Bachelors of Vocation – Medical Imaging Technology

The Vocational course is a three-year program consists a combination of Practical, Theory and Generic courses. The three-year program will be divided into 6 semesters; 2 semesters per year.

- 1st year will be a **Diploma,**
- 2nd year will be **Advance Diploma** &
- 3rd year will be a **Degree**.

The program is a work integrated training which include on-the-job training (practical) for 4 to 5 days a week and 1 day of theory training. The courses also include generic module for overall development of the candidate. The 1st two years of this program are in line with the Community College framework of the AICTE. The B. Voc. Degree program is designed as per the UGC guidelines.

SEMESTER - I

SEMESTER – I
Course Title: Anatomy
Credits: Theory – 1
Total Credit Hours: Theory – 15
Introduction and Course Objectives:
The course aims to impart students with knowledge regarding Anatomy, so that they understand the investigative aspect better. It will also enable them to take appropriate decisions in critical conditions. It will also play an important role especially in Cath lab.

Main Concepts:

- Anatomy
- Cardiovascular system
- Respiratory system
- Digestive system
- Musculoskeletal system

Course Content:

- Details about Musculo-skeletal system
- Awareness regarding joint structure
- Details regarding various joints
- Details of Cardio-vascular system
- Details of Respiratory system
- Details of Digestive system
- Details of Uro-genital system

- Osteology

Learning Objectives:

- Discuss details about Musculo-skeletal system
- Describe various joint structure
- Describe anatomy Respiratory system
- Describe Cardio-Vascular system
- Describe anatomy Digestive system
- Describe anatomy Uro-genital system
- Describe Osteology

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:

- Human Anatomy Vol 1,2 & 3 - B. D. Chaurasia

Course Title: Physiology

Credits: Theory – 1

Total Credit Hours: Theory – 15

Introduction and Course Objectives:

Physiology will help student understand the functioning of human body, thus help them co-relate the investigations with the condition of the patient. It will not only help the students to understand the investigations better but also in taking prompt decision in critical situations.

Main Concepts:

- Physiology
- Cardiovascular system
- Haemopoetic system
- Uro-Genital system
- Respiratory system

Course Content:

- Awareness of Digestive system
- Details regarding Respiratory system
- Details of Uro-genital system
- Details of cardio-vascular system
- Awareness of Haemopoetic system
- Details of endocrine system
- Details of digestive system

Learning Objectives:

- Discuss physiology Digestive system
- Discuss physiology of Respiratory system
- Discuss physiology of Uro-genital system
- Discuss physiology of cardio-vascular system
- Discuss physiology of Haemopoetic system
- Discuss physiology of endocrine system
- Discuss physiology of digestive system

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:

- Human physiology – C C Chaterjee

Course Title: Clinical Pathology
Credits: Theory – 1
Total Credit Hours: Theory – 15
Introduction and Course Objectives:

Main Concepts:

- Clinical pathology
- Tumors
- Birth defects

Course Content:

- Pathology pertaining to various systems
- Tumours and Neoplasm
- Vascular pathology
- Congenital birth defects

Learning Objectives:

- Discuss Pathology pertaining to various systems
- Describe Tumours and Neoplasm
- Describe Vascular pathology
- Discuss Congenital birth defects

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:
Textbook of Pathology – Harsh Mohan

Course Title: Radiation Physics – I
Credits: Theory – 1
Total Credit Hours: Theory – 15
Introduction and Course Objectives:
The radiation physics is an important chapter in this course as it teaches the student regarding safety measures to be taken while using ionizing radiation such as X-Rays. The course will enable the students to understand the nature of X-Rays and to take necessary precautions while handling the X-Ray machine.

Main Concepts:

- Atomic Physics

Course Content:

- Atomic Physics
- Dual Nature of Radiation and Matter Relativity
- X-Ray Interaction with Matter

Learning Objectives:

- Describe Atomic Physics
- Explain Dual Nature of Radiation and Matter Relativity
- Describe X-Ray Interaction with Matter

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & Reference

Coure Title: Radiology Equipment and Imaging
Credits: Theory – 1
Total Credit Hours: Theory – 15
Introduction and Course Objectives:
This chapter deals with the details regarding various X-Ray Equipments and the radiographic materials. It will enable the students to develop good radiograph.

Main Concepts:

- Various X-ray Equipment
- Radiographic materials

Course Content:

- Total Radiographic System
- X-Ray Tubes
- X-Ray Generators
- X-Ray Examination Units
- Image Intensifiers , flat panel detectors and Related Systems
- X-Ray Images and Image Quality
- Radiographic Materials and Processing Techniques
- Requirement of Good Radiograph

Learning Objectives:

- Explain Total Radiographic System
- Describe X-Ray Tubes
- Explain X-Ray Generators
- Describe X-Ray Examination Units
- Explain Image Intensifiers, flat panel detectors and Related Systems
- Describe X-Ray Images and Image Quality
- Explain Radiographic Materials and Processing Techniques
- Describe Requirement of Good Radiograph

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:

Course Title: Medical Ethics and Patient care
Credits: Theory – 1
Total Credit Hours: Theory – 15
Introduction and Course Objectives:
Ethics is an essential part of any organization and sector. This module will teach the students ethics pertaining to medical sector and help them in enhancing the patient care.

Main Concepts:

- Medical Ethics

Course Content:

- Medical Ethics
- Patient care

Learning Objectives:

- Describe Medical Ethics
- Discuss patient care

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References

Course Title: Vocational Practical
Credits: 12
Total Credit Hours: 360 hours

Introduction and Course Objectives:
This course will help the students to understand the anatomy, physiology and pathology pertaining to human body. It will also equip the students with the knowledge regarding X-Ray machines. The students will perform practicals pertaining to the various bones and joints of the body.

Course Content:

- X-Ray Cervical Spine
- X-Ray Chest
- X-Ray Abdomen
- X-Ray Clavicle
- X-Ray Shoulder Joint
- X-Ray Humerus
- X-Ray Elbow Joint
- X-Ray Forearm
- X-Ray Wrist Joint
- X-Ray Hand
- X-Ray Fingers
- X-Ray Ribs
- X-Ray Dorsal Spine
- X-Ray Lumbar Spine

Learning Objectives:

- Perform X-Ray Cervical Spine
- Perform X-Ray Chest
- Perform X-Ray Abdomen
- Perform X-Ray Clavicle
- Perform X-Ray Shoulder Joint
- Perform X-Ray Humerus
- Perform X-Ray Elbow Joint
- Perform X-Ray Forearm
- Perform X-Ray Wrist Joint
- Perform X-Ray Hand
- Perform X-Ray Fingers
- Perform X-Ray Ribs
- Perform X-Ray Dorsal Spine
- Perform X-Ray Lumbar Spine

Method of Teaching:
Hand-on practical in lab, hospitals and nursing homes.

Method of Assessment & Weightage: Assignments including instrument identification and its usage, basic nursing procedures and hospital administration

Assessment Tasks:
- Demonstrate X-Rays of various bones and joints
- Adjust KV and mAs according to the patient's anatomy

Weightage: 75%

SEMESTER - II

SEMESTER II
Course Title: Radiation Physics - II
Credits: Theory – 1
Total Credit Hours: Theory – 15
Introduction and Course Objectives:
This chapter will impart students the knowledge regarding radiation and enable them to adopt necessary precautions regarding radiation hazards.
Main Concepts:
- Radiation

Course Content:
- Radiation Protection
- Digital Radiography

Learning Objectives:
- Describe Radiation Protection
- Explain Digital Radiography

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References

Course Title: Image Processing Techniques/ Dark Room Techniques
Credits: Theory – 1
Total Credit Hours: Theory – 15
Introduction and Course Objectives:
Dark room techniques and film processing in an important part of X-Rays. This module will introduce the students with dark room and its techniques.
Main Concepts:

- Dark room
- Fixer and developer
- X-ray films
- Film processing (Including the conventional X-Ray processing and CR-DR systems processing

Course Content:

- Dark room design – Conventional and Modern image processing room
- Choice of fluorescent material
- Fixer and developer
- Photographic emulsions, photographic latent image
- X-Ray films and types, Spectral sensitivity of film material, choosing films for different studies
- Film processing methods – Manual and automatic
- X-Ray cassettes , Intensifying screens , Fluorescence, structure and unsharpness
- Film processing - Dry and Wet processing
- Effect of environmental factors during Processing of X-ray films
- Image processing equipment
- Day-light system and
- Advantages and disadvantages of day – light system
- Computer Radiography and Direct Radiography, their advantages over conventional Dark Room Processing techniques

Learning Objectives:

- Describe dark room design – Conventional and Modern image processing room
- Select appropriate fluorescent material
- Describe fixer and developer
- Demonstrate appropriate use of fixer and developer
- Describe photographic emulsions, photographic latent image
- Define and describe X-Ray films and types
- Choose appropriate X-Ray films according to investigation
- Describe Spectral sensitivity of film material
- Choose films for different studies
- Describe film processing methods – Manual and automatic
- Define and describe: X-Ray cassettes – Intensifying screens – Fluorescence, structure and unsharpness
- Describe Film processing - Dry and Wet processing
- Discuss Effect of environmental factors during Processing of X-ray films
- Enlist image processing equipment
- Describe day – light system
- Discuss advantages and disadvantages of day – light system

- Describe Computer Radiography and Direct Radiography systems , their advantages over conventional Dark Room Processing techniques

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:

Course Title: Positioning – Clinical Radiography
Credits: Theory – 1
Total Credit Hours: Theory – 15
Introduction and Course Objectives:
Appropriate positioning of the patient is very necessary for good image. The Region of Interest has to be exposed properly by positioning the patient appropriately. This course will train the students in the art of positioning.
Main Concepts:
- Positioning

Course Content:
- **Clinical Radiography**
  - Radiological equipment
  - Positional radiography
  - Radiographic views of different parts of body
    - Chest, abdomen, spine
    - Upper limb, lower limb
    - Skull, facial bones and paranasal sinuses
    - Gastro Intestinal Tract, (GIT) Genito Urinary Tract (GUT)

Learning Objectives:
- List radiological equipment
- Describe positional radiography
- Discuss and demonstrate radiographic views of different parts of body
  - Chest, abdomen, spine
  - Upper limb, lower limb
  - Skull, facial bones and paranasal sinuses
  - Gastro Intestinal Tract, (GIT) Genito Urinary Tract (GUT)

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.
Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)
Reading Lists & References:

Course Title: Special Radiographic Procedures
Credits: Theory – 1
Total Credit Hours: Theory – 15
Introduction and Course Objectives:
Apart from the routine X-Ray investigations, some special procedures are also performed with the help of X-Rays to aid the diagnosis and treatment. This course will introduce the students various special procedures.

