesions? (2+4+4)

7. a) Describe the biological attribute that is exploited for producing images in diffusion tensor imaging (DTI)
b) What is fractional anisotropy and mean diffusivity? Give two clinical scenarios in which they may be altered.
c) Describe the clinical application of tractography (3+4+3)

8. a) Describe the underlying physics principle of MR Elastography and its clinical applications.
b) List the clinical applications of dual-energy CT and describe the underlying principle for any 2. (5+5)

9. Describe the imaging pattern correlating with pathophysiology/embryological abnormality in the BRAIN for TWO conditions in each of the below categories a. Malformations of cortical development b. Disorders of diverticulation/cleavage (5+5 marks)

10. Describe the role of PET CT in any 5 non-malignant aetiologies. (10)

# Annexure 1 (Part A)

| KEY-CAPABILITIES IN THE PRACTICE OF RADIODIAGNOSIS | |
|---|---|
| 1 | Modality Procedures With Diagnostic Interpretation |
| 2 | Pre-Procedure evaluation |
| 3 | Image-Guided Interventions |
| 4 | Formulation of imaging strategy for clinical scenarios |
| 5 | Generation of Patient Reports for Unfamiliar Imaging Patterns/Findings |
| 6 | Management of emergency in radiology suite |
| 7 | Communication skills |
| 8 | Research |
| 9 | Teaching-learning |
| **Learning objectives for key-capabilities in practice of radiodiagnosis** | |

## KEY CAPABILITIES

| | | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| **No.** | Key Capabilities | **6** | **12** | **18** | **24** | **30** | **36** |
| **1** | **MODALITY PROCEDURES WITH DIAGNOSTIC INTERPRETATION** | | | | | | |
| FLUOROSCOPY | | | | | | | |
| | Fluoroscopic examination of<br><br>gastrointestinal tract (GIT) with barium (barium swallow/meal/ meal follow-through/enema)<br>urinary system (IVU, MCU,RGU)<br><br>uterus with water-soluble iodinated contrast (HSG), sialogram, evaluation of sinuses (branchial sinus etc.)/fistulas/operated site leaks with water soluble contrast | 2 | 3 | 4 | 5 | | |
| RADIOGRAPHS - interpret | | | | | | | |
| | Age determination from elbow, wrist and pelvis radiographs Bone tumours/lesions<br>Lines and tubes in the chest – indications for use, correct positions and identification of malposition | 2 | 3 | 4 | | | |
| | Emergency radiographs - fractures, bowel obstruction (including volvulus, internal and external hernia), perforation etc<br><br>Chest X-rays, Abdomen X-rays, skull x-rays, Spine x-rays, Pelvis x-rays and extremity x-rays | 3 | 4 | | | | |
| MAMMOGRAM - perform and interpret | | | | | | | |
| | Perform BIRADS categorisation for lesions detected on mammogram and Digital tomosynthesis<br><br>Post-operative breast follow up ( including differentiate scar from recurrence)<br>axillary lymph node assessment | | 3 | 4 | | | |
| ULTRASOUND - acquire and interpret | | | | | | | |
| | Acquire images using trans-abdominal low and high frequency probes | 3 | 4 | | | | |
| | Acquire image from intracavitary probes such as in transvaginal sonogram and Transrectal ultrasound* | | | | 2 | 3 | 4 |
| | Perform TIRADS categorisation for thyroid lesions<br>Perform and interpret lung ultrasound<br>Evaluation of placenta abnormalities, adhesive disorders and invasion, detection of hydrops fetalis | 3 | 4 | | | | |

| | | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| **No.** | Key Capabilities | **6** | **12** | **18** | **24** | **30** | **36** |
| | Twin pregnancy evaluation (chorionicity, amnionicity)<br>Perform BIRADS categorisation for breast lesions<br>Perform and interpret Carotid doppler for TIA, peripheral arterial doppler, DVT evaluation, venous doppler for varicose veins, doppler of portal, hepatic veins and IVC<br>Doppler of ophthalmic artery and superior ophthalmic vein | | 2 | 3 | 4 | | |
| | Obstetric ultrasound: Dating scan(intra or extra uterine, foetal pole, yolk sac) , predicting viability in early pregnancy, 11-14 scan (nuchal translucency , nasal bone, other sonographic markers), 18 to 20 week ( targeted anomaly scan (TIFA) – brain, spine, body wall, limbs, face, heart, diaphragm), foetal echocardiography, cervical incompetence, biophysical profile<br>Perform screening for aneuploidy | | | 3 | 4 | | |
| | Obstetric ultrasound: IUGR evaluation – uterine, umbilical, ductus, MCA | | | | 3 | 4 | |
| | Acquire images and interpret ultrasound of nerves - Median nerve, ulnar nerve, common peroneal, posterior tibial | | | | 3 | 4 | |
| | Evaluate AV fistula - doppler ultrasound Evaluate for renal causes of hypertension Elastography for liver fat quantification etc<br>Neurosonogram | | 3 | 4 | | | |
| | Evaluate renal graft<br>Acquire images and interpret ultrasound of the shoulder joint | | | 3 | 4 | | |
| | Penile doppler to evaluate for erectile dysfunction | | | | 2 | 3 | |
| | Infertility evaluation in women – follicular study | 1 | 4 | | | | |
| CT - acquire and interpret | | | | | | | |
| | CT brain, CT spine | | 3 | 4 | | | |
| | CT head and neck, CT extremity, CT joints<br><br>Detect findings suggestive of interstitial lung diseases from HRCT images and describe patterns as per latest guidelines. Perform lung cancer screening as per latest guidelines (guidelines gives in Annexure 1 PART B)<br>CT thorax<br>CT abdomen, CT angiogram<br>Adrenal adenoma versus space occupying lesion | | | 3 | 4 | | |

| | | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| **No.** | Key Capabilities | **6** | **12** | **18** | **24** | **30** | **36** |
| | Primary staging and assessment of resectablility of malignancy of lung, liver, uterus, cervix, oesophagus, stomach, ovary, pancreas, liver, colorectal, GB, cholangiocarcinoma<br><br>Response assessment - lung, liver, uterus, cervix, oesophagus, stomach, ovary<br><br>Liver transplant, renal transplant– pre-operative assessment, post-transplant complications<br><br>Dual energy CT protocols and their applications in clinical practice | | | 2 | 3 | 4 | |
| | Cardiac CT and coronary CT ( coronary calcium, plaque, stenosis, CABG, stent evaluation)<br>Paediatric cardiac CT | | | | 3 | 4 | |
| | liver fat quantification<br>CT perfusion - brain and body | | | | | 1 | 2 |
| MRI - acquire and interpret | | | | | | | |
| | MRI brain - basic protocol (T1, T2, FLAIR, DWI, SWI), MR angiogram (non-contrast and contrast enhanced, Dynamic), MR venogram, MR spectroscopy, MR perfusion (including T1, T2), CSF flow studies, MR cisternogram /MRCP/MRU | | | | 1 | 3 | 4 |
| | MRI brain - functional MRI, DTI | | | | | 1 | 2 |
| | MRI knee, spine, abdomen, pelvis, hip, SI joint, long bones, MR mammogram, head and neck (including orbit), brachial plexus | | | | 1 | 3 | 4 |
| | MRI shoulder, elbow, wrist and hand, ankle and foot | | | | | 2 | 4 |
| | MRI temporomandibular joint | | | | | 1 | 3 |
| | Cardiac MRI - basic protocol (dark blood, cine), late gadolinium enhancement | | | | | 2 | 4 |
| | liver fat quantification, liver iron quantification ( for haemochromatosis, haemosiderosis) | | | | | 1 | 2 |
| | Cardiac MRI - T1 mapping, T2 mapping and T2* mapping | | | | 1 | 2 | 3 |
| | Cardiac perfusion MRI | | | | | 1 | |
| | MRI brachial plexus | | | | 1 | 2 | |
| | Diagnostic scoring - PIRADS | | | | | 3 | 4 |
| VASCULAR INTERVENTIONAL RADIOLOGY | | | | | | | |

| | | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| **No.** | Key Capabilities | **6** | **12** | **18** | **24** | **30** | **36** |
| | DSA - GI bleed, mesenteric thrombosis, bronchial artery, uterine artery embolisation, tumour embolisation, TACE, adrenal venous sampling | | | | | 1 | |
| | Sclerotherapy for varicose veins/slow flow venous malformations, PTBD | | | | | 1 | |
| | Loading drugs aseptically, hand-washing, draping patient for intervention, wearing gloves, preparing the probe | | | | 1 | 2 | 3 |
| MULTIMODALITY | | | | | | | |
| | Carotid plaque imaging | | | | | | 1 |
| **2** | **PRE-PROCEDURE EVALUATIONS** | | | | | | |
| | TAVI<br>Cochlear implant Liver transplant Renal transplant | | | | 3 | 4 | |
| | Malignancy - Extension of disease, operability, Staging | | | 3 | 4 | | |
| **3** | **IMAGE-GUIDED INTERVENTIONS** | | | | | | |
| | US guided FNAC, biopsy, drainage | 1 | 2 | 3 | | | |
| | Stereotactic biopsy, Wire localisation for breast lesions | | | | | 1 | 2 |
| | CT guided soft tissue FNAC/ biopsy/drainage, bone biopsy | | | 1 | | 2 | 3 |
| | Radio-frequency ablation, microwave ablation, cryotherapy, photodynamic therapy for lung cancer | | | | | 1 | |
| | Percutaneous nephrostomy, cholecystostomy | | 1 | 2 | | | |
| | PTBD, Uterine artery embolisation | | | | 1 | | |
| | Endoscopic biopsy and FNAC | | | | 1 | | |
| | Catheter, embolic agents, steps of DSA, sterile precautions, post procedure monitoring and pre procedure investigation | | | | | 3 | |
| **4** | **FORMULATION OF IMAGING STRATEGY FOR CLINICAL SCENARIOS** | | | | | | |
| **Thorax** | | | | | | | |
| | Chest pain, Triple rule out CT angiogram (coronary MI, pulmonary thromboembolism, aortic dissection)<br>Acute syncope<br>Acute coronary syndrome ( unstable angina, MI, stable angina)<br><br>Breathlessness, Exertional dyspnoea, cyanosis, congenital heart disease, heart failure, haemoptysis | 1 | | | 2 | 3 | 4 |
| | Solitary pulmonary nodule (solid, sub-solid, ground-glass) | | | 3 | 4 | | |

| | | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| **No.** | Key Capabilities | **6** | **12** | **18** | **24** | **30** | **36** |
| | Recurrent respiratory tract infection in children | 1 | 2 | 3 | 4 | | |
| | Neonatal respiratory distress | | | 2 | 3 | 4 | |
| **Abdomen** | | | | | | | |
| | Renal hypertension<br><br>Abdominal pain ( localised/generalised, obstruction/peritonitis) , diarrhoea, change in bowel habit (acute, chronic), features suggestive of malabsorption (weight loss, steatorrhoea), vomiting, gastro-intestinal bleeding, ascites under evaluation<br><br>Neonatal vomiting, failure to pass meconium (suspected anorectal malformation etc)<br>Obstructive jaundice | | 2 | 3 | 4 | | |
| | Dysphagia | 1 | 2 | 3 | 4 | | |
| **Head, neck and CNS** | | | | | | | |
| | Stroke, seizures, focal neurological deficit, altered sensorium, quadriparesis, paraparesis | 1 | | | 2 | 3 | 4 |
| | Proptosis/ orbital mass | | | 3 | 4 | | |
| | CSF Rhinorrhoea<br>Neck lumps, thyroid mass<br>hearing loss /ear pain/tinnitus/vertigo<br>Orbital cellulitis/facial swelling/acute sinusitis Cranial Nerve palsy/neuralgia<br>Trismus, temporomandibular joint locking/clicking<br>Epistaxis<br>Chronic sinusitis/ nasal obstruction Hoarseness<br>Difficulty swallowing, stridor<br>Headache, visual loss, diplopia | | | | 3 | 4 | |
| **Musculoskeletal** | | | | | | | |
| | Scoliosis<br><br>Low back ache, spondyloarthropathy, Radiculopathy, myelopathy, claudication<br>Incidental findings on plain radiographs Internal derangement of the knee Rotator cuff injury<br>Acute limb ischemia, Swollen limb | | | | 3 | 4 | |
| **Breast** | | | | | | | |
| | Assessment of integrity of breast implants | | | | 3 | 4 | |
| | breast lumps/ulceration, nipple inversion, breast tenderness, gynaecomastia | | | 3 | 4 | | |

| | | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| **No.** | Key Capabilities | **6** | **12** | **18** | **24** | **30** | **36** |
| **Others** | | | | | | | |
| | Chest trauma, Blunt abdomen trauma, Head/spine injury, Bone trauma | | | | 3 | 4 | |
| **5** | **GENERATION OF PATIENT REPORTS FOR UNFAMILIAR IMAGING PATTERNS/FINDINGS** | | 2 | 3 | | 4 | |
| **6** | **MANAGEMENT OF EMERGENCY IN THE RADIOLOGY SUITE** | | | | | | |
| | BLS (basic life support)<br>Contrast related reactions<br><br>hypoglycaemia, vasovagal attack, immediate intervention in seizures, prevention of aspiration<br><br>Procedure related bleed, pseudo aneurysm - immediate intervention | 2 | 3 | 4 | | | |
| **7** | **COMMUNICATION SKILLS** | | | | | | |
| | Multi-disciplinary discussion | | 2 | | | 3 | |
| | Critical findings communication | 3 | 4 | | | | |
| **8** | **RESEARCH** | | | | | | |
| | Dissertation writing | 2 | | | 3 | 4 | |
| | Critiquing a research paper | | | 2 | 3 | | 4 |
| | Dissemination in conference presentation, journal publication | | | 2 | | | 3 |
| **9** | **TEACHING-LEARNING** | | | | | | |
| | Take part in teaching and training | | | 2 | 3 | | |
| | Keep updated with emerging novel techniques in imaging - ‘lifelong learner’ | | | | | 1 | |

## LEARNING OBJECTIVES FOR KEY CAPABILITIES

### 1. MODALITY PROCEDURES & 2. PRE-PROCEDURE EVALUATIONS

1. Review medical history, clinical information, and prior studies; consult with referring providers; evaluate clinical indications considering appropriate use criteria and perform or direct pre- procedure patient evaluation and education.
2. Select the appropriate imaging modality/modalities for a given clinical condition.
3. Screen for contraindications for radiation/magnetic resonance imaging (MRI), contrast (allergy etc), pharmacologic agents, other contraindications specific to procedure
4. Demonstrate skill in starting intravenous lines.
5. Design the appropriate protocol or alter an existing protocol and acquire the images, demonstrate knowledge of dose and timing of intravenous contrast, decide on further views based on clinical suspicion and direct further imaging
6. Demonstrate leadership and teamwork in working with technicians to acquire images
7. Differentiate anatomy/pathology from artifacts.
8. Correlate findings with other imaging modalities
9. Interpret the images, provide a differential diagnosis.
10. Provide a written report to guide diagnosis/patient management with the formulation of recommendations for additional imaging evaluation.
11. Discuss the procedure, findings, and interpretation in scientific discussion within and outside the department.
12. Demonstrate knowledge of the limitations and potential fallacies of an imaging modality

### 3 IMAGE GUIDED INTERVENTIONS

1. Assess the imaging features of the lesion and derive differential diagnosis.
2. Assess coagulation parameters, h/o anticoagulant or anti-platelet agents.
3. Determine whether the lesion is one that is safe to biopsy (e.g.- exclude lesions such as phaeochromocytoma, vascular malformations etc)
4. Determine presence of access to the lesion and rule out presence of vessels, vital organs along the planned trajectory.
5. Drape the part aseptically.
6. Give local anaesthesia, as required.
7. Perform the biopsy procedure.
8. Look for post-biopsy complications.
9. Communicate with patient and clinician.
10. Document the procedure.

