

Curriculum

DNB Broad Specialty



Radio Diagnosis

- ◆ Programme Goals and Objectives
- ◆ Teaching and Training Activities
- ◆ Syllabus
- ◆ Competencies
- ◆ Log Book
- ◆ Recommended Text Books and Journals

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I. PROGRAMME GOALS AND OBJECTIVES

1. PROGRAMME GOAL

- To make them understand & implement the knowledge regarding the role of various imaging modalities, helpful in the management of different clinical conditions. At the end of his/her training, he/she should be capable to take up a career in teaching institution or in diagnostic center or in research.
- Aimed at imparting training in both conventional radiology and modern imaging techniques so that the candidate is fully competent to practice, teach and do research in the broad discipline of radiology including ultrasound, Computed Tomography and Magnetic Resonance Imaging. Candidate should be well versed with medical ethics and consumer protection act and the Prenatal Diagnostic Technique (PNDT) Act.
- To orient and train student in different aspects of diagnosis with interventional radiology
- Special emphasis will be on new imaging techniques like (USG, CT, MRI) interventional radiology.
- Training will be oriented for technical aspects of clinical radiology and applied radiology and post treatment follow up in cancer.
- Ultimate goal will be to provide quality education for the post graduates and quality diagnostic care for different sections of the society

2. PROGRAMME OBJECTIVES

- Etiology, patho-physiology, and principles of diagnosis and management of common problems including emergencies, in adults and children.
- Demonstrate understanding of basic sciences relevant to this specialty.
- Identify important determinants in a case (e.g. social, economic, environmental) and take them into account for planning therapeutic measures.

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- Recognize conditions that may be outside the area of specialty/competence and to refer them to proper specialist or ask for help.
 - Advise regarding the management (including interventional radiology) of the case and to carry out the management effectively.
 - Update oneself by self-study and by attending courses, seminars, conferences and workshop which are relevant to the field of radio- Diagnosis.
 - Carry out guided research with the aim of publishing his/her work and presenting work at various scientific fora.
 - Take a proper clinical history, examine the patient, perform essential diagnostic/interventional procedures and interpret the results to come to a reasonable diagnosis or differential diagnosis in the condition.
 - Provide basic lifesaving support service in emergency situations.
 - Undertake complete patient monitoring including the care of the patient.
 - Independently conduct and interpreted all routine and special radiological and imaging investigations
 - Interact with other specialists for the maximum patient benefit
 - Undertake further specialization in field of Radiology
 - To conduct teaching program for undergraduate and paramedical and technical staff
 - Adopt ethical principles in all aspects of his/her practice. Professional honesty and integrity to be fostered.
 - Develop communication skills in order to explain the various options available in management and to obtain a true informed consent from the patient.
 - Be humble and accept the limitations of his knowledge and skills and to ask for help from colleagues/ seniors when needed.

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- Respect patient rights and privileges including patient's right to information and right to seek a second opinion.
 - Organize CMES and workshops utilizing modern methods of teaching and evaluation

II. TEACHING AND TRAINING ACTIVITIES

The fundamental components of the teaching programme should include:

1. Case presentations & discussion- once a week
2. Seminar – Once a week
3. Journal club- Once a week
4. Grand round presentation (by rotation departments and subspecialties)- once a week
5. Faculty lecture teaching- once a month
6. Clinical Audit-Once a Month
7. A poster and have one oral presentation at least once during their training period in a recognized conference.

The rounds should include bedside sessions, file rounds & documentation of case history and examination, progress notes, round discussions, investigations and management plan) interesting and difficult case unit discussions.

The training program would focus on knowledge, skills and attitudes (behavior), all essential components of education. It is being divided into theoretical, clinical and practical in all aspects of the delivery of the rehabilitative care, including methodology of research and teaching.

Theoretical: The theoretical knowledge would be imparted to the candidates through discussions, journal clubs, symposia and seminars. The students are exposed to recent advances through discussions in journal clubs. These are considered necessary in view of an inadequate exposure to the subject in the undergraduate curriculum.

Symposia: Trainees would be required to present a minimum of 20 topics based on the curriculum in a period of three years to the combined class of teachers and

students. A free discussion would be encouraged in these symposia. The topics of the symposia would be given to the trainees with the dates for presentation.

Clinical: The trainee would be attached to a faculty member to be able to pick up methods of history taking, examination, prescription writing and management in rehabilitation practice.

Bedside: The trainee would work up cases, learn management of cases by discussion with faculty of the department.

Journal Clubs: This would be a weekly academic exercise. A list of suggested Journals is given towards the end of this document. The candidate would summarize and discuss the scientific article critically. A faculty member will suggest the article and moderate the discussion, with participation by other faculty members and resident doctors. The contributions made by the article in furtherance of the scientific knowledge and limitations, if any, will be highlighted.