Main Concepts:
- Special procedures

Course Content:

- Barium swallow, Barium meal, Barium follow through and Barium enema
- Follow through IC Junction
- Follow through IC Junction – Under Bucky
- Sino grams
- Sialogram
- Fistulograms
- Enteroclysis (fluoroscopic X-Ray of small intestine)
- PTCA – Percutaneous Transhepatic Cholangiogram
- HSG
- IVU – Intra Venous Urogram
- IVP

Learning Objectives:

- Explain and perform: Barium swallow, Barium meal, Barium follow through and Barium enema
- Describe and perform Sinograms
- Describe and perform Fistulograms
- Explain and perform Enteroclysis (fluoroscopic X-Ray of small intestine)
- Describe and perform: PTCA – Percutaneous Transhepatic Cholangiogram
- Explain and perform: HSG
- Describe and perform Sialogram
- Explain and perform: IVU – Intra Venous Urogram
- Explain and perform IVP examination

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:

Course Title: Quality control and safety measures
Credits: Theory – 1
Total Credit Hours: Theory – 15
Introduction and Course Objectives:
Essential part of any department is quality control. It is also equally important to adopt necessary safety measures for proper functioning of the department. This course will enable the students to understand the importance of quality control and how to effectively work to maintain quality.

Main Concepts:

- Quality control
- Safety measures
- TLD badges

Course Content:

- Quality Control procedures as per NABH standards

Learning Objectives:

- Demonstrate Quality Control procedures as per NABH standards

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:

Course Title: Steps taken in improving Image Quality
Credits: Theory – 1
Total Credit Hours: Theory **–** 15
Introduction and Course Objectives:
Good image is key to better diagnosis and treatment. This course will train students to develop good quality images by undertaking steps to improve image quality.
Main Concepts:

- Image quality

Course Content:

- Poor image quality
- Various causes for Poor Image quality
- Steps for improving image quality i.e. the resolution of image

Learning Objectives:

- Describe Poor image quality
- Enlist Various causes for Poor Image quality
- List and explain steps for improving image quality

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:

Course Title: Vocational Practical
Credits: 12
Total Credit Hours: 360 hours
Introduction and Course Objectives:
This course will teach students about safe handling of the patients and also assist in physiotherapy. The appropriate categorization, proper disposal of the biomedical waste and the use of PPE will be taught in this chapter. The course will enable the students to properly collect and sample the urine and stool samples. It will also teach the students to identify appropriate bottles for histopathology. The aim is to help students understand bedsores and prepare them in assisting minor dressings.

Course Content:

- X-Ray Dorso—Lumbar Spine
- X-Ray Pelvis
- X-Ray Hip Joint
- X-Ray Skull
- X-Ray Towne's View
- X-Ray PNS view
- X-Ray Nasal Bones
- X-Ray Mastoid
- X-Ray Mandible

- X-Ray Femur
- X-Ray Knee Joint
- X-Ray Tibia Fibula
- X-Ray Ankle Joint
- X-Ray Foot

Learning Objectives:

- Perform X-Ray Dorso—Lumbar Spine
- Perform X-Ray Pelvis
- Perform X-Ray Hip Joint
- Perform X-Ray Skull
- Perform X-Ray Towne's View
- Perform X-Ray PNS view
- Perform X-Ray Nasal Bones
- Perform X-Ray Mastoid
- Perform X-Ray Mandible
- Perform X-Ray Femur
- Perform X-Ray Knee Joint
- Perform X-Ray Tibia Fibula
- Perform X-Ray Ankle Joint
- Perform X-Ray Foot

Method of Teaching:
Hand-on practical in lab, hospitals and nursing homes.

Method of Assessment & Weightage

- Practicals related to performing X-rays of various bones and joints

Assessment Tasks:

- Demonstrate X-Rays of various bones and joints

Weightage: 75%

SEMESTER - III

Semester III
Course Title: Principles of Computed Tomography
Credits: Theory – 1
Total Credit Hours: Theory **– 15**

Introduction and Course Objectives:
Understanding the concept of CT scan, its Working Mechanism & understanding the Computer Applications in Radiology is very important. This course will help the students understand various aspects of the CT scan.

Main Concepts:

- Understanding the concept of CT scan
- Working Mechanism of CT scan
- Computer Applications in Radiology
- Physical Principles of CT
- Advantages and Limitations of CT

Course Content:

- Description of CT, its Working Mechanism & Physical Principles.

- Limitations of radiography and conventional tomography.
- Lambert-Beer's law.
- Homogenous and a heterogenous beam of radiation.
- Data acquisition geometry and data processing.
- CT numbers and the linear attenuation coefficient.
- High kVp is generally used in CT.
- CT numbers and the gray scale of the CT image.
    - Window Width (WW)
    - Window Level (WL)
- Format of the CT image.
- Field of view (FOV), pixel size and matrix size.
- Identify the equipment components that make up a CT scanner
- Flow of data in a CT scanner.
    - -raw data
    - -convolved data
    - -reconstructed data or image data
- Computer Applications in Radiology.
- Advantages and limitations of CT.

Learning Objectives:

- Description of CT, its Working Mechanism & Physical Principles.
- State the limitations of radiography and conventional tomography.
- Explain briefly how these limitations are overcome by CT.

  Explain the meaning of the term data acquisitions and describe two methods of acquiring data from the patients.
- Define each of the following:
    - relative transmission
    - penetration measurement
    - linear attenuation coefficient
- State Lambert-Beer's law.
- Compare and contrast the attenuation of a homogenous and a heterogenous beam of radiation.
- Explain what is meant by the terms data acquisition geometry and data processing.
- Describe the relationship between CT numbers and the linear attenuation coefficient.
- State several reasons why a high kVp is generally used in CT.
- Describe the relationship between CT numbers and the gray scale of the CT image.
- Define each of the following:
    - Window Width (WW)
    - Window Level (WL)
- Describe the format of the CT image.
- Explain what is meant by the field of view (FOV) and show how it is related to pixel size and matrix size.
- Identify the equipment components that make up a CT scanner
- Describe the flow of data in a CT scanner.
- Define each of the following:
    -raw data
    -convolved data
    -reconstructed data or image data
- List the advantages and limitations of CT

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:

Course Title: Various types of CT equipment
Credits: Theory – 1
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
With the advancement of the technology various types of CT scan equipment are available. The students will be given through knowledge regarding various types of CT equipment.

Main Concepts:
- Various types of CT scan Equipment

Course Content:
- Various types of CT scan Equipment
- Conventional CT Scanning (CCT)
- Spiral/Helical CT
- Multi Slice CT
- Electron Beam Computed Tomography
- Mobile Computed Tomography
- Importance of various types
- Differences between various types
- Indication of a particular type

Learning Objectives:
- Identify & Describe various types of CT scans Equipment
- Describe Conventional CT Scanning (CCT)
- Describe Spiral/Helical CT
- Describe Multi Slice CT
- Describe Electron Beam Computed Tomography
- Describe the difference between various types of CT scans
- Describe importance of various scans
- Perform various types of CT scan

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:

Course Title: CT scanner system components
Credits: Theory- **1**
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
CT scan as a unit has many components. They work together to produce good images. The students will learn about the components of the CT scan that will enable them to produce better images.

Main Concepts:

- Various CT scan components
  - Instrumentation
  - Image Display
  - Room Layout for CT Equipment
- Accessories
- Hardware and software

Course Content:

- Three major systems of a CT scanner and list the components of each.
  - Instrumentation
  - Image Display
  - Room Layout for CT Equipment
- CT gantry (including the x-ray tube and generator, as well as the data acquisitions system), and the basic features of the patient table.
- CT computer and image processing system:
- Image display, storage, and recording in CT.
- Main components of a CT control console.
- Several hardware and software options for CT.
- Accessories for use in CT.
- Modular Design Concept
- Operating Modes of the Scanner
- Typical Room Layout for a CT Scanner
- Major technical specifications and features of a CT scanner.

Learning Objectives:

- Identify the three major systems of a CT scanner and list the components of each.
- Instrumentation
- Image Display
- Room Layout for CT Equipment
- Describe the components of the CT gantry (including the x-ray tube and generator, as well as the data acquisitions system), and the basic features of the patient table.
- Describe the following three elements of a CT computer and image processing system:
  - processing architecture
  - hardware
  - software
- Describe the characteristics of image display, storage, and recording in CT.
- Describe the main components of a CT control console.
- Describe several hardware and software options for CT.
- Identify accessories for use in CT.
- Describe briefly what is meant by each of the following:
  -modular design concept
  -operating modes of the scanner
- Describe a typical room layout for a CT scanner.
- Identify the major technical specifications and features of a CT scanner.

