JSS ACADEMY OF HIGHER EDUCATION & RESEARCH
(DEEMED TO BE UNIVERSITY) MYSURU

JSS Academy of Higher Education & Research
(Deemed to be University)
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Sri Shivarathreeshwara Nagara Mysuru - 570015, Karnataka

Regulation & Syllabus

MD RADIODIAGNOSIS

2020

Competency Based Medical Education (CBME)

P.G CURRICULUM

For

M.D IN RADIODIAGNOSIS

DEPT OF RADIO-DIAGNOSIS
JSS MEDICAL COLLEGE,
JSS ACADEMY OF HIGHER EDUCATION AND RESEARCH
MYSURU, KARNATAKA

SYLLABUS FOR MD RADIO DIAGNOSIS

Preamble:

The purpose of PG education is to create specialists who would provide high quality health care and advance the cause of science through research & training.

The Goal of this program is to impart training in conventional and modern radiology and imaging techniques so that the post graduate student becomes well versed and competent to practice, teach and conduct research in the discipline of radiology. The student should also acquire basic knowledge in the various sub-specialities of radiology

The purpose of this document is to provide teachers and learners illustrative guidelines to achieve defined outcomes through learning and assessment.

PROGRAM OUTCOME

PO1: Expertise in Imaging Techniques: Post graduates will possess in-depth knowledge and practical skills in various imaging modalities such as X-ray, CT scan, MRI, ultrasound, Doppler and nuclear medicine.
PO2: Diagnostic Accuracy: Students will demonstrate the ability to accurately interpret and diagnose medical images, making use of advanced radiological techniques and their understanding of pathological conditions.

PO3: Patient Management: Post graduates will be proficient in effectively communicating with patients, understanding their medical history, correlating clinically and guiding them through the imaging process, ensuring their comfort and safety.
PO4: Research and Innovation: Students will develop research skills and contribute to the advancement of radiological science by conducting research, publishing papers, and participating in conferences, fostering innovation in the field including the latest advancements such as artificial intelligence.
PO5: Radiation Safety and Protection: Post graduates will possess a comprehensive understanding of radiation safety principles, ensuring proper use of radiological equipment and minimizing radiation exposure for patients and healthcare professionals.
PO6: Team Collaboration: Students will excel in collaborating with multidisciplinary healthcare teams, effectively communicating and providing accurate radiological information to aid in the diagnosis and treatment planning of patients.
PO7: Quality Assurance: Post graduates will implement quality control measures to ensure the accuracy and reliability of radiological equipment and imaging protocols, adhering to national and international standards.
PO8: Professional Ethics: Students will demonstrate a strong commitment to ethical practices, respecting patient confidentiality, maintaining professional integrity, and upholding the highest standards of patient care.
PO9: Lifelong Learning: Post graduates will possess a mindset of continuous learning, keeping up with the latest advancements in radiology, attending workshops, conferences, publishing and pursuing further specialization to enhance their knowledge and skills.
PO10: Leadership and Management: Students will develop leadership skills, enabling them to effectively manage radiology departments, mentor junior colleagues, and contribute to the development and implementation of policies and protocols in healthcare institutions.

Course outcomes:

Paper I: Basic sciences related to Radiology (consists of Anatomy, Pathology, Basic and Radiation Physics, Imaging Techniques and Film processing).
CO1: Comprehensive Anatomy Knowledge: Develop a comprehensive understanding of anatomical structures relevant to radiology, enabling accurate identification and interpretation of imaging findings.

CO2: Acquire the ability to recognize and interpret pathological changes and disease processes on radiological images, aiding in accurate diagnosis and treatment planning

CO3: Gain a solid foundation in radiation physics principles, ensuring a thorough understanding of radiation safety, dose optimization, and quality control in radiological practice

CO4: Develop proficiency in a wide range of imaging modalities, including X-ray, CT scan, MRI, ultrasound, doppler and nuclear medicine, allowing for accurate selection and utilization of appropriate imaging techniques for different clinical scenarios.

CO5: Acquire expertise in film processing techniques, digital image acquisition, and image quality assessment to ensure optimal visualization and accurate interpretation of radiological images

CO6: To understand and apply the knowledge and principle of radiation protection, both for the patient and the operator.

CO7: To understand the importance of PCPNDT and ensuring to legal compliance, ethical practices and facilitating accurate record keeping regarding pre natal diagnostic techniques.

CO8: Apply the knowledge gained in anatomy, pathology, radiation physics, imaging techniques, and film processing to effectively contribute to clinical decision-making, patient management, and the delivery of high-quality radiological services

Paper II: Chest, CVS, CNS including Head & Neck, Eye, ENT, endocrine and metabolic, paediatric radiology and Mammography.

CO1: Expertise in Chest Radiology: Develop specialized knowledge and skills in interpreting and diagnosing chest radiographic images, including X-rays, CT scans, and MRI scans, to accurately identify and evaluate thoracic abnormalities and diseases.
CO2: Proficiency in Paediatric Radiology: Develop skills in interpreting and diagnosing radiographic images specific to paediatric patients, to accurately assess and manage congenital anomalies, paediatric tumours, and paediatric-specific pathologies.
CO3: Competence in Mammography: Acquire specialized knowledge and skills in breast imaging techniques, including mammography and breast ultrasound, to detect and evaluate breast abnormalities, including breast cancer, cysts, and other breast conditions.

CO4: To be able to analyze the results of the diagnostic procedure, make diagnosis and record the findings and to communicate the report in a concise manner.

CO5: Proficiency in Cardiovascular System (CVS) Radiology: Acquire a comprehensive understanding of various imaging techniques, such as CT angiography and cardiac MRI, to effectively diagnose and assess cardiovascular pathologies, including coronary artery disease, congenital heart defects, and vascular disorders.