### 4 IMAGING MODALITY SELECTION FOR CLINICAL SCENARIO

1. Demonstrate knowledge of pathophysiology of the condition
2. Demonstrate knowledge of differential diagnosis and body systems to be investigated.
3. Demonstrate knowledge of potential and limitations of imaging modalities
4. Describe the contribution of imaging in the context of the larger picture of diagnostic work-up of the patient with other non-imaging methods.
5. Creation of imaging strategy for clinical scenario
6. Feedback/ follow-up: operative findings (emergency cases), histopathology, tumour board / MDD meetings

## 5. GENERATION OF REPORT FOR UNFAMILIAR PATTERNS

1. Performs literature search.
2. Demonstrates clinical reasoning (correlation with anatomy/embryology/other imaging and non-imaging findings)
3. Seeks required information from multidisciplinary discussions.

## 6 PATIENT EMERGENCIES

1. Demonstration of knowledge of signs and symptoms of acute emergencies
2. Demonstration of knowledge of doses of pharmacological agents to treat acute emergencies.
3. Demonstrate judgement in institution of life saving procedures and drugs.
4. Demonstrate ability to mobilise resources appropriately.
5. Communicate effectively with physicians and other health care professionals for further management of the patient.

## 7. COMMUNICATION SKILLS

1. Multidisciplinary discussion - Demonstrate that he seeks to understand the clinical problem, and the perspectives of the problem from the point of view of different disciplines; communicates clearly the role/solutions from imaging to the clinical problem.
2. Demonstrates timely communication of critical findings to the clinical team and documentation of the same

## 8 RESEARCH

1. Recognition of knowledge gaps and lacunae in current practice
2. Formulation of question to address knowledge gap and lacunae
3. Identification of sources of knowledge to answer the question
4. Interpretation and critique of evidence
5. Determination of validity and risk of bias in evidence
6. Application and potential integration of evidence into practice
7. Formulation of research study design to answer question
8. Execution of research protocol
9. Analysis and interpretation of research findings
10. Dissemination of research findings in conference presentation
11. Dissemination of research findings in journal publication

## 9 TEACHING-LEARNING

1. Ensure patient safety during bedside teaching/small group teaching
2. Use best practices instructional methods for large group teaching
3. Collaboratively identify learners needs and establish expectations between teaching and learner
4. Establish expectations between teacher and learner
5. Provide appropriate supervision, constructive feedback and coaching during bedside teaching/small group teaching
6. Efficient use of teaching moments
7. Evaluate teaching session
8. Provide effective role modelling by teacher