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Ultrasound Imaging
Credits: Theory- **1**
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
Ultrasound imaging is a non-invasive medical test that helps physicians to diagnose and treat medical conditions.The students will be imparted with the basic knowledge of Ultrasound Imaging & will be trained to prepare the patients appropriately for the investigations

Main Concepts:

- Basics of Ultrasound
- Ultrasound Imaging Artifacts
- Transducer and Machines
- Ultrasound Physics
- Doppler
- The Ultrasound Scanning Room
- Indications, Technique, Preparation, Scanning Techniques of -
    - Abdomen
    - Abdominal Aorta
    - Inferior Vena Cava
    - Liver
    - Gall Bladder and Biliary Duct
    - Pancreas
    - Spleen
    - Peritoneal Cavity and Gastrointestinal Tract
    - Scrotum and Testis
    - Urinary Bladder
    - Kidneys and Ureter
    - Neonates
    - Neck
- Ultrasound Guided Needle Puncture

Course Content:

- Details about Basics of Ultrasound
- Details about Ultrasound Imaging Artifacts
- Details about Transducer and Machines
- Details about Ultrasound Physics
- Details about Doppler
- Details about Ultrasound Scanning Room
- Details about Indications, Technique, Preparation, Scanning Techniques of -
    - Abdomen
    - Abdominal Aorta
    - Inferior Vena Cava
    - Liver
    - Gall Bladder and Biliary Duct
    - Pancreas
    - Spleen
    - Peritoneal Cavity and Gastrointestinal Tract
    - Scrotum and Testis
    - Urinary Bladder
    - Kidneys and Ureter
    - Neonates
    - Neck
- Details about Ultrasound Guided Needle Puncture

Learning Objectives:

- Discuss Basics of Ultrasound
- Discuss & Describe Ultrasound Imaging Artifacts
- Discuss & Describe Transducer and Machines
- Discuss & Describe Ultrasound Physics
- Explain Doppler
- Discuss & Describe Ultrasound Scanning Room
- Discuss & Describe Indications, Technique, Preparation, Scanning Techniques of -
  - Abdomen
  - Abdominal Aorta
  - Inferior Vena Cava
  - Liver
  - Gall Bladder and Biliary Duct
  - Pancreas
  - Spleen
  - Peritoneal Cavity and Gastrointestinal Tract
  - Scrotum and Testis
  - Urinary Bladder
  - Kidneys and Ureter
  - Neonates
  - Neck
- Discuss & Describe Ultrasound Guided Needle Puncture

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Patient Preparation, Positioning and Protocols in CT Scan
Credits: Theory – 1
Total Credit Hours: Theory **– 15**

Introduction and Course Objectives:
Positioning the patient appropriately is very essential to have a better visualization of the Region ~~area~~ of interest and to produce better images. This course will teach the students necessary skills to produce quality image by positioning patients appropriately.

Main Concepts:
- Patient Preparation for Spiral CT
- Patient Positioning for Spiral CT
- Various Spiral CT protocols in plain and contrast for different areas of interest

Course Content:
- Patient Preparation for Spiral CT
- Patient Positioning for Spiral CT
- Various Spiral CT protocols in plain and contrast for different areas of interest
  - Spiral CT protocol in plain and contrast for Head.
  - Spiral CT protocol in plain and contrast for Neck.
  - Spiral CT protocol in plain and contrast for Chest.
  - Spiral CT protocol in plain and contrast for Abdomen/Pelvis.
  - Spiral CT protocol in plain and contrast for Vascular System
  - Spiral CT protocol in plain and contrast for Bone.

- Importance of positioning
- Precautions to be taken for preparing & positioning the patient.

Learning Objectives:

- List various conditions requiring specific positioning
- Identify position required for particular investigation
- Position patient in required position
- List precaution while positioning
- Explain the importance of the position to the patient
- Demonstrate Various Spiral CT protocols in plain and contrast for different areas of interest
- Demonstrate Spiral CT protocol in plain and contrast for Head.
- Demonstrate Spiral CT protocol in plain and contrast for Neck.
- Demonstrate Spiral CT protocol in plain and contrast for Chest.
- Demonstrate Spiral CT protocol in plain and contrast for Abdomen/Pelvis.
- Demonstrate Spiral CT protocol in plain and contrast for Vascular System
- Demonstrate Spiral CT protocol in plain and contrast for Bone.

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:

Course Title: Data Acquisition in CT
Credits: Theory - 1
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
Understanding the X-Ray tubes and data acquisition are important aspects of CT scan. This course will impart to students essential knowledge regarding X-Ray tubes and data acquisition.

Main Concepts:

- Data Acquiring Concepts
- Basic concept of data acquisition.
- Data acquisition geometrics.
- Slip-Ring Technology
- Design and Power Supply of a CT Room.
- Advantages of Slip-Ring Technology.
- CT Detector Technology
- Characteristics of the Detector.
- List and describe the Types of Detectors.
- Explain Plug-in Detector Modules.
- Describe Multi-Slice Detectors.
- Detector Electronics
- Functions of Detectors.
- Components of Detectors.
- Data Acquisition and Sampling.

Course Content:

- Basic components of a data acquisitions scheme in CT.
- Five generations of CT scanners and state the basis for the categorization.
- Characteristics of five generations of CT scanner geometries
- Slip rings and essential elements of two types of slip rings: Low and High Voltage
- Type of Generators used in CT scanners.
- Main Features of X-ray Tubes for CT scanners.
- Filtration and Collimation in CT.
- CT Detector Characteristics.
- Data acquisition system (DAS) and Describe how it works.
- Three methods used to increase the number of Measurements or Samples needed for Image Reconstruction

Learning Objectives:

- Identify and describe the basic components of a data acquisitions scheme in CT.
- Identify the five generations of CT scanners and state the basis for the categorization.
- Describe the characteristics of five generations of CT scan geometries.
- Define the term Slip Ring and Describe the essential elements of two types of slip-rings: Low Voltage and High Voltage.
- Describe the Type of Generators used in CT scanners.
- Describe the Main Features of X-ray tubes for CT scanners.
- Discuss Filtration and Collimation in CT.
- Explain each of the following CT detector characteristics:
  - Efficiency
  - Stability
  - Response Time
  - Dynamic Range
- Describe these two following detectors:
  - Scintillation detectors
  - Gas-ionization detectors
- State the purpose of the Data Acquisition System (DAS) and Describe how it works.
- Identify and briefly explain three methods used to increase the number of measurements or samples needed for image reconstruction.

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:

Course Title: Image Reconstruction
Credits: Theory- **1**
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
Formation of image and its reconstruction forms important aspect of the CT scan. The students will be taught various aspects pertaining to image reconstruction.

Main Concepts:

- Basic Principles of Image Reconstruction
- Image Reconstructions from Projections
- Types of Data in Image Reconstruction

Course Content:

- Sequence of events after the signals leave the CT detectors.
- Following Basic Principles related to the Image Reconstruction Process :-
- Algorithm
- Fourier transform
- Convolution
- End Interpolation
- Details of Image reconstruction from projections:-
- History of Reconstruction Techniques.
- Identification of the problems in CT.
- Description of filter back projection.
- Iterative Algorithms.
- Fourier Reconstruction.
- Image Reconstruction in Single and Multiple Slice Spiral/Helical CT.
- Types of Data in Image Reconstruction
- Types of data in Image Reconstruction.
- Comparison of Reconstruction Algorithms.
- 3D Algorithms.

Learning Objectives:

- Trace the Sequence of events after the signals leave the CT detectors.
- Define the following Basic Principles related to the Image Reconstruction Process :-
- State the Algorithm
- Explain the Fourier transform
- Explain the Convolution
- Explain the End Interpolation
- Explain briefly what is meant by "Image reconstruction from projections" with reference to the following points:-
- Trace the History of Reconstruction Techniques.
- Identify the problems in CT.
- Describe What is the filter back projection?
- State the Iterative Algorithms.
- Explain Fourier Reconstruction.
- Describe Image Reconstruction in Single and Multiple Slice Spiral/Helical CT.
- Describe the Types of Data in Image Reconstruction:-
- Types of data in Image Reconstruction.
- Comparison of Reconstruction Algorithms.
- 3D Algorithms.

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Image Manipulation
Credits: Theory- **1**
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
The CT scan images are manipulated to obtain a good scan. The students will be taught to manipulate images to produce better images.

Main Concepts:

- Image Manipulation
- Specialised Computer Programs in Image Manipulation
- Visualisation Tools and Analysis Workstations

Course Content:

- Image Manipulation
- Describe Image Manipulation
- Explain windowing.
- Explain manipulating window width and window level.
- Describe the effect of window width on image contrast.
- Describe the effect of window level on image display.
- Describe preset windows.
- Specialised Computer Programs in Image Manipulation
- Describe multiplanar reconstruction.
- Describe quantitative CT.
- Explain Xenon CT.
- Explain 3D imaging.
- Describe the radiation therapy treatment planning.
- Visualisation Tools and Analysis Workstations
- Identify and explain basic tools.
- Identify and explain advanced tools.
- Describe advanced visualisation tools.

Learning Objectives:

- Image Manipulation
- Describe What is Image Manipulation?
- Explain What is windowing?
- Explain How to manipulate window width and window level?
- Describe What is the effect of window width on image contrast?
- Describe What is the effect of window level on image display?
- Describe What is preset windows?
- Specialised Computer Programs in Image Manipulation
- Describe What is multiplanar reconstruction?
- Describe quantitative CT.
- Explain Xenon CT.
- Explain 3D imaging.
- Describe the radiation therapy treatment planning.
- Visualisation Tools and Analysis Workstations
- Identify and explain Basic Visualisation Tools.
- Identify and explain Advanced Visualisation Tools.

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Vocational Practical
Credits: 12
Total Credit Hours: 360 hours

Introduction and Course Objectives:
Performing the practical forms an important part of any vocational course. It helps to build skills by training an individual well. The course aims to impart sufficient skills to students so as to function well in Imaging Department.