CO6: Expertise in Eye Radiology: Gain specialized knowledge in ophthalmic imaging techniques, to diagnose and manage various eye diseases, including retinal disorders, glaucoma, and ocular tumors.

CO7: Proficiency in Central Nervous System (CNS) Radiology: Acquire a comprehensive understanding of various imaging techniques, such as CT scans, and MRI scans apart from CT AND MR Angiography, to effectively diagnose and assess CNS pathologies, including infarcts, tumours, congenital anomalies, vascular disorders and various other anomalies.

CO8: Expertise in Eye Radiology: Gain specialized knowledge in ophthalmic imaging techniques, to diagnose and manage various eye diseases, including retinal disorders, glaucoma, and ocular tumors

Paper III: Abdominal Imaging including GI, GU, Hepatobiliary, musculo-skeletal, Obstetrics and gynaecology and Interventional radiology

CO1: Competence in Gastrointestinal (GI) Radiology: Gain expertise in interpreting imaging studies, such as contrast-enhanced CT scans and fluoroscopy, to diagnose and evaluate gastrointestinal conditions, such as bowel obstructions, inflammatory bowel disease, and gastrointestinal tumors.

CO2: To recognise and evaluate emergency conditions of GIT and urinary tract like trauma, vascular compromise and obstruction on various imaging modalities and to communicate precisely about them to the clinicians.
CO3: To know the proper approach to fluoroscopy: which includes developing proficiency in GIT and GUT fluoroscopy, mastering the equipment with proper radiological protection measures
CO4: Acquire in-depth knowledge of imaging modalities, such as X-rays, MRI, and bone scans, to accurately diagnose and enumerate the radiographic features that differentiate benign and malignant bone tumours, acute and chronic osteomyelitis, discitis (including tb), features of various endocrine and metabolic bone diseases, various form of arthritis, sports injuries & fractures and in other basic musculoskeletal disease
CO5: Mastery of Genitourinary (GU) Radiology: Develop advanced knowledge and skills in imaging techniques, such as ultrasound and CT urography, to diagnose and manage genitourinary disorders, including kidney stones, urinary tract infections, and urological malignancies.

CO6: Know normal vascular anatomy applicable to angiographic procedures performed and know normal anatomy and landmarks to perform other non-vascular procedures

CO7: To understand and apply accordingly the potential risks and complications of any of the above mentioned procedures performed

Paper IV: Recent advances, nuclear medicine; Radiology related to clinical Specialties
CO1: To be able to interpret common nuclear medicine examinations (including cardiac cases) and to be able to determine further imaging needed (non-nuclear medicine also).

CO2: Should have good understanding of physical and biological properties of commonly used radiopharmaceuticals and should be able to ensure basic radiation safety measures while dealing with isotopes.

COD3: Should be able to demonstrate the skills to acquire the knowledge about the recent advances related to radiology

CO5: To understand basics of intervention radiology including minimally invasive procedures advanced therapeutic interventions & precise and targeted treatments and its use for better patient care.

CO6: To develop expertise in applying radiological knowledge and skills to various clinical specialities, including oncology, cardiology, neurology, musculoskeletal, and paediatric radiology, to facilitate accurate diagnoses, guide appropriate treatment strategies, and contribute to comprehensive patient care

SPECIFIC LEARNING OBJECTIVES:

The objective of the program is to train a student to become a skilled and competent radiologist to conduct and interpret various diagnostic/interventional imaging studies (both conventional and advanced imaging), to organize and conduct research and teaching activities and be well versed with medical ethics and legal aspects of imaging/ intervention.

SUBJECT SPECIFIC COMPETENCIES:

A. Cognitive Domain

A post graduate student on completing MD (Radiodiagnosis) should acquire knowledge in the following areas, and be able to:

1. Acquire good basic knowledge in the various sub-specialties of radiology such as chest radiology, neuro-radiology, GI-radiology, uro-radiology, cardio-vascular radiology, musculoskeletal, interventional radiology, emergency radiology, pediatric radiology and women's imaging.

2. Independently conduct and interpret all routine and special radiologic and imaging investigations.

3. Provide radiological services in acute emergency and trauma including its medicolegal aspects.

4. Elicit indications, diagnostic features and limitation of applications of ultrasonography, CT and MRI and should be able to describe proper cost effective algorithm of various imaging techniques in a given problem setting.

5. Decide on the various image-guided interventional procedures to be done for diagnosis and therapeutic management.

6. Able to decide on further specialization to be undertaken in any of the branches in Radiodiagnosis such as gastrointestinal radiology, uro-radiology, neuro-radiology, vascular radiology, musculoskeletal radiology, interventional radiology etc.

7. Able to formulate basic research protocols and carry out research in the field of radiology- related clinical problems.

8. Acquire knowledge and teaching capabilities to work as a post graduate student /consultant in Radiodiagnosis and conduct teaching programmes for undergraduates, post graduates as well as paramedical and technical personnel.

9. Interact with other specialists and super-specialists so that maximum benefit accrues to the patient.

10. Should be able to organize CME activities in the specialty utilizing modern methods of teaching and evaluation.

11. Acquire knowledge to impart training in both conventional radiology and modern imaging techniques so that the post graduate student is fully competent to practice, teach and do research in the broad discipline of radiology including ultrasound, Computed Tomography and Magnetic Resonance Imaging.

12. Acquire knowledge of interventional radiology.

B. Affective Domain:

1. Should be able to function as a part of a team, develop an attitude of cooperation with colleagues, and interact with the patient and the clinician or other colleagues to provide the best possible diagnosis or opinion.