# Annexure 1 (Part B)

| CORE IDEAS IN THE PRACTICE OF KEY-CAPABILITIES | |
|---|---|
| 1 | Normal imaging anatomy - to be identified |
| 2 | Embryology relevant to congenital diseases seen in imaging |
| 3 | Principles of functioning of imaging equipment |
| 4 | Image acquisition techniques and views in radiographs, ultrasound |
| 5 | Variant anatomy in clinically normal people - to be recognised |
| 6 | Modality specific artifacts and appearances - to be recognised |
| 7 | Clinically useful patterns - Display logical approach and differential diagnosis |
| 8 | Peripheral speciality (Nuclear Medicine) - To optimise imaging strategy |
| 9 | Guidelines, Regulations and Classifications |
| 10 | Diseases to be diagnosed |
| 11 | Artificial intelligence in medical imaging |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| **1** | **NORMAL IMAGING ANATOMY - IDENTIFY** | | | | | | |
| | Radiograph – skull, neck, chest, abdomen and pelvis, extremities (including normal ossification centre at wrist, elbow, hip, knee, shoulder),<br>spine | 1 | 4 | | | | |
| | Ultrasound – abdomen and pelvis, foetal, small parts (thyroid, breast, testis and scrotum, neurosonography), cervical node stations, MSK<br>(shoulder, tendoachilles, newborn hip, knee), median and ulnar nerve | 1 | 2 | 4 | | | |
| | CT - brain, neck spaces, chest, abdomen (including peritoneal spaces, retroperitoneum, segmental anatomy of liver), HRCT temporal bone, PNS, orbit, skull - cranial foramen, canals, vascular anatomy (including ICA, ECA, EJV, IJV, arterial (Circle of Willis, Vertebro-basilar) and venous anatomy of brain), cardiac and coronary artery anatomy, peripheral artery (upper limb, lower limb), Venous anatomy (superficial and deep), thorax<br>and abdomen vascular anatomy | | 1 | 3 | 4 | | |
| | MRI anatomy of body systems<br>• brain (including myelination milestones, names of prominent gyri and sulci, intracranial and extra cranial course of cranial nerves, medial temporal lobe, brainstem, cerebellum and vermis, sellar/suprasellar/ parasellar ( pituitary, stalk, hypothalamus, mammillary body, cavernous sinus)), spine<br>• cardiac, MSK ( shoulder, knee, hip, elbow, wrist ,ankle, SIJ), female and male pelvis, hepatobiliary, pancreatic<br>• Foetal<br>• Brachial plexus | | | | 2 | 3 | 4 |
| | Lymph node stations relevant to imaging - cervical, mediastinal, abdominal | | | 3 | 4 | | |
| **2** | **EMBRYOLOGY RELEVANT TO CONGENITAL DISEASES SEEN IN IMAGING** | | | | | | |
| | brain, branchial cleft, spine, cardiac and great vessels, gastrointestinal<br>and genitourinary tract (including anorectal malformations) | 1 | | | | | |
| **3** | **PRINCIPLES OF FUNCTIONING OF IMAGING EQUIPMENT** | | | | | | |
| | X-ray tube physics - radiation protection, x ray generation and interaction, tube, collimator, cone, cylinder, tube rating, filter, grid, image receptor, computed radiography, digital radiography, flat panel detectors,<br>IITV and DR fluoroscopy, factors determining image quality | 1 | | | | | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | US machine physics - probe construction and types<br>• USG controls - gain and TGC, frequency, focus, depth<br>• Doppler -colour and spectral optimisation (beam steering, angle correction, PRF, baseline, wall filter)<br>• Elastography, harmonics, Speckle reduction imaging, compound imaging, contrast ultrasound | 1 | 4 | | | | |
| | Contrast types, safety and management of reactions | 1 | | | | | |
| | CT machine physics - generations of CT, kinds of detectors, MDCT, image acquisition and reconstruction, gating, pitch, dose reduction and radiation protection, post processing and reformation, contrast ( type,<br>flow rate, timing of acquisition) | | 1 | | | | |
| | Development in CT hardware technology - Dual energy CT, Photon<br>counting CT | | | 1 | | | |
| | MRI machine physics - safety, image formation, sequences ( spin echo, gradient echo, angio, diffusion, MRCP, spectroscopy, gating, DTI, CSF<br>flow quantification, BOLD) | | | | 1 | | |
| | Equipment used for interventional radiology (biopsy gun – automatic, semi-automatic, gauge, co-axial), drainage catheters and guide-wires,<br>angiographic catheters, embolic agents, stents and balloons. | | | | | 1 | |
| | IT skills related to radiology - DICOM, PACS, | | | | | | 1 |
| | Radiom ics, radiogenomics, artificial intelligence - discuss scope in clinical<br>radiology | | | | | | 1 |
| **4** | **IMAGE ACQUISITION TECHNIQUES AND VIEWS IN RADIOGRAPHS, ULTRASOUND** | | | | | | |
| | skull views (PNS, Townes, Caldwells, submento-vertical, lateral) skull landmarks (chamberlain line, basal angle, orbitomeatal line etc) Basic views in chest, abdomen, extremity<br>Double contrast barium enema | 1 | | | | | |
| | Basic views in mammogram<br><br>Dental X-rays views, OPG | | 1 | | | | |
| | Enteroclysis versus enterography | | | 1 | | | |
| | Echocardiography, coronary angiogram - basic views | | | | | 1 | |
| **5** | **VARIANT ANATOMY IN CLINICALLY NORMAL PEOPLE - TO BE RECOGNISED** | | | | | | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | PNS variants | | 1 | 4 | | | |
| | Coronary artery variants Aortic arch variants<br>Hepatic artery variants and biliary anatomy variants<br><br>cerebral artery ( persistent trigeminal artery, persistent stapedial artery, foetal posterior cerebral artery, other variants in Circle of Willis), cerebral veins | | | 1 | 4 | | |
| | Skull - intracranial calcifications | | | 4 | | | |
| **6** | **MODALITY SPECIFIC ARTIFACTS AND APPEARANCES - TO BE RECOGNISED** | | | | | | |
| | Radiographs - conventional, digital | 2 | 3 | 4 | | | |
| | Ultrasound – comet tail artefacts/reverberation, mirror image, aliasing,<br>posterior acoustic enhancement, anisotropy artefact etc | 2 | 4 | | | | |
| | CT – ring artefact, beam hardening, cone beam artefact etc | | 1 | 4 | | | |
| | MRI - CSF flow artefacts, aliasing, chemical shift artefact, zipper artefact, magic angle, magnetic susceptibility artefact etc. | | | 1 | | 3 | 4 |
| **7** | **CLINICALLY USEFUL PATTERNS - DISPLAY LOGICAL APPROACH AND DIFFERENTIAL<br>DIAGNOSIS** | | | | | | |
| **Respiratory system** | | | | | | | |
| | Normal anatomy – secondary pulmonary lobule, bronchopulmonary segments and airways (CT)<br><br>Mosaic attenuation<br><br>Abnormal patterns – ground glass opacities, septal thickening, air trapping and conditions associated with them, approach to ILDs<br><br>Patterns of collapse<br><br>Common signs in lung imaging: silhouette sign etc, air fluid level, subcutaneous emphysema | | 2 | 3 | 4 | | |
| | Ultrasound patterns and signs in the lung | 2 | 3 | 4 | | | |
| **Mediastinum and Cardiac** | | | | | | | |
| | Patterns of cardiac chamber enlargement in radiograph<br>Pulmonary vascular patterns in radiograph - normal and abnormal<br>Anatomical segmentation of mediastinum<br>Radiographic localisation signs - silhouette, cervico-thoracic sign, hilum overlay and convergence sign | 2 | 3 | 4 | | | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | Subclavian steal phenomenon<br><br>Aortic emergencies | | 2 | 3 | | | |
| | Cardiac CT anatomy based approach to congenital cardiac diseases | | | | 3 | 4 | |
| | MRI Enhancement pattern in cardiomyopathy | | | | | 3 | 4 |
| **Breast** | | | | | | | |
| | Calcification patterns Architecture distortion<br>BIRADS classification | | | 3 | 4 | | |
| | Dynamic contrast - time intensity curves<br><br>Non mass enhancement in MRI | | | | | 3 | 4 |
| **Gastrointestinal, hepatobiliary system and retroperitoneum** | | | | | | | |
| | Patterns in barium esophagogram - benign (webs etc.) , malignant, motility, hernia<br><br>pneumoperitoneum signs - radiograph, CT motility disorders patterns, malabsorption<br>Inflammatory bowel diseases patterns - fluoroscopy | 2 | 3 | 4 | | | |
| | Focal lesion in liver in adults – patterns in solitary, multiple; cystic liver masses<br>Flow patterns in portal vein, hepatic artery, hepatic veins in doppler Pediatric liver masses - patterns | 1 | 2 | 3 | 4 | | |
| | Biliary strictures - benign and malignant patterns<br>Focal lesions of pancreas - CT and ultrasound patterns<br>Inflammatory bowel diseases - CT | | | 3 | 4 | | |
| | paediatric radiograph patterns - necrotising enterocolitis, meconium<br>ileus, microcolon, neonatal GI obstruction, Hirschsprung disease etc | 3 | 4 | | | | |
| | paediatric abdominal masses - hepatoblastoma, neuroblastoma,Wilm's tumor, lymphangioma, rhabdomyosarcoma | | 2 | 3 | 4 | | |
| **Genitourinary system and Gynaecology** | | | | | | | |
| | IVP/CT uro patterns assessment<br><br>Appearances in calculi, mass, inflammation | 2 | 3 | 4 | | | |
| | Paediatric renal lesions - patterns, paediatric ovarian lesions | | 3 | 4 | | | |
| | CT/ MR urography | | | 3 | 4 | | |
| | Congenital anomalies, vascular diseases | | 2 | 3 | 4 | | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| **Musculoskeletal system** | | | | | | | |
| | Periosteal reactions Soft tissue calcifications<br>Approach to bone tumours from radiographs, lytic/sclerotic lesions | 2 | 3 | 4 | | | |
| | Marrow in MRI | | | | 3 | 4 | |
| **Central nervous system** | | | | | | | |
| | Hydrocephalus, patterns in congenital anomalies | | 2 | 3 | 4 | | |
| | Myelination milestones, patterns in diffuse paediatric brain disorders - HIE, leukodystrophy, inborn errors of metabolism<br><br>Patterns in stroke, vascular territories Patterns in epilepsy<br>Space occupying lesions patterns Cranial nerve pathology patterns<br>Patterns in dementia, movement disorders<br><br>Patterns in infection - granulomatous, HIV related, viral, bacterial, fungal, others<br><br>Patterns in inflammation - demyelination, autoimmune Patterns in head injury<br>Patterns in bony skull, spine, pituitary, sella | | | | 3 | 4 | |