Course Content:

- USG Scanning Techniques of -
  - Abdomen
  - Abdominal Aorta
  - Inferior Vena Cava
  - Liver
  - Gall Bladder and Biliary Duct
  - Pancreas
  - Spleen
  - Peritoneal Cavity and Gastrointestinal Tract
  - Scrotum and Testis
  - Urinary Bladder
  - Kidneys and Ureter
  - Neonates
  - Neck
- Ultrasound Guided Needle Puncture
- CT Scan of Brain (Plain)
- CT Scan of Brain (Plain + Contrast)
- CT Scan of Orbit (Plain)
- CT Scan of Temporal Bones (Axial)
- CT Scan of Paranasal Sinus (Coronal)
- CT Scan of Neck (Plain)
- CT Scan of Chest (Plain)
- CT Scan of H R C T Chest
- CT Scan of Abdomen and Pelvis (Plain)

Learning Objectives:

- Perform USG Scanning Techniques of -
- Abdomen
- Abdominal Aorta
- Inferior Vena Cava
- Liver
- Gall Bladder and Biliary Duct
- Pancreas
- Spleen
- Peritoneal Cavity and Gastrointestinal Tract
- Scrotum and Testis
- Urinary Bladder
- Kidneys and Ureter
- Neonates
- Neck
- Perform Ultrasound Guided Needle Puncture
- Perform CT Scan of Brain (Plain)
- Perform CT Scan of Brain (Plain + Contrast)
- Perform CT Scan of Orbit (Plain)
- Perform CT Scan of Temporal Bones (Axial)
- Perform CT Scan of Paranasal Sinus (Coronal)
- Perform CT Scan of Neck (Plain)
- Perform CT Scan of Chest (Plain)
- Perform CT Scan of H R C T Chest
- Perform CT Scan of Abdomen and Pelvis (Plain)

Method of Teaching:
Hand-on practical in lab, hospitals and nursing homes.

Method of Assessment & Weightage: Practicals performed for various CT scans

Assessment Tasks:
CT scan of various bones and joints

Weightage: 75%

SEMESTER - IV

SEMESTER IV
Course Title: CT Image Formation
Credits: Theory- 1
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
Understanding the formation of images in CT is essential to produce good quality images. This course will teach the students the process of image formation and help them in producing good quality images.

Main Concepts:
- Digital Image Formation in CT
- Image Digitisation
- Image Processing Techniques

Course Content:
- Digital Image Formation in CT.
- Define image Formation in CT.
- Identify and explain the Various Components of Image Display.
- Describe Image Formation.
- Describe Image Representation.
- Image Digitisation
- Describe Scanning.
- Describe Sampling.
- Describe Quantisation.
- Describe Analog to Digital Conversion.
- Explain the Need for Digitised Images.
- Describe the Advantages of Digitised Images.
- Image Processing Techniques
- Describe Point Operations Technique.
- Describe Local Operations Technique.
- Describe Global Operations Technique.
- Describe Geometric Operations Technique.
- Describe Image Processing Hardware.
- Explain CT as a Digital Image Processing System.

Learning Objectives:
- Describe Digital Image Formation in CT.

- Define What is image Formation in CT?
- Identify and explain the Various Components of Image Display.
- Describe What is Image Formation & Image Representation?
- Describe Image Digitisation
- Describe What is Scanning & What is Sampling?
- Describe What is Quantisation?
- Describe the Analog to Digital Conversion.
- Explain the Need for Digitised Images.
- Describe the Advantages of Digitised Images.
- Image Processing Techniques
- Describe What is Point Operations Technique?
- Describe What is Local Operations Technique?
- Describe What is Global Operations Technique?
- Describe What is Geometric Operations Technique?
- Describe What is Image Processing Hardware?
- Explain CT as a Digital Image Processing System.

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: CT Image Quality
Credits: Theory- **1**
Total Credit Hours: Theory – 15
Introduction and Course Objectives:
Image quality depends upon many factors including the artefacts. The student will be trained to reduce artefacts so as to produce good quality images.

Main Concepts:
- Image Quality in CT
- Image Artifacts in CT
- Quality Control in CT Images

Course Content:
- Image Quality in CT.
- List the factors affecting image quality.
- Describe image quality in CT.
- Explain the resolutions in CT.
- Describe contrast detailed diagram.
- Image Artifacts in CT.
- Define image artifacts in CT.
- Describe the various artifacts and their correction techniques.
- Quality Control in CT Images
- Identify and explain noise properties.
- Describe linearity.
- Describe cross-field uniformity.
- Describe the image quality in spiral/Helical CT.
- Describe quality control in CT.

Learning Objectives:

- Write out a general expression for image quality.
- State several methods for measuring image quality.
- Identify two popular types of phantoms for measuring image quality.
- Define each of the following:
    - Spatial resolution
    - Contrast resolution
    - Noise
    - Linearity
    - Cross-field uniformity
- Discuss the factors affecting Spatial Resolution in CT.
- Explain What is meant by High-Resolution CT.
- Discuss the Factors affecting Contrast Resolution in CT.
- Explain what is meant by a Contrast-Detail Diagram.
- Calculate the Noise Level in a CT image.
- List Seven Sources of Noise in CT.
- Identify the Sources of Artifacts in CT.
- Explain the production of the following Artifacts in CT:
    - -Motion Artefacts
    - -Metal Artefacts
    - -Beam Hardening Artefacts
    - -Partial Volume Artefacts
    - -Ring Artefacts
- Explain how the above Artifacts can be reduced?
- Describe How to maintain the Quality Control in CT Images?
- Identify and explain noise properties.
- Describe what is Linearity?
- Describe what is Cross-Field Uniformity?
- Describe How to control Image Quality in Spiral/Helical CT?

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Patient Safety and Quality Control
Credits: Theory- **1**
Total Credit Hours: Theory – 15
Introduction and Course Objectives:
Observing the safety of the patient and technician is important. The students will be trained to prepare the patients appropriately for the investigations and observe the safety of self and the patient.

Main Concepts:

- Patient Safety in CT
- Rules of Body Mechanics
- Quality Control of CT scan

Course Content:

- Patient Safety in CT
- Describe the safety procedures for X-ray radiation.
- Explain the procedures of safety for various forms of fire.
- Describe safety of patient from physical injury.

- Explain the safety procedures from medical drugs.
- List the emergency drugs used in radiology department.
- Describe the management of emergency in radiology department.
- Describe Crash cart or Emergency trolley.
- Rules of Body Mechanics
- Describe the concepts of body mechanics.
- Describe the rules of body mechanics.
- Describe the various safe patient transfer procedures.
- Quality Control of CT scan
- Describe quality control of CT scan.
- Explain the need of Quality control in CT scan.
- Describe the various principles of quality control.
- Describe the quality control tests for CT scanners.

Learning Objectives:

- Patient Safety in CT
- Demonstrate the safety procedures for X-ray radiation.
- Demonstrate the protocol of safety for various forms of fire.
- Describe safety of patient from physical injury.
- Demonstrate the safety procedures from medical drugs.
- List the emergency drugs used in radiology department.
- Demonstrate the management of emergency in radiology department.
- Demonstrate the preparation of Crash cart or Emergency trolley.
- Rules of Body Mechanics
- Explain the concepts of body mechanics.
- Demonstrate the rules of body mechanics.
- Demonstrate the various safe patient transfer procedures.
- Quality Control of CT scan
- Describe What is quality control of CT scan?
- Explain the need of Quality control in CT scan.
- Describe the various principles of quality control.
- Describe the quality control tests for CT scanners.

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Three Dimensional Computed Tomography (3D CT)
Credits: Theory- **1**
Total Credit Hours: Theory – 15

Introduction and Course Objectives:

3D Imaging Technology is used to create visual representations of the interior of the body & they are used for making clinical analysis of complex diseases in a short period of time. The students will be imparted with the Fundamentals & Technical Aspects of 3D Imaging. This will help them to prepare the patients appropriately for the investigations by 3D Imaging.

Main Concepts:

- Fundamentals of 3D Imaging
- Technical Aspects of 3D Imaging
- Rendering Techniques

- Equipment and Clinical Application of 3D Imaging

Course Content:

- Fundamentals of 3D Imaging
- Describe the fundamentals of 3D imaging.
- Explain the rationale for 3D imaging.
- Classify 3D imaging.
- Describe the generic 3D imaging system.
- Technical Aspects of 3D Imaging
- Define 3D medical imaging.
- Describe data acquisition.
- Explain the creation of 3D space.
- Describe the processing of 3D image display.
- Rendering Techniques
- Describe surface rendering.
- Describe volume rendering.
- Explain intensity projection.
- Compare 3D rendering techniques.
- Equipment and Clinical Application of 3D Imaging
- Identify and explain the equipment used in 3D imaging.
- State the clinical application of 3D imaging in CT.
- State the clinical application of 3D imaging in MRI.
- Describe the future of 3D imaging.
- Explain the role of radiologist technician in 3D imaging.

Learning Objectives:

- Discuss & Describe Fundamentals of 3D Imaging
- Describe the fundamentals of 3D imaging.
- Classify 3D imaging.
- Discuss & Describe Technical Aspects of 3D Imaging
- Define 3D medical imaging.
- Describe data acquisition.
- Explain the creation of 3D space.
- Describe the processing of 3D image display.
- Discuss & Describe Rendering Techniques
- Describe surface rendering.
- Describe volume rendering.
- Explain intensity projection.
- Compare 3D rendering techniques.
- Discuss & Describe Equipment and Clinical Application of 3D Imaging
- Identify and explain the equipment used in 3D imaging.
- State the clinical application of 3D imaging in CT.
- State the clinical application of 3D imaging in MRI.
- Describe the importance of 3D imaging.
- Explain the role of radiologist technician in 3D imaging.