Research: The student would carry out the research project and write a thesis/ dissertation in accordance with NBE guidelines. He/ she would also be given exposure to partake in the research projects going on in the departments to learn their planning, methodology and execution so as to learn various aspects of research.

Posting

The postgraduate student should be posted in all sections (Conventional radiology, U/S, CT, MRI etc.) so that there is adequate exposure to all modalities. The proposed duration of postings is as under.

- Conventional 10 to 14 months
- U/S 10 to 12 months
- CT / MRI 10 to 12 months

Schedule for Rotation of Residents

1st Year	Musculoskeletal	Emergency	US	US	Chest	Chest
	GU	GU	GIT	GIT	CT	CT
2nd Year	US	US	Chest	Musculoskeletal	Emergency	Emergency

	CT	CT	Intervention US / CT	US	MRI	MRI
3rd Year	GIT	GIT	US	US/CT Intervention	CT	CT
	MRI	MRI	US	Chest	Elective	Elective

Radiological Procedure which the candidates must know

S No.	Name of Procedure	As Observer	As first assistant	Independently supervision	under
	RADIODIAGNOSIS				
1	Dark room(each step)	20	20	100	
2	CYR & apicogram & H-virus, decabities	20	20	50	
3	Other X-rays(extremities & spine)	20	20	20	
4	Skull	100	50	100	
5	Fluroscopy	50	50	50	
6	Barium Swallow BMUGI BMFT (& Enteroclysis) B enema	10	10	50	
7	IVP, MCU, RGU	10	10	30	
8	Tube based procedures	20	20	20	
	<ul style="list-style-type: none"> • nephrostmy-T tube • sinogram, fistulogram 				
9	Drainage procedures	10	10	50	
10	Biopsy / FNAC	10	10	50	
11	Doppler	50	100	100	
12	TRUS, TVS	50	50	100	
13	Neonatal cranial USG	10	20	20	

Radiological procedures which the candidates may know/desirable

Name of procedure
RADIO DIAGNOSIS
CT enteroclysis Dark
MR enteroclysis

Diffusion & perfusion & MRS
Angiography <ul style="list-style-type: none"> • CT • MR
DSA
Sonourethrography
Bowel Ultrasound
USG contrast
Transcranial
Interventional Radiology
Nuclear Imaging <ul style="list-style-type: none"> • Echocardiography • Angiography

Investigations/ tests which the candidates must know to interpret

Name of Investigations
ERCP
PTC
Arteriography/Venography
CT cisternography
CT Myelography, Myelogram
MRCT
MRCP
CT/MR Angiogram/ Venogram

III. SYLLABUS

Physics related to Radio diagnosis

- Introduction to general properties of radiation and matter. Fundamental of nuclear physics and radioactivity.
- Production of x-ray
- X-ray generating apparatus
- Interaction of x-rays and gamma rays with matter and their effects on irradiated materials.
- Measurement of x and gamma rays
- Interaction of x-rays with the patients
- Radiographic image

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- The image receptor
 - Contrast media.
 - Radiation protection & Radiation hazard
 - Picture archiving and communication system (PACS) and Radiology Information system
 - Image quality and quality assurance
 - Radionuclide imaging (gamma camera, spect. PET)
 - Computed tomography
 - Principles of diagnostic ultrasound and Doppler
 - Magnetic resonance imaging

Radiography and Processing techniques

- Dark room technique
- Radiography of the extremities
- Radiography of the spine, abdomen, pelvic girdle and thorax
- Radiography of the skull
- Contrast techniques of GI tract, biliary tract, GU tract
- Contrast techniques of C.N. system
- Contrast techniques of the cardio vascular system including chest
- Miniature radiography, macro radiography & magnification techniques
- Pediatric Radiography
- Dental, portable and emergency radiography
- Contrast & contrast reactions
- Quality Assurance

Anatomy

- Gross and cross sectional anatomy of all the body systems.

Pathology

- Gross morphology of pathologies condition of systemic disease.

Radiodiagnosis – Course Contents

Various diseases involving the following systems-

- Musculoskeletal System
- Respiratory System
- Cardio-vascular system
- Gastro-intestinal tract including Hepatobiliary system

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- Urogenital tract.
 - C.N.S. including spine
 - Radiology of obstetric and Gynecology
 - E.N.T, EYES, Teeth, soft tissue, Breast.
 - Endocrinal Glands
 - Clinical applied radionuclide imaging.
 - PAC'S, digital radiography and other recent advances, molecular and Functional imaging.
 - Emergency radiology and trauma
 - Interventional Radiology related to different system of the body.
 - Radiation Physics.

