Syllabus for MD Radio diagnosis, AIIMS, Bibinagar, Hyderabad

OBJECTIVES:

At the end of completing his/her MD (Radiodiagnosis), A Resident, should have acquired a basic knowledge in the various sub-specialties of radiology and should be able to apply this training at secondary and tertiary level of medical care.

In order to achieve the goal of this course, following objectives are to be accomplished by the time the candidate completes the 3 years course.

Three broad domains of the objectives are:

1. Cognitive domain (Knowledge)
2. Psychomotor domain (Skills)
3. Attitudinal domain (Human values, ethical practice etc.)

Cognitive Domain (Knowledge)

1. Describe aetiology, pathophysiology, and principles of diagnosis and management of common problems including emergencies, in adults and children.
2. Understand the basic sciences relevant to this specialty.
3. Elicit indications, diagnostic features and limitation of the application of USG. CT and MRI and should be able to describe the proper cost-effective algorithm of various imaging techniques in a given problem setting.
4. Recognize conditions that may be outside the area of specialty/competence and to refer them to proper specialist or ask for help.
5. Have knowledge about the management (including interventional radiology) of the case and to carry out the management effectively.
6. 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.
7. The candidate should be well versed with medical ethics and consumer protection act and the Preconception-Prenatal Diagnostic Technique (PC-PNDT) Act

Psychomotor Domain (Skills)

1. Provide radiological services in acute emergency and trauma
2. Perform (under supervision) basic image- guided interventional procedures for diagnosis and therapeutic management
3. Work as a consultant in Radiodiagnosis and conduct the teaching programme for undergraduates, postgraduates as well as paramedical and technical personnel.
4. Organize CME in the specialty utilizing modern methods of teaching and evaluation.
5. 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.

6. Provide basic life saving support service in emergency situations.
7. Undertake complete patient monitoring including the care of the patient.

Attitudinal Domain

1. Adopt ethical principles in all aspects of his/her practice. Professional honesty and integrity to be fostered.
2. Develop communication skills in order to explain the various options available in management and to obtain a true informed consent from the patient.
3. Be humble and accept the limitations of his knowledge and skills and to ask for help from colleagues/ seniors when needed.
4. Respect patient rights and privileges including patient's right to information and right to seek a second opinion
5. Identify important determinants in a case (e.g. social, economic, and environmental) and take them into account for planning therapeutic measures.
6. To interact with other specialists and super-specialists so that maximum benefit to the patient accrues

SYLLABUS

THEORY

1st SEMESTER

BASIC SCIENCES RELATED TO RADIO-DIAGNOSIS

Radiation physics and Radio-Biology

Radiological anatomy and pathology of various organ systems

Imaging Techniques,

Radiography. Includes all aspects of: 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, cine fluorography, 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..

Structure of X-ray tube , Production of X rays, X-ray generators, Basic interactions between X Rays and matter, attenuation, filters, beam restrictors, Grids, luminescent screens.

Physical characteristics of X-Ray Film and Film processing.

Photographic characteristics of X-Ray film.

AERB act and radiation safety

X-Ray equipment.

• Conventional X Ray Units

• Digital X-Ray Units

• Computed Radiography system Fluoroscopy units (conventional. digital); Fluoroscopic screen, tilting tables, over and under couch tubes, safety features, image intensifier tubes.

Types of daylight film handling system, types of optical coupling and methods of viewing, recording of the intensified image, CCTV, cine fluorography.

Introduction to advanced imaging equipment.

US, CT, MRI, Angiography, cine fluoroscopy and cine angiography

• Film procession darkroom equipment and procedures-manual, automatic,

• Daylight processing

• Quality assurance

• Radiation hazards and radiation protection

• Mammography and Breast Intervention: Screen film mammography (conventional) and digital mammography in screening of breast cancer, benign and malignant lesions of the breast.

• Mammography: Equipment and physics related to mammography.

Details of BIRADS.