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: MRI physics

Credits: Theory-
Total Credit Hours: Theory –
Introduction and Course Objectives:
Physical properties of Magnetic materials and their usage in developing MRI equipment will be covered in this subject. The course will explain to the students the physics behind the MRI equipment
Main Concepts:

- Basic Principles of MRI
- Instrumentation and Equipment's of MRI
- MRI safety and Site Planning
- Image weighting and Contrast in MRI

Course Content:

- Basic Principles of MRI
- Atomic Structure
- Motion in the atom
- MR Active Nuclei
- Alignment
- Precession
- Larmor Equation
- Resonance and Result of Resonance
- MR signal
- Free Induction Decay Signal (FID)
- Relaxation, T 1 Recovery and T 2 Decay
- Pulse Timing Parameters
- Instrumentation and Equipment of MRI
- Introduction
- Magnetism
- Permanent Magnets
- Electromagnets
- Superconducting Electromagnets
- Fringe Fields
- Shim Coils
- Gradient Coils
- Radio Frequency (RF)
- Patient Transportation System
- MR Computer Systems and the User Interface
- MRI safety and Site Planning
- Introduction
- Government Guidelines
- Safety Terminology
- Hardware and Magnetic Field Considerations
- Radio Frequency Fields
- Gradient Magnetic Fields
- The Main Magnetic Field
- Projectiles
- Siting Considerations
- MRI Facility Zones
- Safety Education
- Protecting the General Public from the Fringe Field
- Implants and Prostheses
- Pacemakers
- Patient Conditions
- Safety Policy
- Image weighting and Contrast in MRI
- Introduction
- Image Contrast

- Contrast Mechanisms
- Relaxation in Different Tissues
- T1 Contrast & T2 Contrast
- Proton Density Contrast Weighting
- Introduction to Pulse Sequences
- The spin echo pulse sequence
- Timing parameters in spin echo
- The gradient echo pulse sequence
- Gradients
- The advantages of gradient echo pulse sequences
- The disadvantages of gradient echo pulse sequences
- Timing parameters in gradient echo
- Weighting and contrast in gradient echo

Learning Objectives:

- Discuss MAGNET TYPES
- Describe Permanent magnets
- Describe Resistive Magnets
- Discuss Superconducting magnets
- Discuss RF COILS
- Describe Volume RF Coils
- Describe Surface coils
- Describe Quadrature Coils
- Describe Phased Array Coils
- Discuss MAGNETIZATION
- Discuss EXCITATION
- Discuss RELAXATION
- Discuss T1 Relaxation
- Discuss T1 Relaxation Curves
- Discuss T2 Relaxation
- Describe Phase and Phase coherence
- Describe T2 Relaxation Curves
- Describe Acquisition
- Discuss Computing and display
- Describe GRADIENT COILS
- Explain SIGNAL CODING
- Discuss Slice Encoding Gradient
- Describe Phase Encoding Gradient
- Describe Frequency Encoding Gradient
- Discuss Side Step: Gradient Specifications
- Explain Side Step: Slice Thickness
- Discuss PULSE SEQUENCES
- Discuss SPIN ECHO (SE) SEQUENCE.

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Understanding MRI systems and Components

Credits: Theory- **1**

Total Credit Hours: Theory – 15

Introduction and Course Objectives:
MRI systems are complex and it is essential to understand its various components. This is useful to understand the machine and help in adopting safety measures and improve image quality.

Main Concepts:

- Understanding MRI Systems and Components
- Encoding
- Data Collection & Image Formation
- Various factors of Image Quality
- Pulse Sequences
- Mechanism of Flow Phenomena
- Various Artifacts and their Compensation

Course Content:

- Understanding MRI Systems and Components
- Encoding
- Data Collection & Image Formation
- Image Quality
- Signal to Noise Ratio (SNR)
- Contrast to Noise Ratio (CNR)
- Spatial Resolution
- Scan Time
- Trade – Offs
- Decision Making
- Volume Imaging Uses
- Volume Imaging Resolution
- Pulse Sequences
- Spin Echo Pulse Sequences
- Gradient Echo Pulse Sequences
- Parallel Imaging Techniques
- Mechanism of Flow Phenomena
- Various Artifacts and their Compensation

Learning Objectives:

- Describe various components of MRI Systems
- Describe What is Encoding?
- Demonstrate the steps in Data Collection & Image Formation
- Describe following components of Image Quality :-
- Signal to Noise Ratio (SNR)
- Contrast to Noise Ratio (CNR)
- Spatial Resolution
- Scan Time
- Trade – Offs
- Decision Making
- Volume Imaging Uses
- Volume Imaging Resolution
- Describe & Demonstrate following Pulse Sequences:-
- Spin Echo Pulse Sequences
- Gradient Echo Pulse Sequences
- Parallel Imaging Techniques
- Describe Mechanism of Flow Phenomena
- Describe Various Artifacts and their Compensation

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Patient Positioning and Protocol in MRI

Credits: Theory- **1**

Total Credit Hours: Theory – 15

Introduction and Course Objectives:

Positioning the patient appropriately is essential to produce good quality image and to visualize the area of interest. The course will imbibe into student the importance of the patient positioning and will train them to correctly position patient for various investigations.

Main Concepts:

Patient Positioning and Protocol in :-

- MRI of Head and Neck
- MRI of Body
- MRI of Extremities
- Vascular and Cardiac Imaging
- Functional Imaging Techniques
- Contrast Agents in MRI

Course Content:

- MRI of Head and Neck
- Brain and Skull
- Orbit
- Sella
- Soft Tissues of the Neck
- Cervical Spine
- MRI of Body
- Chest
- Sternum
- Breast
- Upper Abdomen/Liver
- Biliary Tree
- Small Intestine (Hydro-MRI)
- Pancreas
- Kidney
- Adrenal Gland
- Pelvis
- Testes
- Thoracic Spine
- Lumbar Spine
- MRI of Extremities
- Temporomandibular Joint
- Shoulder
- Upper Arm
- Forearm
- Wrist
- Finger
- Hip
- Thigh
- Knee
- Lower Leg

- Ankle
- Vascular and Cardiac Imaging
- Conventional MRI Vascular Imaging Techniques
- Magnetic Resonance Angiography (MRA)
- Cardiac MRI
- Cardiac Gating
- Peripheral Gating
- Pseudo - Gating Multiphase Cardiac Imaging
- Ciné
- SPAMM
- Functional Imaging Techniques
- Diffusion Weighted Imaging (DWI) Effects, Sequences & Uses
- Perfusion Imaging Uses
- Susceptibility Weighting (SWI) and Uses
- Functional Imaging (fMRI)
- Interventional MRI
- MR Spectroscopy (MRS)
- Whole Body Imaging
- MR Microscopy (MRM)
- Mechanism of actions of Contrast Agents in MRI

Learning Objectives:

- Demonstrate the patient positioning protocol in MRI for the following parts of Head and Neck:-
- Brain and Skull
- Orbit
- Sella
- Soft Tissues of the Neck
- Cervical Spine
- Demonstrate the patient positioning protocol in MRI for the following Body parts:-
- Chest
- Sternum
- Breast
- Upper Abdomen/Liver
- Biliary Tree
- Small Intestine (Hydro-MRI)
- Pancreas
- Kidney
- Adrenal Gland
- Pelvis
- Testes
- Thoracic Spine
- Lumbar Spine
- Demonstrate the patient positioning protocol in MRI of the following Extremities:-
- Temporomandibular Joint
- Shoulder
- Upper Arm
- Forearm
- Wrist
- Finger
- Hip
- Thigh
- Knee
- Lower Leg
- Ankle
- Demonstrate the patient positioning protocol in Vascular and Cardiac Imaging for:-
- Conventional MRI Vascular Imaging Techniques

- Magnetic Resonance Angiography (MRA)
- Cardiac MRI
- Cardiac Gating
- Peripheral Gating
- Pseudo - Gating Multiphase Cardiac Imaging
- Ciné
- SPAMM
- Demonstrate the patient positioning protocol in Functional Imaging Techniques for:-
- Diffusion Weighted Imaging (DWI) Effects, Sequences & Uses
- Perfusion Imaging Uses
- Susceptibility Weighting (SWI) and Uses
- Functional Imaging (fMRI)
- Interventional MRI
- MR Spectroscopy (MRS)
- Whole Body Imaging
- MR Microscopy (MRM)
- Demonstrate Mechanism of actions of Contrast Agents in MRI

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Vocational Practical
Credits: 12
Total Credit Hours: 360 hours

Introduction and Course Objectives:
Performing practicals hones the student's skills. The course will train the students while performing practicals.

Course Content:
- CT Scan of Abdomen and Pelvis (Plain + Contrast)
- Pulmonary Angiography
- Renal Angiography
- CT Scan of Circle of Wills
- CT Scan of Abdominal Aorta
- CT Scan of Bone Joints (Upper Extremities)
- CT Scan of Bone Joints (Lower Extremities)
- CT Scan of Bone (Upper Extremities)
- Arthrography

also called: Direct Arthrography
Joint X-ray
X-ray, Arthrography - joints

- Magnetic Resonance (MRI)-Guided Breast Biopsy

also called: Biopsy-Breast, MR-Guided
Breast Biopsy, MR-Guided
MR-Guided Breast Biopsy
Needle biopsy of the breast, MR-guided

- Magnetic Resonance Cholangiopancreatography (MRCP)
- Magnetic Resonance Imaging (MRI) - Body
  also called: Body MR
- Magnetic Resonance Imaging (MRI) - Breast
  also called: Breast MRI
- Magnetic Resonance Imaging (MRI) - Cardiac (Heart)
  also called: Cardiac MRI Heart (Cardiac) MRI
- Magnetic Resonance Imaging (MRI) - Chest
  also called: Chest MRI
- Magnetic Resonance Imaging (MRI) - Head
  also called: Head MR
- Magnetic Resonance Imaging (MRI) - Knee
  also called: Knee MRI

Learning Objectives:

- Perform CT Scan of Abdomen and Pelvis (Plain + Contrast)
- Perform Pulmonary Angiography
- Perform Renal Angiography
- Perform CT Scan of Circle of Wills
- Perform CT Scan of Abdominal Aorta
- Perform CT Scan of Bone Joints (Upper Extremities)
- Perform CT Scan of Bone Joints (Lower Extremities)
- Perform CT Scan of Bone (Upper Extremities)
- Perform Arthrography

also called: Direct Arthrography
Joint X-ray
Arthrography - joints

- Perform Magnetic Resonance (MRI)-Guided Breast Biopsy

also called: Biopsy-Breast, MR-Guided
Breast Biopsy, MR-Guided
MR-Guided Breast Biopsy
Needle biopsy of the breast, MR-guided

- Perform Magnetic Resonance Cholangiopancreatography (MRCP)
- Perform Magnetic Resonance Imaging (MRI) - Body
  also called: Body MR
- Perform Magnetic Resonance Imaging (MRI) - Breast
  also called: Breast MRI
- Perform Magnetic Resonance Imaging (MRI) - Cardiac (Heart)
  also called: Cardiac MRI Heart (Cardiac) MRI
- Perform Magnetic Resonance Imaging (MRI) - Chest
  also called: Chest MRI
- Perform Magnetic Resonance Imaging (MRI) - Head
  also called: Head MR
- Perform Magnetic Resonance Imaging (MRI) - Knee
  also called: Knee MRI

Method of Teaching:
Hand-on practical in lab, hospitals and nursing homes.