Contrast Agents: -

Contrast media, their type, formulation, mechanisms of action, dose schedule, routes of administration, adverse reactions and their management and recent development.

The Respiratory System

- The normal chest, methods of investigations, techniques, interpreting chestradiograph and disease differential diagnosis. The mediastinum, chest wall, pleura and diaphragm; Diseases of airways: collapse and consolidation; pulmonary infections; pulmonary neoplasm's;
- Diffuse lung diseases; occupational lung disease; chest trauma, pulmonary thromboembolism; chest in critical care patients, interventional techniques; chest in neonates, and pediatric chest radiology.

The Cardiovascular System:

- Goal is to provide experience in the role of imaging in cardiovascular diseases by different techniques including cardiac catheterization and cardiac angiography, Digital subtraction angiography (DSA) and interventional procedures in non cardiac arterial and venous diseases
- Diseases and disorders of cardiovascular system including congenital conditions and the role of imaging by conventional, ultrasound, Echo, color-Doppler, CT, MRI, angiography (including DSA) and radionuclide studies. It also includes interventional procedures e.g; balloon angioplasty, embolization etc.

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- Understand the anatomy and common pathology of congenital and acquired cardiac conditions.
 - Correlate plain film findings of common congenital abnormalities with those shown by angiography and explain the pathophysiology including abnormal pressure measurements.
 - Correlate plain film findings and the echocardiographic studies of patients with acquired valvular diseases and other common pathologic conditions including pericardial pathology.
 - Understand the role of newer modalities like CT/MRI, in aortic diseases e.g., aorto- arteritis, aortic dissection and aortic aneurysm.
 - Should be able to perform fluoroscopy on patients before and after valve replacement and identify those with complications after valve replacement.
 - Understand the principle and logic behind various interventional procedures carried out in the cardiovascular labs e.g; PTCA, balloon dilatation of valvular lesions, septostomy etc.
 - The normal heart: anatomy and techniques of examination.
 - Acquired heart disease
 - Techniques: the chest radiograph, non-invasive imaging echocardiography, nuclear imaging, CT, MRI. Invasive imaging and interventional techniques
 - Congenital heart disease, ischemic heart disease, radiology of pulmonary circulation, cardio my apathies and tumors, pericardial disease cardiac transplant surgery; role of Radiology in cardiac prostheses and
 - pacemakers, Arteriography and interventional angiographic techniques, Phlebography

The Abdomen and Gastrointestinal Tract

- Basic anatomy and physiology in clinical practice relevant to imaging examinations of the gastrointestinal tract, hepatobiliary tract, pancreas

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- Clinical significance of pathology associated with clinical presentation and link with likely diagnoses
 - Construction of appropriate imaging pathway and protocol considering different pathologies and management options and according to available resource and case complexities
 - Common surgical procedures, expected post-operative imaging appearances and common complications
 - Understand indications, contraindications and limitations of relevant specialized barium/contrast imaging examinations of the gastrointestinal and hepatobiliary tract
 - Role of plain films in modern era imaging of GIT
 - Conventional examination of GIT using barium and water soluble contrast media- esophagus, upper gastrointestinal study, follow through for small bowel (including small bowel enteroclysis) and enema (both conventional and double contrast) for colon.
 - Other investigations done using fluoroscopic guidance - fistulogram, sinogram, t-tube cholangiography, sialography etc.
 - Examination of liver, biliary system and pancreas using all the imaging modalities available to a radiologist including specialized investigations like ERCP, PTC and interventional procedures like abscess drainage, percutaneous trans hepatic biliary drainage (PTBD, internal and external), tumor embolization, radiofrequency(RFA) ablation etc.
 - Indications and limitations of ultrasound, CT and MR
 - Understand indications, limitations and contraindications of various interventional radiology techniques
 - Diseases and disorders of GIT, omentum, peritoneum and mesentery. Diseases and disorders of hepato-biliary-pancreatic system. Conventional and other imaging methods like US, CT, MRI, DSA and isotope studies pertaining to these systems.
 - The Abdomen : Normal appearance, abdominal calcification, acute abdomen, pneumoperitoneum, post operative abdomen, Intraperitoneal fluid, inflammatory conditions, intraabdominal abscesses, intramural gas and other conditions.
 - The Esophagus-anatomy and normal appearances, radiological investigation like barium, usg, including endovascular, CT, MRI. diseases- hiatus hernia, oesophagitis, neoplasm, esophageal Varices, associated dermatological conditions, trauma, esophageal web, motility disorders, eosophageal

diverticulum, extrinsic esophageal compression, post operative changes, scintigraphy.