| **Head and neck** | | | | | | | |
| | Orbital ultrasound patterns – retinal detachment, choroidal detachment<br><br>Cystic mass of the neck - approach based on location | | 3 | 4 | | | |
| | Orbital mass, PNS -inflammation , mass | | | 3 | 4 | | |
| | Temporal bone - fracture, inflammation (cholesteatoma), hearing loss<br><br>Dental imaging patterns | | | 2 | 3 | 4 | |
| **8** | **PERIPHERAL SPECIALITY (NUCLEAR MEDICINE) - TO OPTIMISE IMAGING STRATEGY FOR A GIVEN CLINICAL CONDITION** | | | | | | |
| | Gamma camera, SPECT, PET CT - principles and uses<br><br>List of major radionuclides and radiopharmaceuticals available and purpose for which they are used<br><br>Principles of bone scintigraphy | | | | | | 1 |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | Principles of hepatobiliary scintigraphy - role in neonatal jaundice, bile leak<br><br>Principles of radionuclide imaging of urinary tract - diuretic renogram (EC, DTPA), Cortical scan (DMSA), DRCG<br><br>Principles of scintigraphy in ischaemic heart diseases - Stress myocardial perfusion scan, Myocardial viability assessment, MUGA<br><br>Principles of lung ventilation/perfusion scintigraphy<br><br>Principles of radionuclide scan for obscure GI bleed, motility studies Principles of thyroid scintigraphy<br>Principles of oncologic PET imaging - FDG, DOTANOC, PSMA PET | | | | | | |
| **9** | **GUIDELINES, REGULATIONS AND CLASSIFICATIONS (Older versions should be replaced by updated versions, as they become available)** | | | | | | |
| | PC-PNDT act, e LORA, MRI and intravenous iodinated contrast safety guidelines ( also in particular scenarios such as reduced renal function, pregnancy, lactation) | 1 | | | | | |
| | ASPECTS score | 2 | 3 | 4 | | | |
| | AAST - liver, spleen, kidney<br><br>TLIC and severity scale | 1 | 2 | 3 | 4 | | |
| | Criteria to diagnose IPF as per 2018 ATS/ERS guidelines 2013 classification of idiopathic interstitial pneumonia<br>How to diagnose hypersensitivity pneumonitis as per 2020 ATS/JRS/ ALAT guidelines<br><br>BIRADS (mammogram and US), Breast cancer screening guidelines, TIRADS | | 2 | 4 | | | |
| | LUNG RADS and Fleischner – when to use which. Criteria to differentiate benign from malignant pulmonary nodules in CT / PET | | 2 | 3 | 4 | | |
| | Pancreatitis - modified CT severity index<br><br>ORADS, ovarian cyst, Bosniak classification of renal cysts | | 3 | 4 | | | |
| | CADRADS, LIRADS<br><br>NIRADS ( neck imaging RADS) - NIRADS primary, nodal | | | 3 | 4 | | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | Adenocarcinoma in situ -spectrum classification, Classification of lung cancer (based on histology and IHC) | | | | | | |
| | BIRADS (MRI)<br><br>PIRADS | | | | | 3 | 4 |
| | WHO classification of CNS tumours | | | 1 | | | |
| | Response assessment criteria for cancer | | | 1 | 3 | 4 | |
| **10** | **DISEASES TO BE DIAGNOSED** | | | | | | |
| **Respiratory system** | | | | | | | |
| | Airway related - emphysema, Bronchiectasis and associated (Kartagener's syndrome, cystic fibrosis, alpha antitrypsin deficiency), ABPA<br><br>Pneumonia – viral, bacterial (including actinomycosis, tuberculosis), fungal (aspergillosis, mucormycosis, pneumocystis), parasitic(hydatid)<br><br>Pulmonary oedema, ARDS<br>Congenital - CPAM, congenital lobar emphysema, sequestration<br>Trauma chest, foreign body inhalation, lipoid pneumonia | | 3 | 4 | | | |
| | Infections in immunocompromised<br><br>ILDs – (1) exposure related - Occupational/ radiation/ drug induced/ avocational (2) Autoimmune and connective tissue diseases - RA, SLE, Sjogren, vasculitis associated disease, HP (3) idiopathic (4) neurofibromatosis, LAM, LCH, eosinophilic pneumonia<br><br>Pulmonary thromboembolism<br><br>Other pulmonary vascular - Pulmonary hypertension, pulmonary veno- occlusive, pulmonary capillary haemangiomatosis, excipient disease<br><br>RS: Lung cancer, Lymphangitis carcinomatosa, neuroendocrine tumours, mesothelioma, metastasis, neoplastic lymphoproliferative disorders, fibrous tumour of the pleura, Kaposi sarcoma | | | 3 | 4 | | |
| | Other Congenital/inherited - Birt-Hogg-Dube syndrome, Hermansky- Pudlak syndrome, Tuberous sclerosis, primary Childhood ILDS, familial idiopathic pulmonary fibrosis, | | | | 3 | 4 | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | surfactant deficiency, primary ciliary dyskinesia, chronic granulomatous disease<br><br>Other lung diseases - Amyloidosis, light chain deposition, alveolar microlithiasis, metastatic pulmonary ossification, idiopathic pulmonary hemosiderosis, diffuse pulmonary ossification | | | | | | |
| **Mediastinum and cardiac** | | | | | | | |
| | Congenital heart diseases - heterotaxy, anomalies of venous return, septal defects, valvular defects including endocardial cushion defects, ventricular anomalies, outflow anomalies (TGA, TA), aortic arch and pulmonary artery anomalies<br><br>Pericardial diseases - effusion, constrictive, masses<br><br>Diseases of Aorta - Atherosclerosis, aneurysm, dissection, vasculitis IVC developmental abnormalities. eg - retrocaval ureter Mediastinal masses and their classification Acquired valvular heart diseases<br>Adult congenital heart diseases<br><br>Cardiac mass - CT | | | 3 | 4 | | |
| | Ischaemic heart disease<br>Cardiomyopathies - dilated, hypertrophic, restrictive Cardiac mass - MRI | | | | | 3 | 4 |
| **Breast** | | | | | | | |
| | Fibroadenoma, Phylloides, lipoma, Hamartoma, papilloma, radial scar/ complex sclerosis lesion, galactocele, fat necrosis, abscess, PASH, Mondors disease, Inflammatory conditions (mastitis, granulomatous mastitis, plasma cell mastitis etc)<br><br>Tumours (in situ, invasive, metastatic) atypical ductal hyperplasia, lobular hyperplasia | | 3 | 4 | | | |
| **Gastrointestinal, hepatobiliary system and retroperitoneum** | | | | | | | |
| | oesophagus - tumours, hernia, achalasia, motility disorders<br><br>Paediatric - bowel obstruction (malrotation, intussusception, volvulus, pyloric stenosis), necrotising enterocolitis, tracheo-oesophageal fistula, duplication cysts, Hirschsprung, ano-rectal malformation, atresia - duodenal, microcolon, congenital diaphragmatic hernia | 2 | 3 | 4 | | | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | Diffuse liver diseases: steatosis, hepatitis, cirrhosis, iron overload diseases, primary biliary cirrhosis<br><br>Liver congenital - Biliary atresia, choledochal cyst<br><br>Liver infections – hepatitis , tuberculosis, hydatid, pyogenic and amoebic liver abscesses<br><br>Cholecystitis | | 3 | 4 | | | |
| | Hepato-pancreatic biliary<br><br>Liver vascular - Hepatic veno-occlusive disease , Budd-Chiari syndrome, Portal hypertension, EHPVO, congenital (Abernathy syndrome) and surgical shunts (TIPS, surgical)<br><br>Liver focal lesions - Hepatoblastoma, infantile haemangioendothelioma, mesenchymal hamartoma, Biliary cystadenoma, hepatic cyst, focal nodular hyperplasia, nodules associated with cirrhosis, haemangioma, adenoma, epithelioid haemangioendothelioma<br><br>Pancreas congenital – pancreatic divisum, annular pancreas, agenesis, ectopic pancreatic rests, ectopic pancreas<br><br>Cholangiocarcinoma (intrahepatic, hilar ,distal CBD), carcinoma gall bladder, benign lesions in the gall bladder<br><br>Cholangitis, Ig4 associated cholangiopathy<br><br>Tumours – pancreas (including pancreatic ductal adenocarcinoma, SPEN, pancreatic endocrine tumours, pancreatic cystic tumours )<br><br>Neuroendocrine tumours ( MEN syndrome) Pancreatitis - acute, chronic, CT severity index<br>Spleen - melioidosis, TB, cyst, splenosis, splenunculi, angiosarcoma and tumours of the spleen<br><br>Lymphoma - Hodgkin’s and Non-Hodgkin’s, nodal and extranodal manifestations | | 2 | 3 | 4 | | |
| | Gastro-intestinal tract<br><br>pharynx - tumours, webs ,diverticulum, herniation | | 2 | 3 | 4 | | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | stomach and duodenum - tumours (staging, operability and response assessment of carcinoma stomach), pyloric stenosis, volvulus, hernia<br><br>small and large intestine – (radiograph, ultrasound and CT) tumours, malrotation, polyposis, carcinoma, GIST, neuroendocrine tumours, inflammatory bowel disease (Crohn's, Ulcerative colitis), mesenteric ischemia, sigmoid volvulus, diverticulitis, colorectal cancer, gallstone ileus, infections (TB, appendicitis, infectious colitis), radiation colitis, ischemic colitis, intestinal obstruction, malabsorption syndromes | | | | | | |
| | small intestine and large intestine (MRI) - perianal fistula, inflammatory bowel disease | | | | 2 | 3 | 4 |
| | peritoneal disease - peritoneal cysts, encapsulating peritonitis, peritoneal carcinomatosis , mesothelioma, mesenteric panniculitis, sclerosing peritonitis, mesenteric and omental cysts, lymphangioma, pseudomyxoma peritonei<br><br>Abdominal wall - tumours, hernia, desmoid<br><br>retroperitoneum - tumours, retroperitoneal fibrosis and its association | | | 3 | 4 | | |
| **Genito-urinary system and gynaecology** | | | | | | | |
| | Migrated IUCD | | 4 | | | | |
| | Congenital – ectopia, agenesis, cross-fused ectopia, persistent foetal lobulations, duplex moiety, ureterocele, bladder exstrophy, polycystic kidney disease etc | 2 | 3 | 4 | | | |
| | Infections – GU TB, pyelonephritis, XGP, melioidosis, parasitic infections, renal abscess, cystitis<br><br>Metabolic – stone disease, nephrocalcinosis Paediatric – posterior urethral valve<br>Renal trauma<br><br>Renal failure | 3 | 4 | | | | |