Method of Assessment & Weightage: Various CT and MRI scans

Assessment Tasks:

- Various CT and MRI scans of bones and joints

Weightage: 75%

SEMESTER - V

Semester V
Course Title: Recent Advances in MRI
Credits: Theory- 1
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
Recent Advances in MRI scans help to understand the applicability of MRI. The students will be taught Recent Advances in MRI scans to understand its applicability.

Main Concepts:

- Recent Advances in MRI scans :-
- Diffusion Tensor Imaging
- Intra operative MRI
- CSF Flow Study in Spine
- Perfusion Imaging
- MR Spectroscopy
- Functional MRI
- MR Elastography
- MR Enterolysis
- MR Urography
- Cardiac MRI
- Whole Body Diffusion Weighted Imaging
- Surgical Mapping
- Weight bearing MRI

Course Content:

- Details of Diffusion Tensor Imaging
- Details of Intra operative MRI
- Details of CSF Flow Study in Spine
- Details of Perfusion Imaging
- Details of MR Spectroscopy
- Details of Functional MRI
- Details of MR Elastography
- Details of MR Enterolysis
- Details of MR Urography
- Details of Cardiac MRI
- Details of Whole Body Diffusion Weighted Imaging
- Details of Surgical Mapping
- Details of Weight bearing MRI

Learning Objectives:

- Demonstrate Diffusion Tensor Imaging Technique

- Demonstrate Intra operative MRI Technique
- Demonstrate the Technique of CSF Flow Study in Spine
- Demonstrate the Technique of Perfusion Imaging
- Demonstrate the Technique of MR Spectroscopy
- Demonstrate the Technique of Functional MRI
- Demonstrate the Technique of MR Elastography
- Demonstrate the Technique of MR Enterolysis
- Demonstrate the Technique of MR Urography
- Demonstrate the Technique of Cardiac MRI
- Demonstrate the Technique of Whole Body Diffusion Weighted Imaging
- Demonstrate the Technique of Surgical Mapping
- Demonstrate the Technique of Weight bearing MRI

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: MRI Angiography
Credits: Theory- 1
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
MRI Angiography help to understand the applicability of MRI in Aniography. The students will be taught various types of MRI Angiography to understand its applicability.

Main Concepts:
MRI Angiography :-
- Cervical Vessels
- Thoracic aorta
- Arteries of the upper arm
- Arteries of the forearm
- Arteries of the hand
- Abdominal Aorta
- Renal arteries
- Arteries of the pelvis and Lower Extremity

Course Content:
Details of MRI Angiography:-
- Cervical Vessels
- Patient Preparation
- Positioning
- Sequences
- Thoracic aorta
- Patient Preparation
- Sequences
- Arteries of the upper arm
- Patient Preparation
- Sequences
- Arteries of the forearm
- Patient Preparation
- Positioning

- Sequences
- Arteries of the hand
- Patient Preparation
- Positioning
- Sequences
- Abdominal Aorta
- Patient Preparation
- Positioning
- Sequences
- Renal arteries
- Patient Preparation
- Positioning
- Sequences
- Arteries of the pelvis and lower extremity
- Patient Preparation
- Positioning
- Sequences for:
- Lower Leg
- Iliofemoral Region

Learning Objectives:

- Demonstrate the protocol for MRI Angiography of Cervical Vessels
- Demonstrate the protocol for MRI Angiography of Thoracic aorta
- Demonstrate the protocol for MRI Angiography of Arteries of the upper arm
- Demonstrate the protocol for MRI Angiography of Arteries of the forearm
- Demonstrate the protocol for MRI Angiography of Arteries of the hand
- Demonstrate the protocol for MRI Angiography of Abdominal Aorta
- Demonstrate the protocol for MRI Angiography of Renal arteries
- Demonstrate the protocol for MRI Angiography of Arteries of the pelvis and lower extremity

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Contrast Media in Diagnostic Radiology
Credits: Theory- 1
Total Credit Hours: Theory – 15

Introduction and Course Objectives:

Contrast Media in Diagnostic Radiology help to understand the applicability of different aspect of MRI. The students will be taught various methods of MRI scans using contrast media to understand its applicability in diagnostic radiology.

Main Concepts:

- Contrast Media in Diagnostic Radiology:-
- General Radiography
- Intravascular contrast media
- Gastrointestinal Tract
- Liver, Biliary tract and Pancreas
- Urinary Tract
- Reproductive system

- Heart
- Arterial system
- Venous system
- Lymph glands, lymphatics and tumours
- Bones and joints
- Brain
- Spine
- Lacrimal system
- Salivary Glands
- Thyroid and parathyroids

Course Content:

- Details of General Radiography
- Details of Intravascular Contrast Media
- Details of Methods of Imaging in Gastrointestinal tract
- Details of Methods of Imaging in liver, biliary tract and pancreas
- Details of Methods of Imaging in Urinary tract
- Details of Methods of Imaging in Reproductive system
- Details of Methods of Imaging in Respiratory system
- Details of Methods of Imaging in in Heart
- Details of Methods of Imaging in arterial system
- Details of Methods of Imaging in venous system
- Details of Methods of Imaging in lymph glands, lymphatics and tumours
- Details of Methods of Imaging in bones and joints
- Details of Methods of Imaging in in brain
- Details of Methods of Imaging in in spine
- Details of Methods of Imaging in lacrimal system
- Details of Methods of Imaging in salivary glands
- Methods of Imaging in thyroids and parathyroids

Learning Objectives:

- Explain Intravascular Contrast Media
- Demonstrate the Method of Imaging in Gastrointestinal tract
- Demonstrate the Method of Imaging in liver, biliary tract and pancreas
- Demonstrate the Method of Imaging inUrinary tract
- Demonstrate the Method of Imaging in Reproductive system
- Demonstrate the Method of Imaging in Respiratoy system
- Demonstrate the Method of Imaging in in Heart
- Demonstrate the Method of Imaging in arterial system
- Demonstrate the Method of Imaging in venous system
- Demonstrate the Method of Imaging in lymph glands, lymphatics and tumours
- Demonstrate the Method of Imaging in bones and joints
- Demonstrate the Method of Imaging in brain
- Demonstrate the Method of Imaging in spine
- Demonstrate the Method of Imaging in lacrimal system
- Demonstrate the Method of Imaging in salivary glands
- Demonstrate the Method of Imaging in thyroids and parathyroids

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Mammography
Credits: Theory - 1
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
Mammography is a specialised screening tool used to diagnose various breast diseases or tumours. The students will be trained to understand its Physics, Clinical Application, Positioning and Radiation Safety while performing Mammography.

Main Concepts:
- Mammography Physics
- Mammography Clinical Application
- Positioning and Radiation Safety in Mammography

Course Content:
- Details of Mammography Equipment
- Details of Physics and Basic Principle of Mammography
- Details of Generations Of Mammography
- Details of Alternative modalities and pathological indications of mammography
- Details of Pathologic Indications for Mammography
- Details of Clinical applications for Mammography:
- Details of Screening Mammography
- Details of Diagnostic Mammography
- Details of Stereotactic Breast Biopsy
- Details of FNAC
- Details of Advantages and Disadvantage of Mammography
- Introduction to Positioning & Radiation safety
- Details of Projections and views
- Details of Procedures to Minimize Dose with reference to the following points:-
- General recommendations
- Procedures for minimizing dose to patients
- Guidelines for screening mammography
- Guidelines for the carrying out of mammographic X-ray examinations
- Appendix I: Recommended Dose Limits of Ionizing Radiation
- Appendix II: Recommended Glandular Dose Limits per Irradiation

Learning Objectives:
- Explain Mammography Equipment
- Discuss about Physics and Basic Principle of Mammography
- Discuss about Alternative modalities and pathological indications of mammography
- List & Identify the Pathologic Indications for Mammography
- List & Identify the Clinical applications for Mammography:
- Describe & Demonstrate Screening Mammography
- Describe & Demonstrate Diagnostic Mammography
- Describe & Demonstrate Stereotactic Breast Biopsy
- Describe & Demonstrate FNAC
- List Advantages and Disadvantage of Mammography
- Describe the importance of Positioning & Radiation safety
- Describe & Demonstrate the Procedures to Minimize Dose with reference to the following points:-
- General recommendations
- Procedures for minimizing dose to patients
- Guidelines for screening mammography
- Guidelines for the carrying out of mammographic X-ray examinations

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Bone Densitometry
Credits: Theory- 1
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
Bone densitometry is also a specialised screening tool used to detect various diseases of bones. The students will be trained to understand its Physics, Clinical Application, Positioning and Radiation Safety while performing Bone densitometry.