2. Always adopt ethical principles and maintain proper etiquette in dealings with patients, relatives and other health personnel and to respect the rights of the patient including the right to information and second opinion.

3. Develop communication skills to word reports and professional opinion as well as to interact with patients, relatives, peers and paramedical staff, and for effective teaching.

C. Psychomotor domain

Practical Training will include two major aspects:

A) Interpretation of images, and

B) Skill in performing a procedure.

A) Interpretation of images:

The student should be able to interpret images on all imaging modalities of diseases of following organs :

1. Musculo-skeletal System - Interpretation of diseases of muscles, soft tissue, bones and joints including congenital, inflammatory, traumatic, endocrine and metabolic, neoplastic and miscellaneous conditions.

2. Respiratory System - Interpretation of diseases of the chest wall, diaphragm, pleura and airway; pulmonary infections, pulmonary vasculature; pulmonary neoplasm; diffuse lung disease; mediastinal disease, chest trauma; post-operative lung and X-ray in intensive care.

3. Cardiovascular System - Interpretation of diseases and disorders of cardiovascular system (congenital and acquired conditions) and the role of imaging by conventional radiology, ultrasound, colour Doppler, CT, MRI, Angiography and Isotopes Studies.

4. Gastro-intestinal tract and hepato-biliary pancreatic system - Interpretation of diseases and disorders of mouth, pharynx, salivary glands, esophagus, stomach, small intestine, large intestine, diseases of omentum, peritoneum and mesentery: acute abdomen, abdominal trauma. Diseases and disorders of liver, biliary system and pancreas.

5. Urogenital System - Interpretation of various diseases and disorders of genitorurinary system. These include: congenital, inflammatory, traumatic, neoplastic, calculus disease and miscellaneous conditions.

6. Central Nervous System (C.N.S.) - Interpretation of diseases and disorders of the head, neck and spine covering, congenital, infective, vascular, traumatic neoplastic degeneration metabolic and miscellaneous condition.

7. Imaging in Emergency Medicine.

8. Imaging in Obstetrics and Gynecology.

9. Imaging of Breast and interventional procedures.

11. ENT, EYE and Dental Imaging.

11. Imaging of endocrine glands and those involved with metabolic diseases.

12. Clinical applied radionuclide imaging.

13. Interventional Radiology

B) Skills in performing a procedure

The student should be able to perform the following procedures:

1) GIT contrast studies: Barium studies (swallow, upper GI, Follow through, enema); fistulogram; sialogram; cologram/ileostogram,

2) GU: Excretory urography, MCU, RGU, nephrostogram, genitogram,

3) Ultrasound: Studies of whole body including neonatal transfontanell studies, Doppler studies,

4) CT scan: should be able to position a patient, plan study as per the clinical indication, do reconstruction of images, perform triple phase study, perform & interpret advanced applications like CT enterography, CT angiography etc.

5) MRI: plan and perform MRI studies of whole body

6) DSA: should be able to describe the techniques, do (if available to student) transfemoral puncture and insert catheter, help in angiographic procedures both diagnostic and interventional.

7) Radiography: should be able to independently do radiography of common and some important uncommon views of different body parts. This includes positioning, centering of X ray beam, setting of exposure parameters, exposing and developing the films. The student should be familiar with not only conventional radiography but with CR and DR systems.

8) Interventional radiology: The student should be able to perform simple, common non- vascular procedures under ultrasound and fluoroscopy guidance e.g. abscess drainage, drainage catheter placement, nephrostomy, biliary drainage etc. The student should have knowledge of common vascular interventions e.g stricture dilatation using balloon catheters, embolization with gel foam and other agents, names of common catheters, handling of intravenous contrast reactions; techniques, indications and contraindications for various procedures;

Course Contents

1. **BASIC SCIENCES RELATED TO RADIO-DIAGNOSIS**

   Radiological anatomy, embryology physiology and pathology.

2. **PHYSICS RELATED TO RADIO-DIAGNOSIS**

   a. Radiation physics and Radio-biology,
   b. Radiological anatomy and pathology of various organ systems
   c. Imaging techniques,
   d. Radiography.

   Fundamentals of electromagnetic radiation, X-Ray production, characteristic properties of X-Rays, units of radiation, radiation measurement, X-ray equipments, X-Ray films, intensifying screens, other X-Ray appliances, dark room equipments and procedures, II TV, cinefluorography, tomography.

   - Quality assurance.
   - Radiation hazards and principle and methods of radiation protection.
   - Contrast media: types, chemistry, mechanisms of action, dose schedule, routes of administration, their potential adverse reactions and management.
   - Clinical applications of important isotopes and instrumentation in Nuclear medicine with advances in both.
   - Physics and applications of advanced imaging i.e., Ultrasound, CT, MRI, Angiography (DSA), PET etc.

3. RESPIRATORY SYSTEM

Diseases of the chest wall, diaphragm, pleura and airways; pulmonary infections; pulmonary vasculature; pulmonary neoplasms; diffuse lung disease; mediastinal disease; chest trauma; post-operative lung and X-Rays in intensive care.

a. Should be able to localize the chest pathology into one of the following compartments: pulmonary, pleural, mediastinal, extra-pleural, extra-thoracic, diaphragmatic, infradiaphragmatic.
b. Recognize chest pathology that requires urgent or emergency treatment and describe this in an adequate manner: Pneumothorax, traumatic aortic rupture, esophageal rupture, acute pulmonary embolism, CHF and tracheo-bronchial foreign bodies.
c. Recognize acute and chronic patterns of bacterial and viral pneumonia's, occupational diseases,allergic states.
d. Recognize acute and chronic cardiac failure patterns and non-cardiogenic edemas.
e. Understand the radiographic features and precipitating causes of adult and infant respiratory distress syndrome.
f. Recognize and describe appropriately the various manifestations of benign and malignant neoplasm's of the lung.