| | Renal tumours – angiomyolipoma, renal lymphoma, oncocytoma, Renal cell carcinoma, transitional cell carcinoma, paediatric tumours ( Wilm's tumour, neuroblastoma, cystic nephroma, rhabdomyosarcoma)<br><br>Adrenal tumour – cortical carcinoma, phaeochromocytoma, neonatal haemorrhage, metastasis, incidentaloma, myelolipoma, adrenal hyperplasia (ACTH) | | 2 | 3 | 4 | | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | Mullerian duct abnormalities, (HSG) – diadelphys, bicornuate ,septate, MRKH, Turners<br><br>Tumors – ca endometrium, cervix, ovary, uterine leiomyosarcoma<br>Fibroid, endometriosis, adenomyosis<br>Infection – tubo-ovarian abscess ,<br>Multicystic dysplastic kidney<br>Neurogenic bladder<br>Undescended testis, hydrocele, varicocele, epididymitis, torsion, microlithiasis, tumours<br><br>Renal lymphangiectasis<br><br>Reno-vascular hypertension - causes, imaging and interventions<br><br>Prostatitis, prostatic abscess, diseases of urinary bladder, urethra, seminal vesicles<br><br>Intra and extra peritoneal rupture bladder, urethral trauma | | 3 | 4 | | | |
| | Prostate cancer – multi-parametric MRI, staging<br>Pelvic floor imaging , pelvic floor descent -MR imaging<br>Ambiguous genitalia | | | | | 3 | 4 |
| **Obstetrics and foetal** | | | | | | | |
| | Normal single pregnancy, multiple gestations, Ectopic pregnancy, Hydatidiform mole<br><br>Foetal anomalies, IUGR, complications of twin gestation<br><br>Confirmation of early pregnancy, 1st trimester bleeding, APH, Obstetric Doppler and soft markers of aneuploidy. | | 2 | 3 | 4 | | |
| | Placental disorders | | 3 | 4 | | | |
| **Musculoskeletal system** | | | | | | | |
| | Congenital: Skeletal dysplasia – terminologies relevant to skeletal dysplasia such as brachydactyly; Marfan syndrome<br><br>Achondroplasia, mucopolysaccharidosis (Hurler and Morquios), cleido cranial dysostosis, osteogenesis imperfecta, osteopetrosis, fibrous dysplasia, diaphyseal eclasia, thanatophoric dwarfism, pyknodysostosis, mellorheostosis, Based on limb length classification of dwarfism;<br><br>Developmental dysplasia of hip (metrics etc), associated proximal focal femoral deficiency | 2 | 3 | 4 | | | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | Metabolic conditions - hyperparathyroidism and related diseases, scurvy, osteomalacia, rickets, Vitamin C, osteoporosis, calcium and Vitamin D deficiency, hypervitaminosis, thyroid acropachy, acromegaly, ochronosis, CPPD, pseudo-fractures, renal osteodystrophy<br><br>Infections - Osteomyelitis – acute, chronic, special forms like Brodie's abscess, sclerosing osteomyelitis of Garré, TB, septic arthritis<br><br>Avascular necrosis in different bones, osteochondritis Paget's disease<br>Joints - Rheumatoid arthritis, Juvenile arthritis, seronegative – psoriatic, Reiters, ankylosing spondylitis, enteropathic arthritis; Charcot's joint<br><br>Osteoarthritis, spondyloarthritis – erosive OA, gout, hypertrophic pulmonary arthritis | 3 | 4 | | | | |
| | Degenerative - Osteoarthritis, spondyloarthritis ( MRI of cartilage ) | | | | | 3 | |
| | Internal derangement of knee, shoulder – rotator cuff, labral imaging, US shoulder | | | 3 | 4 | | |
| | Bone tumours – benign (osteoma, osteoblastoma, osteoid osteoma, osteochondroma, ossifying fibroma, non-ossifying fibroma etc), malignant (osteosarcoma (telangiectatic, paraosteal), etc) – local staging, neurovascular involvement, response assessment; Cartilage forming tumours – chondroma, chondromyxoid fibroma,<br>enchondroma, chondroblastoma, osteochondroma, chondrosarcoma; Fibrous tumours – fibrosarcoma, MFH, fibrous cortical defect, non- ossifying fibroma;<br>Joint tumours – synovial chondromatosis, PVNS, lipoma arborescens, synovial<br>sarcoma;<br>Adamantinoma, GCT, ABC, haemangioma, cystic angiomatosis, glomus tumour, solitary bone cyst, Ewing's sarcoma;<br>chordoma, intraosseous lipoma, dermoid cyst, intraosseous ganglion, DISH;<br>Lymphoreticular - multiple myeloma, plasmacytoma, eosinophilic granuloma, Hand Schuller Christian disease;<br>Soft tissue tumours – lipoma, liposarcoma, soft tissue sarcoma , MRI – differentiate cellulitis<br>(panniculitis), fasciitis and myositis | | 2 | 3 | 4 | | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | Haemopoietic disease – thalassemia, sickle cell anaemia, haemophilia Metastasis – sclerotic, lytic<br>Tumoral calcinosis, parosteal osteosarcoma from myositis, sarcoma. Osteitis condensans ilii, osteochondritis dissecans<br>Leave alone lesions - Osteopathia striata, osteopoikilosis, bone island etc. | 3 | 4 | | | | |
| | Skeletal trauma – fracture classification (spiral, comminuted etc, special (stress, avulsion, post traumatic avascular necrosis), named fractures (Colle, Bennet, Hangman, Burst fracture of spine, instabilities), Salter Harris classification of epiphyseal injuries, avulsion, apophysitis | 3 | | | | | |
| | Acetabular impingement syndrome<br><br>Tarsal coalition | | | | 3 | 4 | |
| **Head and Neck** | | | | | | | |
| | Salivary gland tumours (pleomorphic adenoma, adenoid cystic carcinoma, Warthin's tumour, mucoepidermoid carcinoma), sialectasis, inflammation/infection<br><br>Infective – acute and chronic sinusitis ( drainage pathways), CSOM (complications including cholesteatoma), mucormycosis, PNS fungal sinusitis, parapharyngeal, retropharyngeal, floor of mouth abscess. paravertebral abscess, orbital cellulitis<br><br>Dental tumours – cystic lesions of the jaw , lytic and sclerotic lesions of jaw, (ameloblastoma, dentigerous cyst etc.), infection/inflammation<br><br>Parathyroid adenoma, hyperplasia, carcinoma, 4DCT scan<br>Cervical rib, thoracic outlet syndrome<br>Lymphovenous malformations, dermoid cysts<br><br>Thyroid – carcinoma (papillary, anaplastic, follicular, medullary), thyroiditis, benign nodular disease<br><br>orbital fracture (inferior entrapment, traumatic optic neuropathy) | | 3 | 4 | | | |
| | Orbit diseases – within globe (retinoblastoma, choroid melanoma), outside globe (pseudotumor, haemangioma, vascular malformation, lymphoma), Visual pathway - optic nerve, chiasma, tract; Thyroid ophthalmopathy, pseudotumor orbit, venous varix; Exophthalmos - measurement, approach<br><br>PNS diseases - carcinoma, mucocele, inverted papilloma, juvenile | | | 3 | 4 | | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | nasopharyngeal angiofibroma, rhinosporidiosis<br><br>Nasopharynx, oral cavity including tongue, oropharynx, hypopharynx, larynx diseases – carcinoma, esthesioneuroblastoma, ranula, Thornwaldt cyst<br><br>Temporal bone - congenital malformations of external, middle and inner ear, cholesteatoma | | | | | | |
| | Optic nerve glioma, meningioma, nerve sheath tumour<br><br>Congenital abnormalities – brachial sinus, cyst, thyroglossal cyst, lymphangioma, dermoid, epidermoid, ectopic thyroid, lingual thyroid<br><br>Paraganglioma, neurogenic (schwannoma and neurofibroma), clival chordoma<br><br>Skull base - cranial nerve pathologies, tumours - primary and secondary | | | | 3 | 4 | |
| | Tolosa Hunt syndrome<br><br>Temporomandibular joint abnormalities | | | | | 3 | 4 |
| **Central nervous system** | | | | | | | |
| | Atlanto-occipital assimilation, platybasia, Bony craniovertebral junction abnormalities, Chiari malformation<br><br>Trauma – CT brain analysis, primary effects, secondary effects (herniation syndromes etc)<br><br>Subarachnoid haemorrhage and aneurysms, (perimesencephalic, convexity, pseudo SAH) sulcal hyperintensity due to causes other than haemorrhage<br><br>Aneurysms<br><br>Complications of SAH – vasospasm, cerebral ischemia, obstructive hydrocephalus, superficial siderosis<br><br>Hyperperfusion syndrome<br><br>Dural venous thrombosis and superficial cerebral thrombosis, cavernous sinus thrombosis<br><br>Venous occlusion mimics | | 3 | 4 | | | |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | Stroke<br><br>Perinatal HIE and its imaging features – premature and term infant, sequelae of HIE<br><br>HIE in older children and adults | | 2 | 3 | 4 | | |
| | Spontaneous parenchymal haemorrhage – various stages (haematoma aging etc), neonatal intracranial haemorrhage, hypertensive intracranial haemorrhage, microhaemorrhages<br><br>Vascular malformations – AVM, dural/pial AV fistula, vein of Galen malformation, developmental venous anomalies, cavernous malformation, carotid cavernous fistula, etc<br><br>acute stroke, stroke mimics, subacute/chronic infarct, embolic infarct, lacunar and water shed infarcts, stroke in unusual vascular territories | | | 3 | 4 | | |
| | CNS vasculopathy, intracranial and extracranial atherosclerosis<br>Cerebral microvascular disease<br>Infection (TORCH) - congenitally acquired, TB, fungal, parasitic, HIV, herpes encephalitis, subdural empyema, abscess<br><br>Carotid and vertebral artery dissection<br><br>Neoplasms, cysts and tumour like lesions of spine, compressive and non-compressive myelopathy, spinal cord tumours, degenerative disc disease, spondylosis, disc herniations, infective spondylosis<br><br>Congenital malformation of brain and spine – posterior fossa malformation, commissural and cortical maldevelopment, holoprosencephaly and related disorders<br><br>Neurocutaneous syndromes and familial cancer predispositions syndrome<br><br>Non-neoplastic space occupying lesions – epidermoid, dermoid, arachnoid cyst | | | 3 | 4 | | |
| | Non atheromatous vascular disease – fibromuscular dysplasia, dissection, vasoconstriction syndromes, vasculitis and related, moya moya disease, CADASIL, Neuro Behcet, SLE vasculitis, antiphospholipid syndrome, cerebral amyloidosis | | | | 2 | 3 | 4 |