Main Concepts:
- Working Mechanism (Physics) of Bone Densitometry
- Interpretation and Clinical Application of Bone Densitometry
- Positioning and Radiation Safety in Bone Densitometry

Course Content:
- Details of Working Mechanism (Physics) of Bone Densitometry
- Details of History of Bone Densitometry
- Indications for BMD Testing
- Details of Bone Physiology and Remodelling
- Details of Basic Principle of BMD
- Details of the following Types of Bone Densitometry Equipment's:
- Single Photon Absorptiometry (SPA)
- Dual Photon Absorptiometry (DPA)
- Dual-Energy X-ray Absorptiometry (DXA or DEXA)
- Dual X-ray Absorptiometry and Laser (DXL)
- Single Energy X-ray absorptiometry (SEXA)
- Quantitative Computed Tomography (QCT)
- Quantitative Ultrasound (QUS)
- Digital X-ray Radiogrammetry (DXR)
- Details of Artifacts
- Details of Limitations of BMD
- Details of Interpretation and Clinical Application of Bone Densitometry
- Details of Image Analysis and Interpretation of BMD Study
- Details of Osteopenia
- Details of Osteoporosis
- Details of Positioning and Radiation Safety in Bone Densitometry
- Details of Patient Preparation
- Details of DEXA/DXA Positioning with reference to following points:-
- Routine Positioning
- Additional Positioning
- Peripheral Measurements
- Details of Radiation Safety with reference to following points:-
- Patient Dose
- Radiation Protection for the Patient
- Radiation Protection for the Technologist
- Radiation Protection to Public

Learning Objectives:

- List & Identify the Indications for BMD Testing
- Discuss about Bone Physiology and Remodelling
- Discuss about Basic Principle of BMD
- Describe & Discuss the following Types of Bone Densitometry Equipment's:
- Single Photon Absorptiometry (SPA)
- Dual Photon Absorptiometry (DPA)
- Dual-Energy X-ray Absorptiometry (DXA or DEXA)
- Dual X-ray Absorptiometry and Laser (DXL)
- Single Energy X-ray absorptiometry (SEXA)
- Quantitative Computed Tomography (QCT)
- Quantitative Ultrasound (QUS)
- Digital X-ray Radiogrammetry (DXR)
- Identify Artifacts
- Identify the Limitations of BMD
- Demonstrate the Interpretation of Bone Densitometry
- Identify the Clinical Application of Bone Densitometry
- Demonstrate the Image Analysis and Interpretation of BMD Study
- Discuss What is Osteopenia?
- Discuss What is Osteoporosis?
- Demonstrate different Positioning of the patient
- Demonstrate the protocol for Radiation Safety in Bone Densitometry
- Demonstrate Patient Preparation in Bone Densitometry
- Demonstrate DEXA/DXA Positioning with reference to following points:-
- Routine Positioning
- Additional Positioning
- Peripheral Measurements
- Demonstrate the protocol for Radiation Safety with reference to following points:-
- Patient Dose
- Radiation Protection for the Patient
- Radiation Protection for the Technologist
- Radiation Protection to Public

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Orthopantography
Credits: Theory- 1
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
Orthopantography is also a specialised screening tool used to visualize Jawline. The students will be trained to understand its Physics, Clinical Application, Positioning and Radiation Safety while performing Orthopantography.

Main Concepts:

- Working Mechanism (Physics) of Orthopantography
- Clinical Application of Orthopantography
- Positioning and Radiation Safety in OPG

Course Content:

- Details of Working Mechanism (Physics) of Orthopantography
- Details of the History of Orthopantomography (OPG)
- Details of the Basic Principle and Working Mechanism for Orthopantomography
- Details of Orthopantomography Equipment
- Details of the Generations of OPG
- Details of Artifacts in OPG
- Clinical Application of Orthopantography
- Details of Clinical Applications of OPG with respect to:
- Impacted Teeth
- Periodontal bone loss and Periapical Involvement
- Dental Implants
- Pre and Post-operative Orthodontic Assessment
- Diagnosis of developmental anomalies
- Temporomandibular Joint (TMJ) Disorders
- Dental Bridge
- Salivary Stones (Sialolithiasis)
- Details of Positioning and Radiation Safety in OPG
- Details of patient preparation in OPG
- Details of the technique used in OPG
- Details of Positioning in Cephalometry
- Details of Radiation Safety in OPG with reference to following points:-
- Licensed Dentist and X-ray Machine Registrant Responsibilities
- Patient Protection
- Responsibilities of Dental Personnel Operating X-ray Equipment

Learning Objectives:

- Describe Basic Principle and Working Mechanism for Orthopantography
- List out Orthopantography Equipment
- List out the Artifacts in OPG
- Identify the Clinical Applications of OPG with respect to:
- Impacted Teeth
- Periodontal bone loss and Periapical Involvement
- Dental Implants
- Pre and Post-operative Orthodontic Assessment
- Diagnosis of developmental anomalies
- Temporomandibular Joint (TMJ) Disorders
- Dental Bridge
- Salivary Stones (Sialolithiasis)
- Demonstrate patient preparation in OPG
- Demonstrate the technique used in OPG
- Demonstrate Positioning in Cephalometry
- Demonstrate the protocol for Radiation Safety in OPG with reference to following points:-
- Licensed Dentist and X-ray Machine Registrant Responsibilities
- Patient Protection
- Responsibilities of Dental Personnel Operating X-ray Equipment

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam

Assessment Tasks: Theory question paper

Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Organising and Managing Imaging Department
Credits: Theory- 2
Total Credit Hours: Theory – 30

Introduction and Course Objectives:
Organizing and Managing Imaging Department is very crucial for imparting better results & for maintaining quality assurance. The students will be trained to understand the Outline of Radiological Department, its Basic Design Considerations & Special requirements. Apart from this students will also be trained to handle films along with radiation protection
While performing X-rays, ultrasonography & CT and MRI Scans

Main Concepts:
- Outline of Radiological Department
- The X-ray department
- Basic Design Considerations
- The role of radiology departments in infections
- Special requirements
- Patient Facilities
- Film Handling
- Radiation Protection - 1
- Radiation Protection - 2
- Ultrasonography
- CT and MRI Scans
- Nuclear Medicine
- Quality Assurance

Course Content:
- Details of Outline of Radiological Department i.e X-ray department, Ultrasonography department as well as CT and MRI Scans
- Details of Basic Design Considerations of Radiological Department
- Details of the role of radiology departments in infections.
- Details of Special requirements of Radiological Department
- Details of Patient Facilities in Radiological Department
- Details of Film Handling in Radiological Department
- Details of Radiation Protection - 1
- Details of Radiation Protection - 2
- Details of Nuclear Medicine used in Radiological Department

Learning Objectives:
- Discuss the Outline of Radiological Department i.e X-ray department, Ultrasonography department as well as CT and MRI Scans
- Discuss & Describe Basic Design Considerations of Radiological Department
- Explain the role of radiology departments in infections.
- Explain the Special requirements of Radiological Department
- Describe the Patient Facilities in Radiological Department
- Describe & Demonstrate Film Handling in Radiological Department
- Discuss & Describe Radiation Protection - 1
- Discuss & Describe Radiation Protection - 2
- Discuss & Describe which are Nuclear Medicine used in Radiological Department?

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Vocational Practical
Credits: 12
Total Credit Hours: 360 hours

Introduction and Course Objectives:
It is essential to perform various practicals in order to achieve skills. The students will be trained to undertake various scans.

Course Content:

- Magnetic Resonance Imaging (MRI) – Musculoskeleta - *also called as:* Musculoskeletal MRI
- Magnetic Resonance Imaging (MRI) - Prostate
- Magnetic Resonance Imaging (MRI) – Shoulder - *also called as:* Shoulder MRI
- Magnetic Resonance Imaging (MRI) – Spine - *also called:* Spine MRI
- Magnetic Resonance, Functional (fMRI) – Brain - *also called:* Brain Imaging, (fMRI) Or Functional MRI (fMRI) - Brain
- MR Angiography (MRA) - *also called:* Angiogram, MRI or Angiography, MRI
- MR Enterography - *also called as:* Enterography, MRI
- Urography - *also called as:* CT Urography (CTU) *and* MR Urography (MRU)

Learning Objectives:

- Perform Magnetic Resonance Imaging (MRI) – Musculoskeleta - *also called as:* Musculoskeletal MRI
- Perform Magnetic Resonance Imaging (MRI) - Prostate
- Perform Magnetic Resonance Imaging (MRI) – Shoulder - *also called as:* Shoulder MRI
- Perform Magnetic Resonance Imaging (MRI) – Spine - *also called:* Spine MRI
- Perform Magnetic Resonance, Functional (fMRI) – Brain - *also called:* Brain Imaging, (fMRI) Or Functional MRI (fMRI) - Brain
- Perform MR Angiography (MRA) - *also called:* Angiogram, MRI or Angiography, MRI
- Perform MR Enterography - *also called as:* Enterography, MRI
- Perform Urography - *also called as:* CT Urography (CTU) *and* MR Urography (MRU)

Method of Teaching:
Hand-on practical in lab, hospitals and nursing homes.

Method of Assessment & Weightage:
Assessment Tasks:

Weightage: 75%

SEMESTER – VI

SEMESTER VI
Course Title: Patient Care in Diagnostic Radiology
Credits: Theory- 2
Total Credit Hours: Theory – 30

Introduction and Course Objectives:
This paper covers general aspects of patient care & patient care issues in diagnostic radiology, CT , MRI & other digital imaging techniques. This will enable students to understand about general & special patient care in diagnostic imaging.

Main Concepts:
- General Management of the Patient Undergoing Diagnostic Testing
- Diagnostic Procedures for Central Nervous System
- Diagnostic Procedures for Respiratory System
- Diagnostic Procedures for Cardiovascular System
- Diagnostic Procedures for Urinary System
- Diagnostic Procedures for Gastro-Intestinal System
- Diagnostic Procedures for Liver, Biliary and Lymphatic Systems and Oral Cholecystography
- Diagnostic Procedures for Musculoskeletal System
- Diagnostic Procedures for Reproductive System

Course Content:
- Details of General Management of the Patient Undergoing Diagnostic Testing
- Details of Diagnostic Procedures for Central Nervous System
- Details of Diagnostic Procedures for Respiratory System
- Details of Diagnostic Procedures for Cardiovascular System
- Details of Diagnostic Procedures for Urinary System
- Details of Diagnostic Procedures for Gastro-Intestinal System
- Details of Diagnostic Procedures for Liver, Biliary and Lymphatic Systems and Oral Cholecystography
- Details of Diagnostic Procedures for Musculoskeletal System
- Details of Diagnostic Procedures for Reproductive System

Learning Objectives:
- Discuss & Demonstrate General Management of the Patient Undergoing Diagnostic Testing
- Explain & Demonstrate Diagnostic Procedures for Central Nervous System
- Explain & Demonstrate Diagnostic Procedures for Respiratory System
- Explain & Demonstrate Diagnostic Procedures for Cardiovascular System
- Explain & Demonstrate Diagnostic Procedures for Urinary System
- Explain & Demonstrate Diagnostic Procedures for Gastro-Intestinal System
- Explain & Demonstrate Diagnostic Procedures for Liver, Biliary and Lymphatic Systems and Oral Cholecystography
- Explain & Demonstrate Diagnostic Procedures for Musculoskeletal System
- Explain & Demonstrate Diagnostic Procedures for Reproductive System

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Preventive Cardiology
Credits: Theory- **1**
Total Credit Hours: Theory –15

Introduction and Course Objectives:
Preventive cardiology & cardiac rehabilitation, have become important areas in Modern Cardiology.
The students will be taught various aspect of preventive cardiology.
The aim of Preventive Cardiology/Cardiac Rehabilitation program is basically:-

- To promote and teach heart-healthy habits
- To manage effectively cardiac risk factors
- To rehabilitate patients following myocardial infarction, coronary bypass surgery, coronary angioplasty, and heart transplantation.