• Conventional Radiology: Reading Conventional radiographs including radiographs on chest abdomen, pelvis, skull (including PNS + Orbit), spine. musculoskeletal and soft tissues, and special investigations.

• Contrast media. Types, chemical composition, mechanism of action, dose schedule, route

of administration, adverse reaction and their management.

• Contrast safety

• Basic life support training

• 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

Conventional imaging of radiological anatomy and various pathologies related to

Respiratory System:

Disease of the chest wall, diaphragm, pleura and airway, pulmonary normal vasculature, pulmonary infections, pulmonary neoplasm, diffuse lung disease, Mediastinal disease, Chest trauma; post-operative and intensive care

Imaging interpretation of disease of muscles, soft tissue, bones and joints including congenital, inflammatory, infective, traumatic, metabolic and endocrine, neoplastic and miscellaneous conditions.

2nd SEMESTER

General Topics:

Research methodology: Principle of education Biostatistics, Computer, information and technology

Ethics in Radiology

Internet search

Diagnostic Ultrasound and Doppler-

Physics-The nature and propagation of sound wave, speed of sound in a material medium, intensity of sound, the decibel, ultrasound wave, ultrasound wave properties propagation in tissue, absorption, scattering, reflection and refraction. Acoustic impedance. Doppler's effect, Ultrasonic wave production of ultrasonic wave (piezo-electric effect) in ultrasonography, transducers.

Ultrasonography, A, B and M scanning modes,

Use of the principle of Doppler's effect in Diagnostic radiology (e.g. Echo, blood flow measurement)

Ultrasound image formation and storage/documentation devices.

Types of Transducers, Recording Devices and Orientation of Images, Focus of the beam, sensitivity and gain.

Quality Control / Artifacts.

• Elastography

Ultrasound (including Ob&Gy)

At the completion of this rotation the resident should be able to perform and interpret all ultrasound studies. These studies include: abdomen, pelvis, small parts, neonatal head, color-duplex imaging (including peripheral i.e.; extremity arterial and venous studies), obstetrics/gynecology (in the department of Gyn/Obstetrics) and interventional procedures using ultrasound guidance. The resident should have a thorough knowledge of the common abnormalities of the abdominal/pelvic organs, retroperitoneal structures, neck, chest, extremities and small parts (thyroid/parathyroid, scrotum, orbit, and breast)

Objectives:

1. Determine or select the appropriate diagnostic procedure for the clinical problem. 2. Demonstrate proficiency in patient scanning using appropriate techniques and instrumentation. 3. Modify the procedure, if required, based upon the observed abnormalities (pathology). 4. Analyze the results of the diagnostic procedure, make diagnosis and record the findings. 5. Communicate findings, diagnosis and other relevant information to the referring physician. 6. Present interesting ultrasound cases in the departmental conferences/meetings.

• **Conventional imaging of radiological anatomy and various pathologies related to**

Musculoskeletal Imaging system: (Content Coverage 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.

At the end of the course the resident should be able to correctly interpret all the common abnormalities of the bones and joints. He/She should have a good understanding of the common congenital abnormalities, arthritis, bone and joint trauma, neoplastic conditions, metabolic bone disease and inflammatory diseases. He/She should also have an understanding of the role of CT/MRI in all these conditions and should be able to perform and interpret CT/MRI in diseases of musculo-skeletal system.