4. GASTROINTESTINAL (GIT) AND HEPATO-BILIARY-PANCREATIC SYSTEM

Diseases and disorders of mouth, pharynx, salivary glands, esophagus, stomach, small intestine, large intestine, diseases of omentum, peritoneum and mesentery, acute abdomen, abdominal trauma using conventional and newer imaging methods like CT, MRI, DSA, isotope studies.
Diseases and disorders of hepato-biliary-pancreatic system using conventional & newer imaging methods.

a. Learn to evaluate the clinical condition & needs of a patient and to decide the appropriate studies and approach for examining the GIT or hepato-biliary-pancreatic system of a patient.
b. Learn a proper approach to fluoroscopy: this includes developing proficiency in GIT fluoroscopy, mastering the equipment and using proper radiation protection measures (both for the patient and the operator).
c. Learn the basic pathology and patho-physiology of GIT/hepato-biliary-pancreatic diseases.
d. Learn to communicate the findings both at fluoroscopy and in films, in an accurate, succinct and meaningful way.

5. GENITO-URINARY SYSTEM

Imaging: conventional, ultrasound, CT, MRI, angiography; of various diseases and disorders of genitourinary system. These includes: congenital, inflammatory, traumatic, neoplastic, calculus and miscellaneous conditions.

a. Recognize and evaluate emergency conditions involving the urinary tract including trauma, infection, vascular compromise and obstruction.
b. Recognize and understand the patho-physiology of stone disease.
c. Recognize patterns of infectious diseases and the modalities necessary for diagnostic evaluation.
d. Understand the complete evaluation of renal mass lesions and the evaluation of other urinary tract neoplasms, including the detection and staging of the tumor.
e. Recognize the difference between the pattern of diseases affecting the genito-urinary tract of adults and that of children and understand and identify the common conditions affecting the peadiatric genito-urinary system on imaging.

6. MUSCULOSKELETAL SYSTEM

Imaging (Conventional, ultrasound, CT, MRI, angiography, Radio-isotope studies) and interpretation of diseases of muscles, soft tissue, bones and joints including congenital, inflammatory, traumatic, neoplastic and miscellaneous conditions.

a. Communicate precisely and cogently radiographic descriptions of bone and joint trauma.
b. Differentiate various forms of arthritis and know correlative laboratory and clinical findings.
c. Enumerate the radiogrphic features that differentiate benign and malignant bone tumors with a basic familiarity of more common tumors.
d. Know radiographic features of acute and chronic osteomyelities and discitis (including tuberculosis).
e. Recognize differential features of osteoporosis (including Bone Mineral Density or BMD assessment techniques e.g; US,CT,Dexa) including various endocrine and metabolic diseases e.g; osteomalacia, hyperparathyrodism etc.
f. Know the application and interpretation of ultrasound / CT / MRI / angiography in one or more of the above situations.

7. CARDIOVASCULAR RADIOLOGY

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 angioplaty, embolization etc.

a. Understand the anatomy and common pathology of congenital and acquired cardiac conditions.
b. Correlate plain film findings of common congenital abnormalities with those shown by angiography.
c. and explain the pathophysiology including abnormal pressure measurements.
d. Correlate plain film findings and the echocardiographic studies of patients with acquired valvular diseases and other common pathologic conditions including pericardial pathology.
e. Understand the role of newer modalities like CT/MRI, in aortic diseases e.g., aorto-arteritis,aortic dissection and aortic aneurysm.
f. Should be able to perform fluoroscopy on patients before and after valve replacement and identify those with complications after valve replacement.
g. 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.

8. NEURORADIOLOGY

Includes imaging (using conventional and newer methods) and interpretation of various diseases and disorders of the head, neck and spine covering congenital lesions, infective lesions, vascular lesions, traumatic conditions and neoplasia. It also includes a number of interventional procedures carried out in the department of neuroradiology.

a. Know detailed normal neuro-imaging anatomy on different imaging modalities.
b. Identify pathologic conditions (listed under the content) on images acquired using different techniques and communicate the report in a concise manner.
c. Participate in daily neuroradiology conferences held with the neurosurgery or neurology units.

9. ANGIOGRAPHY AND INTERVENTIONAL RADIOLOGY

a. Evaluate the requisition for appropriate clinical information to determine if additional information is needed.
b. Determine or select appropriate diagnostic procedure for the clinical problem.
c. Assist and perform appropriate procedures under supervision and modify procedures based on observed abnormalities (pathology).
d. Know the potential risks and complications of procedures performed.
e. Know normal vascular anatomy applicable to angiographic procedures performed and know normal anatomy and landmarks to perform other non-vascular procedures.
f. Present interesting cases in the departmental meets.

10. PAEDIATRIC RADIOLOGY

Common diseases and disorders of different organ systems covering congenital, inflammatory, traumatic, neoplastic and other miscellaneous conditions, using both conventional and newer imaging methods.

a. Understand the appropriate indications for various imaging procedures and determine that the patient has been properly prepared for the procedure.
b. Know the standard radiographic views for paediatric examinations.
c. Learn to recognize and evaluate imaging manifestations (on conventional and newer methods) of common paediatric conditions occurring in the head/neck, chest, abdomen/pelvis and in the musculoskeleton.
d. Perform paediatric fluoroscopic examinations with skill and accuracy.
e. Understand and apply the knowledge and principle of radiation protection, both for the child and the operator.