Levels of performance: 1-knows; 2-can do with strict supervision; 3- can do with loose supervision; 4-can do independently; 5-can teach

| No. | Core Ideas | Minimum expected performance at months | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 12 | 18 | 24 | 30 | 36 |
| | Demyelinating disorders ( ADEM, multiple sclerosis, neuromyelitis optica, MOG antibody protein)<br><br>Dysmyelination and hypomyelination (diffuse white matter disorders ) | | | | | | |
| | Toxic, metabolic and degenerative - toxic encephalopathy , inherited and metabolic disorders, dementia and neurodegeneration, hydrocephalus, NPH<br><br>Congenital – craniosynostosis, corpus callosum agenesis, Dandy Walker malformation, Arnold Chiari types, neuronal migrational disorder (lissencephaly, polygyria, pachygyria, heterotopia. Schizencephaly, etc), anencephaly (diagnosed as foetal), congenital hydrocephalus, holoprosencephaly, (relevant embryology), encephalocele (occipito- fronto ethmoid, nasal)<br><br>Neural tube defects. Spinal dysraphism, vertebral segmental abnormalities, scoliosis, diastematomyelia, caudal regression<br><br>Medulloblastoma, hypothalamic hamartoma, atypical teratoid rhabdoid, olfactory lesions<br><br>ependymoma, neurofibroma, haemangioblastoma,<br><br>Neurocutaneous syndrome (phakomatosis) – NF1, NF2 spectrum, tuberous sclerosis, VHL | | | | 3 | 4 | |
| | Neurodegenerative – MSA, Parkinson, PSP, Alzheimer's | | | | | 3 | 4 |
| | Radiogenomics in brain tumours - glioma (IDH mutant), medulloblastoma | | | | | | 1 |
| Others (affecting multiple systems, etc) | | | | | | | |
| | Complications of surgery/radiotherapy/chemotherapy; pseudo-progression/regression | | | | 3 | 4 | |
| 11 | **ARTIFICIAL INTELLIGENCE IN MEDICAL IMAGING** | | | | | | |
| | Current status/current scope of Artificial Intelligence in Medical imaging<br><br>Risks and limitations of artificial intelligence in medical imaging<br><br>Ethical issues with respect to Artificial intelligence in medical imaging | | | | | | 1 |

# Annexure 1 (PART C)

**Learning Objectives-Peripheral posing for MD Radiodiagnosis**

The student will be assessed in the PERIPHERAL POSTING department.

Attendance and feedback will be sent, from the peripheral posting department to the Radiodiagnosis department.

Learning Objectives in peripheral postings

1. Nuclear Medicine

At the end of 2 weeks, the sixth semester student will be able to,

(i) List major radionuclides and radiopharmaceuticals and purpose for which they are used.
(ii) State the principles of bone scintigraphy.
(iii) State the principle of hepatobiliary scintigraphy and its role in neonatal jaundice, identify bile leak.
(iv) State the principles of radionuclide imaging of urinary tract - diuretic renogram (EC, DTPA), Cortical scan (DMSA), DRCG.
(v) State the principle of scintigraphy in ischaemic heart diseases - Stress myocardial perfusion scan, Myocardial viability assessment, MUGA.
(vi) State the principle of lung ventilation/perfusion scintigraphy.
(vii) State the principle of radionuclide scan for obscure GI bleed, motility studies.
(viii) State the principle of thyroid scintigraphy.
(ix) State the principle of oncologic PET imaging - FDG, DOTANOC, PSMA PET

# Annexure 2

# (Consolidated List of Procedures)

The numbers performed independently and with assistance in each of the postings are entered.

| | Procedures | | 1st Pos. | 2nd Pos. | 3rd Pos. | 4th Pos. | 5th Pos. | 6th Pos. | 7th Pos. | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Barium swallow | I | | | | | | | | |
| | | A | | | | | | | | |
| 2 | Barium meal follow through | I | | | | | | | | |
| | | A | | | | | | | | |
| 3 | Barium enema | I | | | | | | | | |
| | | A | | | | | | | | |
| 4 | Loopogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 5 | Intravenous urogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 6 | Micturating cystogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 7 | Retrograde urethrogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 8 | Cholangiogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 9 | Sinogram/Fistulogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 10 | Hysterosalpingogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 11 | US Neck | I | | | | | | | | |
| | | A | | | | | | | | |
| 12 | US Thorax | I | | | | | | | | |
| | | A | | | | | | | | |
| 13 | US Abdomen pelvis | I | | | | | | | | |
| | | A | | | | | | | | |
| 14 | US Small parts | I | | | | | | | | |
| | | A | | | | | | | | |
| 15 | US Breast | I | | | | | | | | |
| | | A | | | | | | | | |
| 16 | US Scrotum | I | | | | | | | | |

| | Procedures | | 1st Pos. | 2nd Pos. | 3rd Pos. | 4th Pos. | 5th Pos. | 6th Pos. | 7th Pos. | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | | | | | | | | |
| 17 | US Cranium | I | | | | | | | | |
| | | A | | | | | | | | |
| 18 | Antenatal ultrasound | I | | | | | | | | |
| | | A | | | | | | | | |
| 19 | Portal vein Doppler | I | | | | | | | | |
| | | A | | | | | | | | |
| 20 | Renal Doppler | I | | | | | | | | |
| | | A | | | | | | | | |
| 21 | Lower limbs venous Doppler | I | | | | | | | | |
| | | A | | | | | | | | |
| 22 | Lower limbs arterial Doppler | I | | | | | | | | |
| | | A | | | | | | | | |
| 23 | Upper limbs venous Doppler | I | | | | | | | | |
| | | A | | | | | | | | |
| 24 | Upper limbs arterial Doppler | I | | | | | | | | |
| | | A | | | | | | | | |
| 25 | Carotid Doppler | I | | | | | | | | |
| | | A | | | | | | | | |
| 26 | Penile Doppler | I | | | | | | | | |
| | | A | | | | | | | | |
| 27 | Doppler AV fistula | I | | | | | | | | |
| | | A | | | | | | | | |
| 28 | Mammogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 29 | CT brain | I | | | | | | | | |
| | | A | | | | | | | | |
| 30 | CT head and neck | I | | | | | | | | |
| | | A | | | | | | | | |
| 31 | CT PNS | I | | | | | | | | |
| | | A | | | | | | | | |