Cardiovascular System: 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

Essential Objectives 1. Understand the anatomy and common pathology of congenital and acquired cardiac conditions. 2. Correlate plain film findings of common congenital abnormalities with those shown by angiography and explain the pathophysiology including abnormal pressure measurements. 3. Correlate plain film findings and the echocardiographic studies of patients with acquired valvular diseases and other common pathologic conditions including pericardial pathology. 4. Understand the role of newer modalities like CT/MRI, in aortic diseases e.g., aorto- arteritis, aortic dissection and aortic aneurysm. 5. Should be able to perform fluoroscopy on patients before and after valve replacement and identify those with complications after valve replacement. 6. 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

3rd SEMESTER

CT Imaging

The goals/objectives to be achieved by the end of this rotation are:

1. Select CT protocol according to the clinical diagnosis. He/she should be able to direct and modify (if required) the performance of the CT examination

2. Demonstrate knowledge of the CT findings of the common pathologic conditions occuring in the head, neck, chest, abdomen, pelvis, and in the soft tissues and musculo-skeletal system.
3. Resident should be familiar with both the conventional and different modified CT techniques (High resolution, Dual phase, CT angio, BMD, multislice CT etc.)
4. Interpret conventional and modified body CT examinations (including HRCT, dual/triple phase CT, CT portography, virtual CT etc.) with a reasonable degree of accuracy.
5. Demonstrate proficiency in verbal and written reporting of CT findings and differential diagnosis.
6. Demonstrate knowledge of the limitations (and potential fallacies) of CT imaging of various pathologic conditions and be able to perform correlations with other imaging modalities including formulations of recommendations for additional appropriate imaging procedures.
7. Perform CT guided biopsy procedures under guidance of seniors.
8. Present interesting cases of CT in the departmental meetings.

Essential Objectives

1. 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.

2. 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.

3. 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 in charge.

4. Participate and present CT cases in departmental and inter departmental meets. Evaluation on daily basis after observing reporting and working in the CT room by a group of faculty. Maintain a log book under the supervision of faculty incharge.

GASTROINTESTINAL (GIT) AND HEPATO-BILIARY-PANCREATIC SYSTEM

Imaging 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 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.

Essential Objectives

1. 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.

2. 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).

3. Learn the basic pathology and patho-physiology of GIT/hepato-biliary-pancreatic diseases.

4. Learn to communicate the findings both at fluoroscopy and in films, in an accurate, succinct and meaningful way

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.

Essential Objectives

1. Know detailed normal neuro-imaging anatomy on different imaging modalities.

2. Identify pathologic conditions (listed under the content) on images acquired using different techniques and communicate the report in a concise manner.

3. Participate in daily neuroradiology conferences held with the neurosurgery or neurology unit

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.

Essential Objectives

1. Recognize and evaluate emergency conditions involving the urinary tract including trauma, infection, vascular compromise and obstruction.

2. Recognize and understand the patho-physiology of stone disease.

3. Recognize patterns of infectious diseases and the modalities necessary for diagnostic evaluation.

4. Understand the complete evaluation of renal mass lesions and the evaluation of other urinary tract neoplasms, including the detection and staging of the tumor.

5. 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

RADIOLOGY IN EMERGENCY MEDICINE

Imaging and Interpretation of emergency radiographic examinations. He/she should also be familiar with medico legal cases (MLC) and procedures.

Essential Objectives

1. Determine and direct radiography in emergency patients and review and interpret the radiographs.

2. If study is incomplete then determine additional views or repeat views.

3. Know indications for and limitations of the common emergency imaging procedures.

4. Communicate findings, diagnosis and other relevant information to the emergency room physician.

5. 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, Ultrasound, Doppler and angiography

4th SEMESTER

MRI:

MRI Physics and pulse sequences

Magnetic shielding and RF

Interpretation of anatomy and pathologies pertaining to the different systems of the body.

The goals/objectives to be achieved by the end of this rotation are:

1. Select MRI protocol according to the clinical diagnosis. He/she should be able to direct and modify (if required) the performance of the examination
2. Resident should be familiar with both the conventional and different modified MRI techniques , protocols and sequences
3. Demonstrate knowldege of the MRI findings of the common pathologic conditions
4. Interpret conventional and modified MRI examinations with a reasonable degree of accuracy.
5. Demonstrate proficiency in verbal and written reporting of MRI findings and differential diagnosis.
6. Demonstrate knowledge of the limitations (and potential fallacies) of MRI imaging of various pathologic conditions and be able to perform correlations with other imaging modalities including formulations of recommendations for additional appropriate imaging procedures.
7. Present interesting cases of MRI in the departmental meetings.