11. RADIOLOGY IN EMERGENCY MEDICINE

a. Know indications for and limitations of the common emergency imaging procedures.
b. Determine and direct radiography in emergency patients and interpret the radiographs in emergency patients.
c. Ability to evaluate incomplete or unsatisfactory examinations and determine additional imaging studies required.
d. Communicate findings, diagnosis and other releveant information to the emergency room physicion.
e. He/she should be able to perform (some under supervision) and interpret special imaging procedures needed in emergency room e.g; barium studies, excretory urography, CT, ultraound, Doppler and angiography.

12. ONCOLOGIC RADIOLOGY

a. Understand pathology and patho-physiology of common neoplasms.
b. Learn the algorithmic approach to image these patients based on the suspected disease, its biological behaviour and potential and limitations of various imaging modalities.
c. 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.
d. Learn to communicate the results in a precise way in a written report to the concerned unit.
e. Present interesting cases in the departmental meets.

13. NUCLEAR MEDICINE

a. Interpret common nuclear medicine examinations (including cardiac cases).
b. He /she should be able to evaluate the examinations for completion and determine what further images (including non nuclear medicine) need to be done.
c. He/she should have a good understanding of the physical and biological properties of the commonly used radiopharmaceuticals, nuclear medicine instruments and safe handling of isotopes and basic radiation safety measures while dealing with isotopes.

14. GENERAL RADIOLGY

a. Learns to direct and perform radiography on patients.
b. He/she should be able to decide on further imaging views based on the clinical suspicion and the initial imaging.
c. Write reports on the radiographs obtained in a methodical, concise and precise way and communicate it to the referring unit.
d. Present interesting cases in the departmental meets.

15. ULTRASOUND

a. Determine or select the appropriate diagnostic procedure for the clinical problem.
b. Demonstrate proficiency in patient scanning using appropriate techniques and instrumentation.
c. Modify the procedure, if required, based upon the observed abnormalities (pathology).
d. Analyze the results of the diagnostic procedure, make diagnosis and record the findings.
e. Communicate findings, diagnosis and other relevant information to the referring physician.
f. Present interesting ultrasound cases in the departmental conferences / meetings.

16. CT

a. The resident will review the daily body CT schedule and based upon the known clinical information and review of other radiologic studies of the same patient done earlier, select the most appropriate CT imaging protocol for the each patient. This may include altering an existing CT protocol to provide the most appropriate examination for an individual patient.
b. Develop a working knowledge of the actual performance of the CT examinations. This includes starting intravenous lines, amount and timing of injecting i.v. contrast, and actual operation of CT machine.
c. Review and report all the completed body CT examinations. Initially this will be under the supervision of the seniors but later independently – but all repots will be signed by the faculty incharge.
d. Participate and present CT cases in departmental and inter departmental meets.

17. MRI

a. The resident will review the daily quality assurance program of the MRI.
b. Review the MRI requests and plan the investigations appropriate to the clinical condition of the patient.
c. Develop a working knowledge of the actual performance of the MR examinations. This includes starting intravenous lines, amount and timing of injecting i.v. contrast, and actual operation of MR machine.
d. Review and report all the completed body MR examinations. Initially this will be under the supervision of the seniors but later independently – but all repots will be signed by the faculty incharge.
e. Participate and present MR cases in departmental and inter departmental meets.

18. MAMMOGRAPHY:

The resident must know the basics of mammographic principles and its Clinical applications.

TEACHING AND LEARNING METHODS

The training is spread over 3 years and includes following components:

1. Physics related to imaging

2. Rotational posting in various sub-specialties.

3. Lectures: Lectures will be kept to a minimum. Certain selected topics will be taken as lectures. Lectures will be didactic or integrated. Didactic lectures will be for selected common topics for postgraduate students of all specialties.

4. Journal Club: Recommended to be held once a week. All the PG students are expected to attend and actively participate in discussion and enter in the logbook with relevant details. The presentations would be evaluated using check lists and would carry weightage for internal assessment. The time table for the subject with names of the students and the moderator should be announced in advance.

5. Subject seminar: Recommended to be held once a week. All the PG students are expected to attend and actively participate in discussion and enter in the logbook with relevant details. The presentations would be evaluated using checklists and would carry weightage for internal assessment. The time table for the subject with names of the students and the moderator should be announced in advance.

6. Case discussion : Recommended to be held once a week. All the PG students are expected to attend and actively participate in discussion and enter in the logbook with relevant details. The presentations would be evaluated using checklists and would carry weightage for internal assessment. The time table for the case presentation with names of the students should be announced in advance.

7. Self Directed Learning (SDL) : SDL sessions are to be conducted once a week. All the PG's are expected to participate in SDL teaching. The evaluation will be done based on the check list and carry weightage for the internal assessment.

8. Spotters : Spotters are conducted once a week where a set of 10-20 spotters (radiographs / CT & MRI / ultrasound images) are shown to the post-graduate students and quizzed on the same. The answers of the spotters are later displayed and a brief teaching session and discussion on the topic is held. In the teaching session the students are briefed about the characteristic imaging findings of every spotter. The session will conclude with a doubt session in which students can clarify all their doubts. Spotters are an integral part of radiology curriculum and marks are reserved for the same in the summative examinations.

9. Clinico-Radiological meetings : Recommended regularly for all post graduate students. Presentation to be done by rotation. Presentations will be assessed using checklist..

10. Inter Departmental Meetings: Strongly recommended particularly with departments of Neurology, Surgery, Orthopedics and Medicine on regular basis. These meetings should be attended by postgraduate students and relevant entries must be made in the logbook. Interesting cases and

imaging modalities will be discussed. Emphasis should be given for the radiological differential diagnosis.

11. Small group discussions (SGD): Case based small group discussions will be carried out once a week.

12. Skills lab : Simulation based skill lab training will be conducted regularly for all the post graduate students. Basic intervention radiology techniques in non-vascular intervention like FNAC of thyroid nodules, breast tissue and renal biopsy . Evaluation will be conducted for each skill lab session in the form of a skill lab questionnaire.