- The Stomach - anatomy and normal appearances, radiological and imaging investigations, inflammatory diseases, tumors, structural and functional abnormalities, extrinsic masses, post operative stomach- USG, CT, MRI, examination, radionuclide studies.
- The Duodenum and small bowel-anatomy and normal appearances, radiological investigations (Barium meal follow through, enteroclysis, CT,MRI, with CT/MRI enteroclysis, virtual endoscopy). diseases- neoplasms, infections, and infestations, radiation enteritis, mechanical small bowel intestinal obstruction, ischemia, intramural hemorrhage, diverticulitis, and blind loop, neuromuscular disorders, malabsorption syndromes, immunological disorders, radionuclide studies of small bowel.
- Large Bowel-Anatomy, colonic function, investigations like (Barium, CT, MRI, Colonography, virtual colonoscopy), diseases- tumors, diverticular diseases, colitis, miscellaneous conditions, appendicitis, Scintigraphic detection of bleeding,
- Abdominal imaging-
Liver: gross anatomy, plain film diagnosis, investigations like USG, CT, MRI, MRCP, PTC, ERCP, T-tube cholangiography, vascular studies, hepatobiliary interventions., portal hypertension, focal masses, diffuse liver disease, inflammatory disease of liver, gall bladder and biliary diseases, gall bladder masses, radiology in liver transplantation. Radiology of spleen pancreas, peritoneum and mesentery, Pancreas; embryology, radiological anatomy, techniques of examination, radiological diagnosis and interventional treatment
- GI manifestation of AIDS; Radiological evaluation, techniques, lesions, oesophagitis, lesions involving stomach, small bowel, colon, biliary tract, lymphadenopathy.
- GI angiography – general considerations, celiac and hepatic, pancreatic, SMA & IMA angiography, GI bleeding, angiography in portal hypertension, PTA and mesenteric ischemia.
- Newborn and young infant: lesions causing obstruction, atresia, gastric, antral or pyloric atresia, small bowel atresia, anal atresia and imperforate anus, anomalies of rotation and mid gut volvulus, enteric duplication, hypertrophic pyloric stenosis, gastro esophageal reflux and hiatus hernia, Hirschsprung's disease, colonic immaturity, neonatal small left colon syndrome, meconium plug syndrome, meconium ileus, intussusceptions, necrotizing enterocolitis
- Role of Imaging in Fetal Medicine

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- Acute abdomen - investigations and interpretations with abdominal trauma imaging
 - Radiology of Post-operative abdomen and organ transplantation (Liver, Pancreas, etc.)
 - Ischemic conditions of Bowel and Mesentery and role of arteriography and Doppler study
 - Upper and lower GI bleeding and GI radiological investigations including scintigraphy
 - GI manifestation of AIDS; Radiological evaluation, techniques, lesions, esophagitis, lesions involving stomach, small bowel, colon, biliary tract, lymphadenopathy

Endocrine Disease

- Introduction, Pathophysiology, radiological techniques, hypothalamus, pineal, pituitary, thyroid, para thyroid, thymus, pancreas, GI tumors, adrenal, female reproductive system, male reproductive system

Genito-Urinary System –

- Applied anatomy to interpret uro-gynaecological imaging
- Clinical significance of pathology associated with presentation and link with likely diagnoses
- Knowledge of local/regional guidelines in relation to clinical presentation
- Various diseases and disorders of genito-urinary system including congenital, inflammatory, infectious, traumatic, neoplastic, calculus disease and miscellaneous conditions.
- Performance, direction and interpretation of the conventional radiological examinations of the urinary tract including: intravenous urography; cystograms, micturating cystourethrography (MCU), hysterosalpingography (HSG) and retrograde urethrography (RGU).
- Diagnostic imaging modalities and procedures which are used to evaluate urinary tract pathology i.e. Ultrasound, CT, MRI, angiography, as well as various interventional procedures like percutaneous nephrostomy, radio frequency ablation (RFA), kidney biopsy, stent placement, antegrade pyelography, tumor embolization etc.
- Emergency conditions involving the urinary tract including trauma, infection, vascular compromise and obstruction.
- Evaluation of renal mass lesions and the evaluation of other urinary tract neoplasms, including the detection and staging of the tumor.