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.

Essential Objectives

1. Understand the appropriate indications for various imaging procedures and determine that the patient has been properly prepared for the procedure.
2. Know the standard radiographic views for paediatric examinations.
3. 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.
4. Perform paediatric fluoroscopic examinations with skill and accuracy. 5. Understand and apply the knowledge and principle of radiation protection, both for the child and the operator.

5TH SEMESTER

ANGIOGRAPHY AND INTERVENTIONAL RADIOLOGY

At the completion, the resident should be able to perform the most common non-cerebral angiographic studies. He/she should have a good basic understanding of both; the vascular interventional radiologic procedures such as angioplasty, embolization using various embolizing agents; as well as the various non-vascular interventional procedures such as percutaneous nephrostomy, stenting, abscess drainage, PTC/PTBD, percutaneous biopsy, balloon dilatation of the esophagus etc. He/she should have a good understanding of the various equipment and available catheters and guidewires and other technical aspects of special procedures. In addition he/she should know all the potential risks and complications of these procedures and their management.

Essential Objectives:

1. Evaluate the requisition for appropriate clinical information to determine if additional information is needed.

2. Determine or select appropriate diagnostic procedure for the clinical problem.

3. Assist and perform appropriate procedures under supervision and modify procedures based on observed abnormalities (pathology).

4. Know the potential risks and complications of procedures performed.

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

6. Present interesting cases in the departmental meets

WHOLE BODY RADIOLOGY

Should be able to interpret and understand the advanced imaging protocols involving CT/MRI of the various systems in the body like musculoskeletal, breast, neuroradiology and abdominal imaging.

Thesis Writing

6TH SEMESTER

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). He/she should be able to perform, interpret and diagnose these patients.

Essential objectives

1. Understand pathology and patho-physiology of common neoplasms.

2. Learn the algorithmic approach to image these patients based on the suspected disease, its biological behaviour and potential and limitations of various imaging modalities.

3. 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.

4. Learn to communicate the results in a precise way in a written report to the concerned unit.

5. Present interesting cases in the departmental meets.

NUCLEAR MEDICINE

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

Essential objectives: 1. Review all cases performed each day. 2. Interpret the results of the procedures and give an appropriate diagnosis. 3. Observe and help in some common procedures performed in the department (e.g; thyroid, kidney, bone, cardiac scans), understand the principle underlying the procedure and the basis for using a particular isotope in an investigation

DISSERTATION

Thesis:

1. Every candidate pursuing MD degree course is required to carry out work on a selected research project under the guidance of a recognized post graduate teacher. The results of such a work shall be submitted in the form of a dissertation.

2. The dissertation is aimed to train a post graduate student in research methods and techniques. It includes identification of a problem, formulation of a hypothesis, search and review of literature, getting acquainted with recent advances, designing of a research study, collection of data, critical analysis, and comparison of results and drawing conclusions.

3. Chief guide will be from the department of Radio-diagnosis while co-guides will be from either the department of Radio-diagnosis or other disciplines related to the dissertation topic.

4. Every candidate shall submit a thesis protocol to the Dean of the Institute in the prescribed proforma containing particulars of proposed dissertation work four months from the date of commencement of the course. The thesis protocol shall be sent through the proper channel. Protocol in essence should consist of: - (a) Introduction and objectives of the research project. (b) Brief review of literature (c) Suggested material and methods (d) Bibliography

5. Such thesis protocol will be reviewed and the dissertation topic will be registered by the Institute. No change in the dissertation topic or guide shall be made without prior approval of the Dean of the Institute.