Main Concepts:

- Broad Goals of Preventive Cardiology
- Preventive Cardiology
- Cardiac Rehabilitation

Course Content:

- Details of Broad Goals of Preventive Cardiology with reference to following points:-
- Medical knowledge
- Patient Care
- Professionalism
- Interpersonal & Communication Skills
- Practice Based Learning
- System Based Learning
- Preventive Cardiology
- Specific Goals & Objectives of Preventive Cardiology
- Cardiac Rehabilitation
- Benefits of Cardiac Rehabilitation Program
- Components of Cardiac Rehabilitation Program

Learning Objectives:

- Demonstrate Interpersonal & Communication Skills
- Describe Specific Goals & Objectives of Preventive Cardiology
- Discuss Benefits of Cardiac Rehabilitation Program
- Discuss different Components of Cardiac Rehabilitation Program

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Cardiovascular diseases
Credits: Theory- **1**
Total Credit Hours: Theory –15

Introduction and Course Objectives:
Having an adequate knowledge of Different Types of Cardiac Diseases & of various Cardiac Procedures gives added advantage to students. It will also enable them to assist the Physician in Various Cardiac Procedures.

Main Concepts:

- Different Types of Cardiac Diseases
- Assisting in Cardiac Catheterisation /Angiography
- Assisting in Angioplasty / PTCA
- Assisting in Coronary Artery Bypass Graft (CABG)

Course Content:

- Details of Different Types of Cardiac Diseases
- Details of Cardiac Catheterisation /Angiography Procedure
- Details of Assisting in Angioplasty / PTCA Procedure
- Details of Assisting in Coronary Artery Bypass Graft (CABG) Procedure

Learning Objectives:

- Describe Different Types of Cardiac Diseases & their OPD as well as IPD Management.
- Describe What is Cardiac Catheterisation /Angiography & How he/she can assist the physician in the Procedure.
- Describe What is in Angioplasty / PTCA & How he/she can assist the physician in the Procedure.
- Describe What is Coronary Artery Bypass Graft (CABG) & How he/she can assist the physician in the Procedure.

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Different Angiography Techniques and related equipments
Credits: Theory- 1
Total Credit Hours: Theory –15

Introduction and Course Objectives:
Classification of Angiography examination techniques and equipments desired for these angiography examinations . Students will be taught various angiography techniques .

Main Concepts:

- Angiography examination techniques
    - Coronary Angiography examination techniques
    - Micro - Angiography examination techniques
    - Peripheral Angiography examination techniques
    - Neuro - vascular Angiography examination techniques
    - Renal Angiography examination techniques
- Various equipments and desired accessories, consumables for Angiography examination techniques

Course Content:

- Details of Angiography examination techniques
    - Details of Coronary Angiography examination techniques
    - Details of Micro - Angiography examination techniques
    - Details of Peripheral Angiography examination techniques
    - Details of Neuro - vascular Angiography examination techniques
    - Details of Renal Angiography examination techniques
- Details of Angiography Equipment and its components
- Details of Desired accessories
- Details of Consumables
- Details of Layout installation plan
- Details of Prerequisites

Learning Objectives:

- Describe & Demonstrate Coronary Angiography examination techniques
- Describe & Demonstrate Micro - Angiography examination techniques
- Describe & Demonstrate Peripheral Angiography examination techniques
- Describe & Demonstrate Neuro - vascular Angiography examination techniques
- Describe & Demonstrate Renal Angiography examination techniques
- Identify different Angiography Equipment and its components
- Explain requirements of various accessories & Consumables
- Discuss the Layout installation plan
- Discuss importance of Prerequisites

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Cath Lab system components
Credits: Theory- 1
Total Credit Hours: Theory –15

Introduction and Course Objectives:
There are several components of a cath lab. The student needs to be well-versed with all the components of the cath lab in order to perform well in Cath Lab. The course will teach the students regarding various aspect of the cath lab system.

Main Concepts:

- Discussion of Cardiac Cath Lab Equipment
- Physics Test Procedures for Cardiac Cath Labs
- Radiation Measurements

Course Content:

- Details of various Cardiac Cath Lab Equipment
- Details of various Physics Test Procedures for Cardiac Cath Labs
- Details of Radiation Measurements

Learning Objectives:

- Discuss & Identify different Cath lab system components

- Discuss & Demonstrate Handling and maintenance of different Cath lab system components
- Describe & Demonstrate Precautions to be followed.

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Electrocardiography (ECG), Stress test and 2D Echo
Credits: Theory- **1**
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
ECG provides clue to many heart conditions. The students will be taught how to perform ECG and interpret ECG as well.

Main Concepts:
- ECG machine
- Abnormal ECGs
- Stress test
- 2D Echo

Course Content:
- ECG machine : Parts
- Performing an ECG
- Pitfalls in taking ECGs
- Recognition of normal ECG waves
- Abnormal ECG
- Stress test
- Abnormal stress test
- 2D echo

Learning Objectives:
- Discuss ECG machine : Parts
- Perform an ECG
- Discuss Pitfalls in taking ECGs
- Recognize of normal ECG waves
- Discuss & recognize Abnormal ECGs
- Describe Stress test
- Discuss Abnormal stress test
- Explain 2D echo

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Defibrillation
Credits: Theory- **1**
Total Credit Hours: Theory – 15
Introduction and Course Objectives:
Defibrillation is used in cases of cardiac arrest. The course will teach the students regarding the defibrillators and the use of defibrillators (its technique).

Main Concepts:

- Defibrillation

Course Content:

- Indication
- Technique
- Complication

Learning Objectives:

- Identify the Indication
- Discuss & Demonstrate the appropriate steps in Technique
- Identify & Explain Complication

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Catheters and Instruments
Credits: Theory- **1**
Total Credit Hours: Theory – 15

Introduction and Course Objectives:
The Angiography technician including Cath lab should possess deep knowledge regarding various catheters and instruments. Technician should also be well informed about sterilization techniques required for the different catheters used during Angiography procedure. The course will teach students regarding various Catheters and Instruments used during angiography examination (in Cath lab.)

Main Concepts:

- Catheters
- Instruments
- Sterilization Techniques of catheters and instruments

Course Content:

Learning Objectives:

Method of Teaching: A combination of vocational theory inputs along with relevant practical exposure that would commensurate with the guidelines provided in the Facilitator's guide.

Method of Assessment & Weightage: Assignments explaining main concepts, mid-term/final exam
Assessment Tasks: Theory question paper
Weightage: 25% (Total weightage for Theory)

Reading Lists & References:-

Course Title: Vocational Practical
Credits: 12
Total Credit Hours: 360 hours

Introduction and Course Objectives:
IT is very essential for the cath lab technician to have detailed knowledge regarding various procedures and the instruments used. The course will impart detailed knowledge regarding the procedures and instruments used.

Course Content:
- Various Cardiac drugs
- Emergency drugs
- Crash trolley
- Various instruments used in Cath Lab
- Septal closure devices
- Various kinds of Catheters
- Cardiac catheterization
- Myocardial biopsy
- Percutaneous Transluminal Coronary Angioplasty
- Stenting
- Atherectomy
- Thrombectomy
- O2 supply
- Defibrillator
- Coronary angiography
- Closure of congenital heart defects
- Stenotic heart valves
- Pacemakers
- Cardiac ablation
- Sterilization

Learning Objectives:
- Discuss Various drugs used in cath lab
- Describe Emergency drugs
- Discuss Crash trolley
- Prepare Crash trolley
- Identify and select Various instruments used in cath lab
- Select Septal closure devices
- Identify various types of Catheters
- Choose appropriate size of catheter for the procedure
- Assist cardiac catheterization
- Assist Myocardial biopsy
- Assist Percutaneous Transluminal Coronary Angioplasty
- Assist Stenting
- Assist Atherectomy
- Thrombectomy
- Adjust and maintain O2 supply
- Identify Defibrillator

- Use defbrillator
- Assist Coronary angiography
- Assist Closure of congenital heart defects
- Assist Stenotic heart valves treatment procedures
- Identify Pacemakers
- Assist in fitting pacemaker
- Assist Cardiac ablation
- Perform sterilization of various equipment in cath lab
- Assist in aortic aneyrysm repair
- Prepare and Assist in cerebral angiogram
- Prepare and Assist in pulmonary angiogram
- Prepare and assist in renal angiogram
- Assist in establishing central line
- Assist in dialysis catheterization
- Prepare and assist in fistulogram
- Assist in PICC line procedure
- Assist in percutaneous Transhepatic Cholangiogram
- Assist in arteriogram
- Assist in electrophysiology syncope study

Method of Teaching:
Hand-on practical in lab and hospitals

Method of Assessment & Weightage:
Various practicals performed and various procedures assisted

Assessment Tasks:
Various procedures performed

Weightage: 75%

Essential Reading:

a. Human Anatomy by B D Chaurasia
b. Human Physiology by C C Chaterjee
c. Textbook of pathology by Harshmohan
d. Diagnostic Radiology and Imaging for Technicians by A N Shastri
e. Principles of Computerized Tomography Imaging by Marjolein Glas
f. MRI physics by Evert Blink
g. Principles of Radiological Physics by Donald Graham
h. Bontrager's Handbook Of Radiographic Positioning And Techniques By Kenneth L. Bontrager & John P. Lampignano
i. Pocketbook Of Radiographic Positioning By Ruth Sutherland & Calum Thomson