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- Recognition of the difference between the pattern of diseases affecting the genitourinary tract of adults and that of children and understand and identify the common conditions affecting the pediatric genito-urinary system on imaging.
 - Evaluation of renal failure & post-transplant kidney.
 - Miscellaneous including cystic disease of kidney, nephrocalcinosis, lower urinary tract obstruction/infection and post-operative problems, male infertility imaging and interventions and trauma of genito-urinary tract
 - Interventional Uroradiology – Percutaneous nephrostomy, renal cyst puncture, FNAC and ureteric stenting.
 - The female reproductive system: ultrasound in obstetrics and gynecology, antenatal ultrasound including TIFFA, NT/NB, obstetric doppler evaluation
 - , imaging in gynecology, MRI of female pelvis, radiological techniques in obstetrics and gynecology, congenital anomalies of female genital tract, inflammatory diseases, tumors of pelvis.
 - Imaging in infertility with detailed knowledge of HSG
 - Methods of investigation – plain films, IVU, MCU, ultrasound, CT scanning, MRI, MR-angiography, antegrade pyelography, retrograde pyelography, cavernosography, radionuclide imaging. Nuclear medicine in genitourinary tract, clearance techniques, dynamic renal scan, static renal scan, V-U reflux, role of radionuclide scanning in renal infections, Urodynamics, lower urinary tract studies, applications in bladder instability, urinary incontinence, outflow obstruction, neurogenic bladder, & upper urinary tract, disease.
 - Renal parenchymal disease; anatomy, normal appearances, differential diagnosis, renal infections. Renal masses: modalities available for diagnosis, non-neoplastic renal masses, neoplastic renal masses - benign and malignant, calculus disease and urothelial lesions, nephrocalcinosis, other lesions, staging of upper urinary tract tumors, staging of bladder tumors.
 - Urinary obstruction: Pathophysiology, diagnosis by different modalities, non obstructive dilatation, causes of obstruction, urinary bladder; normal anatomy, radiological evaluation, pathologies, prostate: Normal anatomy, radiological investigations, congenital processes, infection, calculi, tumors, BHP, carcinoma. Reno vascular hypertension, renal arteriography, Reno vascular disorders, Reno vascular HT - etiology, management, investigative strategy, identification of renal artery stenosis, significance of renal artery stenosis, radiological treatment of Reno vascular hypertension, PTA, embolization in Reno vascular HT. Injuries to urinary tract-kidney, ureter, bladder and urethra classification of renal injuries, principles of management, evaluation, imaging, modalities, radiological

findings, complications. Renal failure and transplantation; renal size and collecting system dilatation, diagnosis of causes of failure, transplant - investigation of donor, IVU, vascular studies, radionuclide imaging, evaluation of recipient, surgical techniques, transplant kidney – radionuclide imaging, ultrasound, angiography, CT, MRI and complications of transplantation.

- Paediatric urology: introduction, techniques, embryology, congenital anomalies, neonatal conditions, infections and V-U reflux, hypertension in a child, renal tumors in childhood.

Musculoskeletal System

- Skeletal Trauma: General conditions, spine: cervical, thoracolumbar, pelvis and acetabulum, appendicular skeleton. General classification of bone lesions, benign tumors & cysts of bone, giant cell tumors, tumors of fibrous origin, other tumors, tumor like conditions synovial tumors, malignant bone tumors, metastatic lesions, primary malignant tumors,– chondral origin, osteoid origin, fibrous origin, marrow origin, notochord origin, synovial origin, other tumors.
- Bone and joint infections: periostitis and osteomyelitis, chronic osteomyelitis, bone and joint infections, in neonates, infections arthritis, granulomatous arthritis, parasitic and fungal infections, viral disorders, sarcoidosis, diabetic osteopathy, infected prostheses.
- Metabolic and endocrine diseases of the skeleton, anatomy, and physiology; increase and decrease in the bone density, generalized or localized; quantitative bone mineral analysis. Skeletal dysplasia's; normal bone growth, disorders affecting growth plate, disorders affecting epiphysis and apophyses metaphyses, diaphyses, mucopolysaccharidoses, mucopolysaccharidoses, miscellaneous conditions including neurofibromatosis and Paget's disease, chromosomal disorders; Cranio – vertebral instability, joint disorders, Patho physiological concept and diagnostic approach Inflammatory (synovial) arthropathies, connective tissue disorders, crystal deposition arthropathies, degenerative joint arthropathies, degenerative disease of spine, arthrography, radiology of soft tissues; imaging techniques, focal lesions, calcification and ossification. Gas in soft tissue, soft tissues tumors; musculo skeletal system in children-development and nutrition; Congenital anomalies and bone Dysplasia, inflammatory neoplastic, traumatic, endocrine, metabolic and systemic skeletal disorders in children; radiology of child abuse;
- Musculo Skeletal CT (computed tomography), techniques aspects of clinical applications; in trauma; musculo skeletal infections neoplasm's and low-back

pain syndromes, quantitative bone mineral analysis, uses in joint diseases, CT-based interventional techniques

- Musculo skeletal MR (Magnetic Resonance Imaging), normal signals, bone marrow-reconversion, infiltration or, replacement, bone marrow edema, myeloid depletion, bone ischemia, bone tumor imaging, joint imaging; Radionuclide bone imaging: Technique, normal bone scan, specific applications.
- Ultrasound in Musculoskeletal system for assessment of muscular, tendinous and ligamentous pathologies and joint.