6. Submission of thesis. Thesis will be submitted at the end of two and a half (2.5) years. Thesis should consist of (e) Introduction (f) Review of literature (g) Aims and objectives (h) Material and methods (i) Results (j) Discussion (k) Summary and Conclusions (l) Tables (m) Annexures (n) Bibliography

7. Two copies of dissertation thus prepared shall be submitted to the Dean AIIMS, six months before the final examination.

8. The dissertation shall be evaluated by two external examiners appointed by the Institute. Approval of dissertation work is an essential precondition for a candidate to appear in the final MD examination. Dissertation is graded as follows: Highly commendable – Commendable – Satisfactory – Rejected. 3 months of time period will be given for resubmission of thesis, if rejected.

MD (Radiodiagnosis), Posting Schedule

Total Duration: 3 years Applied Physics and Basic Sciences

1st year – 1st semester	Conventional radiography (3 months)	Ultrasound (3 month)		
1st year – 2nd semester	USG - Doppler (2 months)	Special Radiographic procedures (2 months)	Emergency Radiology (1 month)	Conventional radiography (1 month)
2nd year – 3rd semester	USG/CT guided procedures (1 month)	CT (3 months)	Mammography (2 months)	
2nd year – 4th semester	Conventional Radiography (1 month)	USG (2 months)	CT (3 months)	
3rd year-5th semester	MRI (2 months)	Doppler and USG (1 month)	USG/CT guided procedures (1 month)	DSA (2 months)
3rd year – 6th semester	MRI (2 months)	Doppler and USG (1 month)	Conventional Radiography / Nuclear medicine (30+15days)	USG/CT guided procedures (45 days)
Dissertation Topic Submission: Within 6 months of Joining the course Dissertation submission at the end of 6 months before the exams Classes on Statistics : A series of lectures held for every one on Biostatistics				

Teaching and learning methods

The teaching is elaborate and consists of both theoretical and applied/hand on training. It is based on the prescribed curriculum of the Institute.

1. Seminars
2. Journal clubs
3. Case discussions
4. Interesting Film Sessions
5. Thesis presentations
6. Clinical-radiological meets
7. Clinical- Surgico-pathology meets

Evaluation

1. Day to day based on reporting and procedures performed
2. Will have to maintain a log book to be checked by faculty incharge after each posting

Assessment

All the PG resident are assessed daily for their academic activities and also periodically.

General Principles

The assessment is valid, objective and reliable.

Formative, continuing and summative assessment is conducted in theory as well as practical.

In addition, thesis is assessed separately.

Examination on Research Methodology and Biostatics.

Timings: end of second semester

Total marks: 100

Will be considered as an internal examination

Candidate should pass to appear in final examination

No marks will be added to final summative examination

Will be conducted by examination cell in the month of June and December

Internal assessment

The formative assessment will be continuous as well as semester examinations. The former would be based on feedback from the senior residents and the faculty concerned.

Continuous assessment will be done on an ongoing basis using a log book covering day today performance of the candidate. It will be compiled and converted into marks by the faculty every 6 months.

Tools and methods will be developed by the departments to assess research, teaching and managerial skills.

Timeline: end of third, fourth and fifth semester, pre final (2 months before final examination)

Mark distribution: Theory 100 marks and practical with Viva and log book will carry 100 marks

(Practical -70, Viva- 20, Logbook – 10)

The marks of the four internal examination will be averaged to 100 each for theory and practical.

The performance of the postgraduate student during the training period should be monitored throughout the course and duly recorded in the log books as evidence of the ability and daily work of the student.

Semester	Topics
3rd semester (18th month)	X-ray physics, USG and Doppler physics, Contrast media, Respiratory system, Cardiovascular system, | Musculoskeletal system.
4th semester (24th month)	CT physics, Genitourinary system, Gastrointestinal system, mammography.
5th semester (30th month)	MRI physics, Nervous system, Head & Neck Imaging, Pediatric Radiology.
Prefinal	Complete syllabus
Final (at the end of 3rd year)	Complete syllabus

Summative assessment

Final assessment will be carried out by two external examiners and two internal examiners. The summary of the examinations are as follows:

A maximum of thousand marks will be awarded the candidate must obtain at least 50% (500 marks) to pass the examination. Of the thousand marks, 200 marks will be from the internal assessment both theory and practical. A total of 800 marks will be assigned to the final examination (theory 400 practical 400).