| | Procedures | | 1st Pos. | 2nd Pos. | 3rd Pos. | 4th Pos. | 5th Pos. | 6th Pos. | 7th Pos. | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 32 | HRCT Temporal bone | I | | | | | | | | |
| | | A | | | | | | | | |
| 33 | CT thorax | I | | | | | | | | |
| | | A | | | | | | | | |
| 34 | CT Thorax abdomen pelvis | I | | | | | | | | |
| | | A | | | | | | | | |
| 35 | CT Cerebral Angiogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 36 | CT Aortogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 37 | CT UL Angiogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 38 | CT LL Angiogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 39 | CT Cisternogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 40 | CT Coronary angiogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 41 | CT Pulmonary angiogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 42 | CT Cardiac | I | | | | | | | | |
| | | A | | | | | | | | |
| 43 | MRI brain | I | | | | | | | | |
| | | A | | | | | | | | |
| 44 | MRI head and neck | I | | | | | | | | |
| | | A | | | | | | | | |
| 45 | MRI extremity | I | | | | | | | | |
| | | A | | | | | | | | |
| 46 | Cardiac MRI | I | | | | | | | | |
| | | A | | | | | | | | |
| 47 | MRI spine | I | | | | | | | | |

| | Procedures | | 1st Pos. | 2nd Pos. | 3rd Pos. | 4th Pos. | 5th Pos. | 6th Pos. | 7th Pos. | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | | | | | | | | |
| 48 | MR Mammogram | I | | | | | | | | |
| | | A | | | | | | | | |
| 49 | MRI abdomen | I | | | | | | | | |
| | | A | | | | | | | | |
| 50 | Foetal MRI | I | | | | | | | | |
| | | A | | | | | | | | |
| 51 | US guided FNAC/ biopsy | I | | | | | | | | |
| | | A | | | | | | | | |
| 52 | CT guided FNAC/biopsy | I | | | | | | | | |
| | | A | | | | | | | | |
| | Any other procedures | | | | | | | | | |

# Annexure 3 (Sample forms)

**JIPMER Radiodiagnosis Work place Observation form – Modalities EXCEPT USG**

EXAMPLE SCORING FOR Report Quality: 0 = Does not meet expectations (incomplete report, many errors) | 1 = Below expectations (frequent errors, often incomplete) | 2 = Meets expectations (minimal errors, appropriate for learning stage) | 3 = Proficient (complete, clinically sound report requiring no correction)

Name of student and semester: Month/year:
Modality: Authorised leaves:
Reporting time: Unauthorised absenteeism:

| | Pl. give a reflection/narrative of your experience during posting, at the back of page | **0** | **1** | **2** | **3** |
|---|---|---|---|---|---|
| | **Clinical work** | | | | |
| 1 | History, clinical examination, safety, patient interaction | | | | |
| 2 | Planning/monitoring of imaging, provisional report | | | | |
| 3 | Report Quality and Adequacy of literature search/discussion/rationale | | | | |
| 4 | Completeness of records (google sheet) | | | | |
| 5 | Completeness of FOLLOW-UP of cases done 2 months prior | | | | |
| | **Teamwork, Leadership, Communication, and Approach to Continuous Learning** | | | | |
| 6 | Quality of seminars led by the student/participation in seminars of others | | | | |
| 7 | Co-ordination and communication with hospital personnel | | | | |
| 8 | Demonstration of responsibility in reducing patient waiting time when scheduling, reporting etc | | | | |
| 9 | Teaching - Shows interest in teaching juniors, Gives appropriate feedback to juniors | | | | |
| 10 | Demonstrates awareness of own strengths and areas for growth; actively integrates feedback as part of an ongoing learning process. | | | | |
| | **Workplace Observation Total (max 30 marks)** | | | | |
| | **Logbook (max 10 marks)** | | | | |

| Team (Day Shift) Number of Patients | **REPORTING STATISTICS -for ONLY this student** | | | **Work quantity (max: 5 marks)** |
|---|---|---|---|---|
| | Entry in Dept records:<br>Not done:<br>Data partial: | Report not-needed:<br>Net to-do:<br>Written: | Pending for more info:<br>Approved:<br>Productivity: | |
| Team (EMS Shift) Toal Number of Patients | | EMS US cases (for all students on duty): | EMS CT cases (including plain, for all students on duty): | |

**JIPMER Radiodiagnosis Work place Observation form – Modalities EXCEPT USG**

EXAMPLE SCORING FOR Report Quality: 0 = Does not meet expectations (incomplete report, many errors) | 1 = Below expectations (frequent errors, often incomplete) | 2 = Meets expectations (minimal errors, appropriate for learning stage) | 3 = Proficient (complete, clinically sound report requiring no correction)

| | | | |
|---|---|---|---|
| This student,<br>EMS US diagnostic:<br>No. done: | This student,<br>EMS US procedures:<br>No. done:<br>No. observed: | This student,<br>Contrast+HRCT numbers:<br>No done:<br>No. written:<br>No. approved | |
| Spotters:<br>attended/conducted<br><br>Marks acquired/total | Morning class:<br>attended/<br>conducted | Evening Seminar:<br>No. taken/<br>No allotted | **Academics (max: 5 marks)** |
| **Faculty sign:** | **Grand Total: (out of 50 marks)** | | |

## Other Academic Activity

| Activity | Date | Comment | Faculty |
|---|---|---|---|
| | | | |
| | | | |

**JIPMER Radiodiagnosis Work place Observation form - Ultrasound**

Name of student and semester: Month/year:

Modality: Authorised leaves:
Reporting time: Unauthorised absenteeism:

*** *Scoring criteria: ( with example in) item 3. Report quality**

| Score 0 (does **not attempt** to meet expectations) | Score 1 (Attempting to, but **yet to meet** expectations) | Score 2 (**meets** expectation) | Score 3 (Proficient, independently exhibits responsibility and standards **beyond** minimum expectations) |
|---|---|---|---|
| Consistently incomplete report plus many mistakes | > average mistakes, report left incomplete often | Minimal mistakes, Average report - corresponding to position in learning curve | Has fluent knowledge of clinically relevant items and report is complete in all aspects - consistently can be approved without correction |

| | Pl. give a reflection/narrative of your experience during posting, at the back of page (optional) | **0** | **1** | **2** | **3** |
|---|---|---|---|---|---|
| | **Clinical work** | | | | |
| 1 | History, clinical examination, safety, privacy, patient interaction | | | | |
| 2 | Acquisition of images, targets scan areas, uses color etc as required clinically, report | | | | |
| 3 | Guided interventions - technique, asepsis, post-procedure care | | | | |
| 4 | Workplace cleanliness/maintenance of equipment | | | | |
| 5 | Follow-up/ archiving of interesting cases | | | | |
| | **Teamwork, Leadership, Communication, and Approach to Continuous Learning** | | | | |
| 6 | Quality of seminars led by the student/participation in seminars of others | | | | |
| 7 | Co-ordination and communication with hospital personnel | | | | |
| 8 | Demonstration of responsibility in reducing patient waiting time when scheduling, reporting etc | | | | |
| 9 | Teaching - Shows interest in teaching juniors, Gives appropriate feedback to juniors | | | | |
| 10 | Demonstrates awareness of own strengths and areas for growth; actively integrates feedback as part of an ongoing learning process. | | | | |
| | **Workplace Observation Total (max 10 marks)** | | | | |
| | **Logbook (max 10 marks)** | | | | |
| | Other mentions (if any): | | | | |

**JIPMER Radiodiagnosis Work place Observation form - Ultrasound**

<table>
<tr><td colspan="2">No. of ultrasounds done by this student:</td><td colspan="3"></td><td rowspan="3">Work quantity ( max: 5 marks)</td></tr>
<tr><td rowspan="2">EMS duty days for this student num (specify US/CT)</td><td colspan="2">EMS US No.(for all students on duty):</td><td colspan="2">Total EMS CT cases (including plain, for all students on duty):</td></tr>
<tr><td>This student, <u>EMS US diagnostic :</u><br>No. done:</td><td>This student, <u>EMS US procedures:</u><br>No. done:<br>No. observed:</td><td colspan="2">This student,<br><u>Contrast+HRCT numbers:</u><br>No done: No. written: No. approved</td></tr>
<tr><td colspan="3">Spotters attended/conducted Marks acquired/total</td><td>Morning class No. attended/ No. conducted</td><td>Evening Seminar No. taken/ No allotted</td><td>Academics (max: 5 marks)</td></tr>
<tr><td colspan="3"><u>Other Academic Contributions</u></td><td colspan="3">Faculty sign:<br>Grand Total:</td></tr>
</table>

| Activity | Date | Comment | Faculty |
|---|---|---|---|
| | | | |