Central Nervous System:

- Methods of examination and diagnostic approach; cranial and intracranial pathologies, intracranial tumors- supra and infratentorial, pituitary tumors, intracranial infections, degenerative disorders, demyelinating disorders, cerebro-vascular ischemia, intracranial vascular abnormalities, HIV infections- cerebral complications.
- Spine: methods and diagnostic approach. Plain Radiography, CT, MRI, Myelography, spinal angiography. Radionuclide imaging of CNS- Radiopharmaceutical and bloodbrain barrier(BBB), scintigraphy, radionuclide arteriography, positron emission tomography(PET), receptor imaging, monoclonal body imaging, ultrasound of infant brain.

Ophthalmology, ENT and Face; Maxillofacial and Dental Radiology

- Orbits: anatomy and techniques, intraocular abnormalities, orbital pathology, orbital trauma, inflammatory disease, space occupying lesions;
- Nose and Para nasal sinuses, Ear-Anomalies or development, methods of investigation, HRCT temporal, anatomy and diseases, MRI for inner ear, mouth, pharynx and larynx, Para pharyngeal spaces.
- Ocular ultrasound and its applications in detection of posterior segment diseases
- Neck anatomy on various modalities and diseases and application of various imaging modalities like CT, MRI, and Isotope studies, PET, SPECT etc
- Neck spaces anatomy in relevance to spread of various diseases across different spaces and compartments.
- Diseases Involving larynx- congenital, infectious, inflammatory and neoplastic
- Malignant & benign neoplastic diseases of head and neck region
- MRI for inner ear, mouth, pharynx and larynx, Para pharyngeal spaces.
- Maxillofacial pathology, fracture, benign lesions, malignant lesions, differential diagnosis of radiolucent and radio opaque lesions, abnormalities of growth and

development, temporomandibular joint, salivary glands, soft tissue calcification, dental radiology, anatomy of teeth and supporting structure

- Dental radiology, anatomy of teeth and supporting structure
- Developmental anomalies, eruption of teeth, dental caries, pulpitis and periapical infection, periodontal disease, fracture of teeth and alveolar bone, resorption of teeth, Neck anatomy on various modalities and diseases.

Reticuloendothelial Disorders

- Lymphoma-pathology and imaging, spleen- Imaging, interventional techniques
- Imaging in oncology-General methods in oncological diagnosis, staging and follow-up, ovarian tumors, nonseminomatous germ cell tumor, colorectal cancers, lung cancer and others
- Radiotherapy, treatment planning, interventional radiology-complication and treatment, radionuclide imaging in oncology, HIV infection and AIDS (Acquired immunodeficiency syndrome), background, epidemiology, treatment pathogenesis, natural history diagnosis complication and treatment
- Myeloproliferative disorders: red blood cell disorders, chronic hemolytic anemia's, other anemia's and bone marrow dyscrasias, white cell disorders, lymphoma, plasma cell disorders, reticulo- endothelial disorders, hemophilia and other bleeding disorders

Angiography –intervention and other techniques

- Embolization, Percutaneous Trans luminal angioplasty, regional arteriography, head and neck, thorax, abdomen, upper and lower extremity angiography, angiography for endocrinal glands.

Venography

- Technique and complications, regional venography of head and neck, thorax and abdomen-SVC venography, IVC venography, Azygos and ascending lumbar venography, Mesenteric and portal venography, gonadal venography, pelvic venography, venous sampling, interventional technique in venous system.

Vascular Imaging

- Doppler Ultrasound, clinical applications, volumetric flow measurements, color- flow imaging, artifacts, error and pitfalls, power Doppler and endovascular ultrasound
- Interventional radiology: informed consent, biopsy procedures

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- Percutaneous decompression, extraction and drainage
 - Image guided therapy
 - Interventional vascular techniques
 - Percutaneous techniques for vascular extractions impact on medicine and radiology

The Breast:

- Understand anatomy and physiology of breast, changes with age and patterns of disease spread and principles of differentiation between normal breast, benign and malignant disease
- Physics of image production and how it affects image quality with respect to mammography, ultrasound & breast MRI with indications for and determining optimal imaging examination
- Clinical presentation, pathogenesis and basic principles of treatment of breast disease
- Role of conventional and digital mammography in screening of breast cancer, benign and malignant lesions of the breast
- Understand basic principles underlying population screening and assessment of screen detected abnormalities
- Breast ultrasound - discriminate cystic v solid mass; recognize typical features of benign and malignant masses; identify and discriminate between normal and abnormal axillary lymph nodes.
- Image guided cyst aspiration, abscess drainage, fine needle aspiration and core biopsy under supervision, Vacuum assisted biopsy (VAB), stereotactic FNAC and biopsy, ductography.
- BIRADS and New BIRADS system for lesion characterization and quality assurance
- MRI breast with emphasis on use of volume MR with newer sequences in breast imaging like DWI & PWI
- Breast tomosynthesis
- Role of breast cancer screening and guidelines
- The mammographic technique, equipment and quality control, indications for mammography, normal anatomy, benign conditions, carcinoma, calcifications, breast screening, lesion localization, breast ultrasound. Role of MRI, PET, thermography, Elastography, CT, Image guided interventions for diagnosis and therapy of breast lesions