It will be essential to pass theory and practical both separately in final examination by securing at least 50% marks in each. Candidate must pass in theory and practical independently by obtaining at least 200 marks in theory and 200 marks in practical respectively.

A. Theory examination (total 400)

Paper 1: Basics Sciences related to radiology - 100

Paper 2: Principles and practice of Radiodiagnosis - 100

Paper 3: Radiodiagnosis as related to pathology - 100

Paper 4: Recent advances and radiology as applied to other specialities – 100

B. Practical Examination and Viva Voce (Total = 400)

The format of the Practical Examination (400 Marks)

Part	Components	Marks allotted
Part A* (200 marks)	Long Case (1 no.)	100
	Short Case (2 nos.)	50
	OSCE/OSPE (5-10 stations)	50
Part B (200 marks)	Operative procedure/Pedagogy/Department specific activity	50
	Critical appraisal of a scientific paper	25
	Thesis presentation and evaluation	50
	Viva	75

*Students should pass (secure 50% marks separately in Part A)

Marking scheme

	1st internal examination (18th month)	2nd internal examination (24th month)	3rd internal examination (30th month)	4th internal examination	Total internal marks (average of 4 exams)	Final exam	Total marks
Time Frame	End of 3rd semester	End of 4th semester	End of 5th semester	Prefinal		36 months	
Theory	100	100	100	100	100	400	500
Practical	100	100	100	100	100	400	500

Best of National and International guidelines/practices will be included in assessing the PG students, and the above marking system/assessment will be updated and amended as per Institute Policy, with approval of the Director.

RECOMMENDED BOOKS

1. Atlas SW. Magnetic Resonance Imaging of the Brain and Spine: Wolters Kluwer Health; 2016.

2. Curry TS, Dowdey JE, Murry RC. Christensen's Physics of Diagnostic Radiology: Lea & Febiger; 1990.

3. Dahnert WF. Radiology Review Manual: Wolters Kluwer; 2017.

4. Davidson AJ. Davidson's Radiology of the Kidney and Genitourinary Tract : Saunders; 1999.

5. Geschwind JFH, Geschwind J, Dake MD. Abram's Angiography: Interventional Radiology: Wolters Kluwer Health; 2013.

6. Gore RM , Levine MS. Textbook of Gastrointestinal Radiology : Elservier – Health Sciences Division; 2014.

7. Grant LA, Griffin N. Grainger & Allison's Diagnostic Radiology Essentials E-Book: Elservier Health Sciences; 2018.

8. Haaga JR, Boll D. Computed Tomography & Magnetic Resonance Imaging of the Whole Body E-Book: Elsevier Health Sciences; 2016.

9. Heywang – Koebrunner SH, Schreer I, Barter S. Diagnostic Breast Imaging: Mammography, Sonography, Magnetic Resonance Imaging and Interventional Procedures: Thieme; 2019.

10. Lawrence R. Goodman MDF. Felson's Principles of Chest Roentgenology, A Programme d Text: Elsevier Health Sciences; 2014.

11. Lee EY, Hunsaker A, Siewert B. Computed Body Tomography with MRI Correlation: Lippincott Williams & Wilkins; 2019.

12. Lichtenstein DA, Pinsky MR, Jardin F. General ultrasound in the critically ill: Springer Berlin Heidelberg; 2008.

13. Margulis AR, Burhenne HJ, Freeny PC, Stevenson GW. Margulis and Burhenne's Alimentary Tract Radiology: Mosby; 1994.

14. Nortons ME. Callen's Ultrasonography in Obstetrics and Gynecology E-Book: Elsevier Health Sciences; 2016.