13. Mortality Meeting: Will be conducted regularly. The post graduate student should prepare the details regarding the cause of death after going through the case records in detail, and should present during the mortality meeting. The death records will be discussed in detail during this meeting.

14. Teaching Skills: Post graduate students must teach under graduate students (Eg. Medical, Radiography, Nursing) by taking demonstrations, clinics, tutorials, lectures etc. assessment is made using a check list by medical faculty as well as by the students. Record of the participation is to be kept in a logbook. Training of post graduate students in Educational Science and Technology is recommended.

15. Continuing Medical Education Programmes (CME): Recommended that at least 1 state/national level CME programmes should be attended by each student during the course.

16. Conferences: Attending conference is compulsory. Post -graduate student should attend at least one National / state level conference during the course. It is mandatory for the degree students to present one paper/poster in a National/State level conference and publish an article in a National / International journal, so as to make him / her eligible to appear at the post graduate degree examination.

17. Basic course in Biomedical research : Acquiring competency in research methods is an integral part of postgraduate medical training in the country. To ensure that postgraduate medical students acquire the necessary skills, the National medical Commission has made it mandatory for all postgraduate students to complete an online course in Research Methods – Basic course in Biomedical Research conducted by the National Programme on Technology Enhanced Learning (NPTEL) by the end of completion of their course

18. Research activities: Post graduate students to be encouraged to carry research activities in the department other than dissertation work. Students will also be encouraged to write and publish articles in the Departmental Teaching Files repository.

19. Interesting Video Lectures : Interesting video lectures of International repute will be shown to the post-graduate students on regular basis, wherein the students will be updated about the recent advances and trends in diagnostic imaging.

20. District Residency Program – Student will be deputed for 3 months as per Government and NMC Guidelines to peripheral government centers by DHO. The amendments will be made as per latest NMC guidelines.

POSTINGS:

During the three years course, the student will work in the following areas:

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 radiography including contrast procedures like IVU, HSG, barium studies, fluoroscopic guided interventions, fistulogram, and mammography- 10 to 12 months
- Ultrasonography and Doppler 10 to 14 months
- CT / MRI 8 to 10months

Suggested rotations in other departments are as follows: -

a. First year: Emergency medicine– 2 weeks
b. Second year: DSA– 2-4 weeks
c. Third year: PET and nuclear medicine – 2 weeks

During each posting, post graduate student should be able to perform the procedures and interpret the findings.

ASSESSMENT:

Formative Assessment: (during the training programme):

Formative assessment should be continual and will assess medical knowledge, patient care, procedural & academic skills, interpersonal skills, professionalism, self directed learning and ability to practice in the system.

General Principles

Internal Assessment will be frequent, covering all domains of learning and used to provide feedback to improve learning; it will also cover professionalism and communication skills. The Internal Assessment will be conducted in theory and practical/clinical examination.

Quarterly assessment during the MD training will be based on the following parameters along with other criteria mentioned in annexure-1.

1. Journal based / recent advances learning
2. Patient based /Laboratory or Skill based learning
3. Self directed learning and teaching
4. Departmental and interdepartmental learning activity
5. External and Outreach Activities / CMEs

The student will be assessed periodically as per categories listed in postgraduate student appraisal form (Annexure I).

Summative Assessment: (assessment at the end of training)

The Post Graduate Examination was conducted in three parts.

1. Thesis:

Every post graduate student shall carry out work on an assigned research project under the guidance of a recognized Post Graduate Teacher, the result of which shall be written up and submitted in the form of a Thesis (Dissertation). Work for writing the Thesis is aimed at contributing to the development of a spirit of enquiry, besides exposing the post graduate student to the techniques of research, critical analysis, acquaintance with the latest advances in medical science and the manner of identifying and consulting available literature.

Thesis shall be submitted at least six months before the Theory and Clinical / Practical examination. The thesis shall be examined by a minimum of two external examiners, who shall not be the examiners for Theory and Clinical examination. A post graduate student shall be allowed to appear for the Theory and Practical/Clinical examination only after the acceptance of the Thesis by the examiners.

2. Theory Examination

The examinations shall be organized on the basis of 'Grading' or 'Marking system' to evaluate and to certify post graduate student's level of knowledge, skill and competence at the end of the training. Obtaining a minimum of 50% marks in 'Theory' as well as 'Practical' separately shall be mandatory for passing examination as a whole. The examination for M.D. shall be held at the end of 3rd academic year. An academic term shall mean six month's training period.

All papers would consist of answer questions covering all aspects of the course and the pattern will be as per JSS AHER guidelines.

There shall be four theory papers:

Paper I: Basic sciences related to Radiology (consists of Anatomy, Pathology, Basic and Radiation Physics, Imaging Techniques and Film processing).

Paper II: Chest, CVS, CNS including Head & Neck, Eye, ENT, endocrine and metabolic, paediatric Radiology and Mammography.

Paper III: Abdominal Imaging including GI, GU, Hepatobiliary, musculo-skeletal, Obstetrics and Gynaecology and Interventional radiology

Paper IV: Recent advances, nuclear medicine; Radiology related to clinical Specialties

Paper I: Basic sciences related to Radiology (consists of Anatomy, Pathology, Basic and Radiation Physics, Imaging Techniques and Film processing).	COD1: Comprehensive Anatomy Knowledge: Develop a comprehensive understanding of anatomical structures relevant to radiology, enabling accurate identification and interpretation of imaging findings.