Diagnostic Techniques and General Conditions-

- Picture archiving and communication systems and digital radiology, intravascular iodinated contrast media, general principles of ultrasound, vascular ultrasound, recent developments in whole body Computed tomography, Basic principles of Magnetic Resonance Imaging, General Principles of Radionuclide imaging, dual energy X-ray absorptiometry, functional imaging, medico legal issues in diagnostic and interventional radiology, patient dosage and radiation protection in diagnostic imaging cost benefit.

Radiology Emergency Medicine

- The student should be able to evaluate emergency radiographic examinations with reasonable accuracy and have clear understanding of the protocol of imaging in emergency situations of different organ systems.

Diagnostic Techniques

General Radiology

The student should be able to evaluate conventional radiographs including radiographs on chest abdomen, pelvis, skull (including PNS+Orbit), spine, musculoskeleton and soft tissues. Student should be able to perform radiography of different body parts.

Ultrasound

The student should be able to perform and interpret all ultrasound studies. These studies include: abdomen, pelvis, small parts, neonatal head, breast, color duplex imaging (arterial and venous studies), obstetric/gynecology and intervention procedures using ultrasound guidance.

CT

- Select CT protocol according to the clinical diagnosis.
- Demonstrate knowledge of the CT finding of the common pathological conditions.
- Interpret conventional and modified body CT examinations like HRCT, dual/triple phase, Vertical CT etc.
- Know limitations of CT in the diagnosis of certain diseases.
- Perform CT guided simple interventions (under supervision)

Angiography

Should be able to perform (under supervision) and interpret routine angiographic procedures and vascular interventions.

MRI

- Select MRI protocol according to the clinical diagnosis
- Knowledge of conventional and modified MRI examinations, including MRA, MRV, MRCP, MRS.
- Demonstrate knowledge of the MRI of the common pathological conditions.
- Mammography and Breast Intervention

Interventional Radiology

The student should be able to perform (under supervision) simple interventional procedures of all the organ systems.

- Vascular interventional radiologic procedures such as Percutaneous transluminal angioplasty, stenting, embolization using various embolic material and arterial & venous thrombolysis.
- Various non-vascular interventional procedures such as percutaneous nephrostomy, stenting, abscess drainage, PTC/PTBD, biliary stenting percutaneous US/CT guided biopsy, balloon dilatation of the esophagus etc
- Regional arteriography of head and neck, thorax, abdomen, upper and lower extremities.
- Venography; technique and complications, regional venography of head and neck, thorax and abdomen-SVC venography, IVC venography, Portal venography, gonadal venography, pelvic venography, venous sampling, interventional technique in venous system
- Trans arterial chemoembolization & Trans arterial radio embolization – indications, technique and complications
- Doppler evaluation and endovascular management of varicose veins
- Neurointerventions in stroke. Aneurysm, AVM, fistula
- Bone biopsy
- Radiofrequency ablation: indications, techniques and contraindications
- Digital subtraction angiography: equipment, applications,
- Radiation protection during interventional procedures

Recent Advances in Radiology

Oncologic Radiology

- At the end of the rotation the resident should be able to interpret radiological investigations in patients with neoplastic diseases (both benign and malignant)
- Understand pathology and patho-physiology of common neoplasms.
- Learn the algorithmic approach to image these patients based on the suspected disease, its biological behavior and potential and limitations of various imaging modalities.
- Perform appropriate investigation (both conventional and newer methods), interpret the results and reach at a reasonable diagnosis/ differential diagnosis based on the clinical and biochemical results.
- Learn to communicate the results in a precise way in a written report to the concerned unit.

Nuclear Medicine

- At the completion of this rotation the resident should be able to interpret common nuclear medicine examinations (including cardiac cases).
- Student should be able to evaluate the examinations for completion and determine what further images (including non nuclear medicine) need to be done.
- Student should have a good understanding of the physical and biological properties of the commonly used radiopharmaceuticals and become familiar with safe handling of isotopes and basic radiation safety measures while dealing with isotopes.

Biostatistics, Research Methodology and Clinical Epidemiology

Ethics

Medico legal aspects relevant to the discipline

Health Policy issues as may be applicable to the discipline

Practicals

- **Physics**
 - Film characteristics

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- Effectiveness of Lead Apron and other protective Devices
 - Beam parameters check
 - Optical Radiation field alignment
 - Assessment of Scatter radiation
 - Quality control of X-rays and Imaging equipments
 - Evaluation of performance of a film processing unit

 - **Practical radiography**
 - Dark room techniques
 - Radiography of the extremities
 - Radiography of the spine, abdomen, pelvic girdle and thorax
 - Radiography of the skull
 - Contrast techniques and interpretation of GI tract, biliary tract, etc.
 - Contrast techniques and interpretation of the Genito-urinary system
 - Contrast techniques and interpretation of the central nervous and cardiovascular system
 - Miniature radiography, Macro-radiography and magnification techniques
 - Dental and portable radiography

 - **Anatomy**
 - Gross and cross sectional Anatomy of all the body systems

 - **Pathology**
 - Gross morphology of pathological condition of various systems

 - **Contrast Media**
 - Their types, formulations, mechanism of action, dose schedule, routes of administration, adverse reactions and their management.

IV. COMPETENCIES

1. General Principles

Acquisition of practical competencies being the keystone of postgraduate medical education, postgraduate training is skill oriented. Learning in postgraduate program

is essentially self directed and primarily emanating from clinical and academic work. The formal sessions are merely meant to supplement this core effort.

2. Teaching Sessions

In addition to conducting and reporting of routine and special investigation in the area of posting under direct supervision, formal teaching session to be held on working days. These include seminars in physics and general radiology, journal clubs, case presentations; Interdepartmental meets, Film reading session.

3. Teaching Schedule

The suggested departmental teaching schedule is as follows:

- Seminar
- Film Reading
- Case presentation
- Inter department meet
- Journal club
- Statistical meetings: Weekly./ monthly
- Mortality meetings
- Interdepartmental Meetings
- Film Reading / Physics Seminar

Note

- All sessions will be co-ordinate by the faculty members.
- All the teaching sessions to be assessed by the consultants at the end of session and graded
- Attendance of the Residents at various sessions should be at least 75%

V. LOG BOOK

A candidate shall maintain a log book of operations (assisted / performed) during the training period, certified by the concerned post graduate teacher / Head of the department / senior consultant.

This log book shall be made available to the board of examiners for their perusal at the time of the final examination.

The log book should show evidence that the before mentioned subjects were covered (with dates and the name of teacher(s) The candidate will maintain the record of all academic activities undertaken by him/her in log book.

1. Personal profile of the candidate
2. Educational qualification/Professional data
3. Record of case histories
4. Procedures learnt
5. Record of case Demonstration/Presentations
6. Every candidate, at the time of practical examination, will be required to produce performance record (log book) containing details of the work done by him/her during the entire period of training as per requirements of the log book. It should be duly certified by the supervisor as work done by the candidate and countersigned by the administrative Head of the Institution.
7. In the absence of production of log book, the result will not be declared.

VI. RECOMMENDED TEXT BOOKS AND JOURNALS

1. MUST READ

- Sutton: Text book of Radiology and Imaging volume-I-II.
- Grainger and Allison's Diagnostic Radiology: Text book of Medical Imaging
- Haaga J.R.: Computed Tomography and MRI volume-I and II. PG
- Rumack: Diagnostic ultrasound volume I & II

2. REFERENCE BOOKS

- Lee: Computed body tomography with MRI volume-I & II
- Osborn A.G.: Diagnostic neuro-radiology
- Jacobson's: Radiology of skeletal disorders
- Gore Levine: Text book of Gastrointestinal Radiology
- Margulis: Alimentary tract radiology volume I & II
- Davidson's: Radiology of the kidney and Genito-urinary tract
- Clark: Positioning in radiology Dahnert: Radiology Review Manual
- Webb: High Resolution CT of the lung
- Som and Curtin: Head and neck imaging
- Stark and Bradley: Magnetic resonance imaging Volume I & II
- Scott W. Atlas: MR imaging of the brain and spine

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- Mittelstaedt CA : General ultrasound
 - Callen: Ultrasonography in obstetrics and gynaecology
 - David Sutlon . Text book of Radiology & Imaging
 - Lee Stanley
 - Hagea
 - Osborn
 - Manju Pandey – Biostatistics

3. JOURNALS

- Indian Journal of Radiology
- Radiology
- Radiological Clinics of North America
- Seminars in U/S, CT and MRI
- American Journal of Neuro-Radiology
- Clinical Radiology
- Radiology
- Neuro Radiology
- Journal of USG, CT, MRI
- A J R
- Seminars in Roentgenology
- RCNA



आयुर्विज्ञान में राष्ट्रीय परीक्षा बोर्ड
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