COURSE OUTCOMES

	COD2: Acquire the ability to recognize and interpret pathological changes and disease processes on radiological images, aiding in accurate diagnosis and treatment planning.
	COD3: Gain a solid foundation in radiation physics principles, ensuring a thorough understanding of radiation safety, dose optimization, and quality control in radiological practice.
	COD4: Develop proficiency in a wide range of imaging modalities, including X-ray, CT scan, MRI, ultrasound, doppler and nuclear medicine, allowing for accurate selection and utilization of appropriate imaging techniques for different clinical scenarios.
	COD5: Acquire expertise in film processing techniques, digital image acquisition, and image quality assessment to ensure optimal visualization and accurate interpretation of radiological images.
	COD6: To understand and apply the knowledge and principle of radiation protection, both for the patient and the operator.
	COD7: To understand the importance of PCPNDT and ensuring to legal compliance, ethical practices and facilitating accurate record keeping regarding pre natal diagnostic techniques.
	COD8: Apply the knowledge gained in anatomy, pathology, radiation physics, imaging techniques, and film processing to effectively contribute to clinical decision-making, patient management, and the delivery of high-quality radiological services.

Paper II: Chest, CVS, CNS including Head & Neck, Eye, ENT, endocrine and metabolic, paediatric radiology and Mammography.	COD1: Expertise in Chest Radiology: Develop specialized knowledge and skills in interpreting and diagnosing chest radiographic images, including X-rays, CT scans, and MRI scans, to accurately identify and evaluate thoracic abnormalities and diseases.
	COD2: Proficiency in Paediatric Radiology: Develop skills in interpreting and diagnosing radiographic images specific to paediatric patients, to accurately assess and manage congenital anomalies, paediatric tumours, and paediatric-specific pathologies.
	COD3: Competence in Mammography: Acquire specialized knowledge and skills in breast imaging techniques, including mammography and breast ultrasound, to detect and evaluate breast abnormalities, including breast cancer, cysts, and other breast conditions.
	COD4: To be able to analyze the results of the diagnostic procedure, make diagnosis and record the findings and to communicate the report in a concise manner.
	COD5: Proficiency in Cardiovascular System (CVS) Radiology: Acquire a comprehensive understanding of various imaging techniques, such as CT angiography and cardiac MRI, to effectively diagnose and assess cardiovascular pathologies, including coronary artery disease, congenital heart defects, and vascular disorders.
	COD6: Expertise in Eye Radiology: Gain specialized knowledge in ophthalmic imaging techniques, to diagnose and manage various eye diseases, including retinal disorders, glaucoma, and ocular tumors.

	COD7: Proficiency in Central Nervous System (CNS) Radiology: Acquire a comprehensive understanding of various imaging techniques, such as CT scans, and MRI scans apart from CT AND MR Angiography, to effectively diagnose and assess CNS pathologies, including infarcts, tumours, congenital anomalies, vascular disorders and various other anomalies.
	COD8: Expertise in Eye Radiology: Gain specialized knowledge in ophthalmic imaging techniques, to diagnose and manage various eye diseases, including retinal disorders, glaucoma, and ocular tumors.
Paper III: Abdominal Imaging including GI, GU, Hepatobiliary, musculo-skeletal, Obstetrics and gynaecology and Interventional radiology	COD1: Competence in Gastrointestinal (GI) Radiology: Gain expertise in interpreting imaging studies, such as contrast-enhanced CT scans and fluoroscopy, to diagnose and evaluate gastrointestinal conditions, such as bowel obstructions, inflammatory bowel disease, and gastrointestinal tumors.
	COD2: To recognise and evaluate emergency conditions of GIT and urinary tract like trauma, vascular compromise and obstruction on various imaging modalities and to communicate precisely about them to the clinicians.
	COD3: To know the proper approach to fluoroscopy: which includes developing proficiency in GIT and GUT fluoroscopy, mastering the equipment with proper radiological protection measures.
	COD4: Acquire in-depth knowledge of imaging modalities, such as X-rays, MRI, and bone scans, to accurately diagnose and enumerate the radiographic features that differentiate benign and malignant bone tumours, acute and chronic osteomyelitis, discitis (including tb), features of various endocrine and metabolic bone diseases, various form of arthritis, sports injuries & fractures and in other basic

	musculoskeletal disease.
	COD5: Mastery of Genitourinary (GU) Radiology: Develop advanced knowledge and skills in imaging techniques, such as ultrasound and CT urography, to diagnose and manage genitourinary disorders, including kidney stones, urinary tract infections, and urological malignancies.
	COD6: Know normal vascular anatomy applicable to angiographic procedures performed and know normal anatomy and landmarks to perform other non-vascular procedures
	OD7: To understand and apply accordingly the potential risks and complications of any of the above mentioned procedures performed.
Paper IV: Recent advances, nuclear medicine; Radiology related to clinical Specialties	COD1: To be able to interpret common nuclear medicine examinations (including cardiac cases) and to be able to determine further imaging needed (non-nuclear medicine also).
	COD2: Should have good understanding of physical and biological properties of commonly used radiopharmaceuticals and should be able to ensure basic radiation safety measures while dealing with isotopes.
	COD3: Should be able to demonstrate the skills to acquire the knowledge about the recent advances related to radiology.

	COD4: To develop a comprehensive understanding of imaging findings, collaborate in multidisciplinary teams, and engage in lifelong learning to contribute in advancement of radiology.
	COD5: To understand basics of intervention radiology including minimally invasive procedures advanced therapeutic interventions & precise and targeted treatments and its use for better patient care.
	COD6: To develop expertise in applying radiological knowledge and skills to various clinical specialities, including oncology, cardiology, neurology, musculoskeletal, and paediatric radiology, to facilitate accurate diagnoses, guide appropriate treatment strategies, and contribute to comprehensive patient care

PROGRAM OUTCOME

1. Expertise in Imaging Techniques: Post graduates will possess in-depth knowledge and practical skills in various imaging modalities such as X-ray, CT scan, MRI, ultrasound, Doppler and nuclear medicine.

2. Diagnostic Accuracy: Students will demonstrate the ability to accurately interpret and diagnose medical images, making use of advanced radiological techniques and their understanding of pathological conditions.

3. Patient Management: Post graduates will be proficient in effectively communicating with patients, understanding their medical history, correlating clinically and guiding them through the imaging process, ensuring their comfort and safety.

4. Research and Innovation: Students will develop research skills and contribute to the advancement of radiological science by conducting research, publishing papers, and participating in conferences, fostering innovation in the field including the latest advancements such as artificial intelligence.

5. Radiation Safety and Protection: Post graduates will possess a comprehensive understanding of radiation safety principles, ensuring proper use of radiological equipment and minimizing radiation exposure for patients and healthcare professionals.

6. Team Collaboration: Students will excel in collaborating with multidisciplinary healthcare teams, effectively communicating and providing accurate radiological information to aid in the diagnosis and treatment planning of patients.

7. Quality Assurance: Post graduates will implement quality control measures to ensure the accuracy and reliability of radiological equipment and imaging protocols, adhering to national and international standards.

8. Professional Ethics: Students will demonstrate a strong commitment to ethical practices, respecting patient confidentiality, maintaining professional integrity, and upholding the highest standards of patient care.

9. Lifelong Learning: Post graduates will possess a mindset of continuous learning, keeping up with the latest advancements in radiology, attending workshops, conferences, publishing and pursuing further specialization to enhance their knowledge and skills.

10. Leadership and Management: Students will develop leadership skills, enabling them to effectively manage radiology departments, mentor junior colleagues, and contribute to the development and implementation of policies and protocols in healthcare institutions.

3. Practical and oral Examination

(Will include cases, spots, ultrasound procedure, physics, implements, etc)

The practical pattern will be as per JSS AHER guidelines

Practical Examination will have:

1. 3-4 Cases
2. Film Quiz (50 Spots)
3. To perform Ultrasound on a patient

Oral/Viva voce will include:

- Radiation Physics and quality assurance
- Implements, Catheters and contrast
- Cassettes, films, dark room equipment
- Radiographic techniques, Radiological procedures,
-PCPNDT/AERB Guidelines

Suggested Reading:

Books (latest edition)

1. Grainger & Allison's Text book of Diganostic Radiology (Churchill Livingstone)
2. Textbook of Gastrontestinal Radiology- Gore and Levine (Saunders)
3. MRI of Brain and Spine - Scott Atlas (LWW)
4. Diagnosis of Diseases of the Chest -Fraser
5. Diagnostic Imaging Series: (Amirsys, Elsevier) Abdominal Imaging, Orthopedics, Head and Neck, Neuroradiology, Pediatric Radiology Chest, Obstetrics, Breast
6. MRI in Orthopedics and Sport Injuries - Stoller
7. Skeletal Radiology - Greenspan
8. Abdominal-Pelvic MRI - Semelka (lWW)
9. Caffey's Pediatric Radiology
10. CTI and MRI of the whole body- John R. Haaga
11. Text Book of Radiology and imaging - Davod sulton
12. Diagnostic ultrasound - Carol C. Rumack
13. AIIMS-MAMC-PGI's Comprehensive Textbook of Diagnostic Radiology, Volumes 1, 2, 3

Journals

1. American Journal of Roentgenology
2. Radiology
3. Seminars in Ultrasound, CT, MRI
4. Radiographics
5. Clinical Radiology
6. British Journal of Radiology
7. Radiological Clinics of North America
8. Pediatric Radiology

9. Australasian Radiology
10. Journal of Computerized Axial Tomography
11. Clinical Imaging
12. MR Clinics of North America
13. Seminars in Roentgenology

Quarterly Postgraduate Students Appraisal Form

Name of the Department: **Radiodiagnosis**
Name of the PG Student:
Period of Training: From……..……...……To……

Student appraisal form for MD in Preclinical/ Paraclinical											
	Elements	**Less than satisfactory**			**Satisfactory**			**More than satisfactory**			**Comments**
1.Scholastic Aptitude & learning											
1.1	Has knowledge appropriate for level of training										
1.2	Participation and contribution to learning activity (e.g., Journal Club, Seminars, CME etc)										
1.3	Conduct of research and other scholarly activity assigned (e.g Posters, publications etc)										
1.4	Documentation of acquisition of competence (eg Log book)										
1.5	Performance in work based assessments										

1.6	Self-directed Learning										
1.7	Thesis/ Research work										
1.8	Internal examination assessment										
2.Work related to training											
2.1	Practical skills that are appropriate for the level of training										
2.2	Respect for processes and procedures in the work space										
2.3	Ability to work with other members of the team										
2.4	Participation and compliance with the quality improvement process at the work environment										
2.5	Ability to record and document work accurately and appropriate for level of										

	training										
2.6	Attitude, Ethics and Communication (AETCOM)										
3.Professional attributes											
3.1	Responsibility and accountability										
3.2	Contribution to growth of learning of the team										
3.3	Conduct that is ethically appropriate and respectful at all times										
4.Space for additional comments											
5. Disposition											
	Has this assessment pattern been discussed with the trainee?	**Yes**					**No**				
	If not explain.										
	Name and Signature of the										

	assesse	
	Name and Signature of the assessor	
	Date	

Publications Yes/ No

Remarks*_____
_____
_____
_____

*REMARKS: Any significant positive or negative attributes of a postgraduate student to be mentioned. For score less than 4 in any category, remediation must be suggested.

Signature of Mentor Signature of Guide Signature of HoD