MAHARASHTRA UNIVERSITY OF HEALTH SCIENCES, NASHIK

BACHELOR OF PARAMEDICAL TECHNOLOGY

Radiographic

Syllabus for 2nd year

Paper	Subject Title	Lectures	Seminars	Demo Lectures	Clinical Attachment	Total Hrs.
Paper I	Physics and Technology: Imaging Equipment (Radiographic Equipment, CR, DR, CT, Ultrasound) Photographic Technology and Film Processing (Darkroom, manual Processing, Automatic Processing, Film-Screen Technology)	70	20	10		
Paper II	Radiography & Radiographic Anatomy (Basic), Procedures and Patient Care (Special Procedures)	100	30	15		
Paper III	Basic Imaging and Imaging Anatomy (CR, DR, CT, B –Mode Ultrasound) Administration, Quality Assurance and Radiation Safety	135	45	35		
	Total				**800**	460

Total Learning Hours – 1260 (for a total of 210 working days)

Paper II : Radiography & Radiographic Anatomy (Basic)	
	Important Surface Landmarks
	Upper Limb: Hand Thumb Wrist Forearm Elbow Humerus Shoulder Clavicle Sterno-Clavicular Joints Scapula
	Lower Limb: Foot Toes Calcaneum Sub-Talar Joint Ankle Joint Leg Knee Femur Hips Neck of femur Pelvis
	Vertebral Column: Sacro-Iliac Joints Atlanto-Occipital Articulation Cervical Spine Cervical Spine 3rd to 7th Vertebrae Cervico-Thoracic Vertebrae Thoracic Spine Lumbar Spine Lumbo-Sacral Spine Sacrum
	Ribs: Lower Ribs Upper Ribs
	Skull Skull Routine Skull Optic Foramina Skull Jugular Foramina Skull Temporal Bones Skull Mastoid Skull Petrous Paranasal Sinuses Facial Bones Orbits Nasal Bone Mandible Temporomandibular Joints

	Dental Radiography: Introduction and Basics Bite Wing Intra-Oral Peri-Apical Occlusal Extra-Oral
	Respiratory System: Pharynx and Larynx Trachea Lungs Apices Paediatric Heart and Aorta
	Abdomen: KUB Urinary Bladder
	Radiography for foreign Bodies
	Care and Maintenance in Routine Radiography
Paper II: Procedures and Patient Care (Special Procedures)	
	Introduction to Special Procedures
	Contrast Media
	Intravascular Radiographic Contrast media : Chemical Structure, Properties, Pharmacology, Use
	Genitourinary Tract: IVU RGU/MCU/Cystogram Nephrostogram/ RGP Investigations of Female Reproductive System Investigations of Male Repsroductive System
	Gastrointestinal Tract: Oral/ Rectal contrast media Pharyngogram/ Oesophagram Barium Meal Small Bowel Meal Enteroclysis Barium Enema Endoscopic Retrograade Cholangiopancreaticography Special Situations
	Miscellaneous Procedures: Sialography Dacryocystography Sinogram/ Fistulogram T-Tube Cholangiogram

Paper I : Physics and Technology: Imaging Equipment (Radiographic Equipment, CR, DR, CT, Ultrasound)	
	Section I : Basic Physics
	Units and measurement
	Newton's laws of motion : Force , Work , Energy and Power .
	Heat Specific heat, thermal capacity Conduction, convection and radiation
	Electrostatics , Charges and their properties , electric field and Potential Difference .
	Electric potential, difference, volt, capacitance
	Electric current, AC and DC, its characters
	Ohm's law and its application .
	Electrical work, power, energy
	Effects of electric current, Electrolysis
	Magnetism: Fundamental Principles and Terminology
	Magnetic induction, flux and demagnetization
	Electromagnetic induction, Faradays laws
	Mutual and self induction
	Mutual induction and self induction
	Transformer : Step up and step down .
	Rectification : Type of rectification .
	Atom, structure, atomic no, mass no, Isotopes, ionisation
	Electromagnetic Spectrum
	Thermionic Emission and its application .
	Interaction of Energy and Matter at the atomic level
	Radioactivity: Laws, Terminology, Half Life
Soun	Sound : Acoustics and wave motion.
	Section II: Technology
	Principles of X Ray Production
	X-Ray machine components and circuit diagram
	Power supply to X-Ray machine , main fuse box , constructions .
	Auto transformer : construction , principles and connections .
	High-tension transformer : Construction , Principles and connections .
	Timer : Construction , type and their proper use
	Filament Control , location , purpose and function
	Filament heating transformer and functions
	Line voltage conpensator
	Rectification : Self and half wave rectification.
	X Ray Generators: Power Supply
	Construction of an X-Ray tube , Rotating anode X-Ray tube
	Production of X-Ray . Effects of KVP & MA
	Tube ratings .
	Earthing of an X-Ray machine
	Radiation Quality: Filtration
	Radiation Quality: Beam Limiting Devices
	Grids: Principles, construction, Uses and limitations
	Radiographic Tables: Design and Constrction
	Mobile X-Ray unit : Design and Use

	Image intensifier : Basic Principles and Construction
	Image Intensifier: Digital
	Radiation Detectors: Principles of Design and Construction
	Applications of Radiation Detectors
	Computed Radiography
	Digital Radiography
	Computed Tomography: Basic Principles
	Computed Tomography: X Ray Tube Design and construction: Special Requirements
	Computed Tomography: Generations, EBCT
	Computed Tomography: Multidetector CT. Design and Construction
	Utrasonography: Physical Principles
	US: Transducer Design and Construction
	US: Types of Imaging (A Mode, B Mode, TM Mode)
Paper I : Physics and Technology: Photographic Technology and Film Processing (Darkroom, manual Processing, Automatic Processing, Film-Screen Technology)	
	Photographic aspects of Radiography and Image formation
	Construction of Radiographic Film
	Principles of Function of Radiographic Film
	Types of Radiographic Film and comparative evaluation
	Intensifying Screen: Principles and Construction
	Intensifying Screen : Performance
	Intensifying Screen : Types and Classification
	Film Cassettes: Construction and Types
	Film- Screen System: Basic Testing Procedures
	Film Processing: Basic Chemistry and Principles
	Film Processing : Development and Fixing
	Film Processing : Making of Chemical Solutions
	Dark Room Design and Construction: Basic Principles and Safe Light
	Manual Processing: Layout and Procedure
	Automatic Processing: Technology
	Automatic Processors: Designs and types
	Film Faults and Their Prevention: I
	Film Faults and Their Prevention: II
	Replenishment
	Environmental Problems in Dark Room Management
	Dark Room : Basic Quality Tests

Paper III : Basic Imaging (CR, DR, CT, B –Mode Ultrasound)	
	CT Introduction and Fundamentals: Terminology and parts
	CT Introduction: Equipment parameters- Basic, Single Slice & Spiral
	CT Introduction : Equipment parameters- Multidetector
	CT Techniques : GIT Preparation
	CT Techniques : Basic Steps in CT scanning
	CT IV Contrast Use: Basics of Contrast Injectin and Use of Power Injectors
	CT Technique: Neurocranium
	CT Technique: Pituitary
	CT Technique Petrous pyramids
	CT Technique Orbit
	CT Technique Paranasal sinuses
	CT Technique Cervical soft tissues including Larynx
	CT Technique Thoracic organs
	CT Technique Upper abdominal organs
	CT Technique Liver
	CT Technique Pancreas
	CT Technique Kidneys
	CT Technique Adrenal glands
	CT Technique Female pelvis
	CT Technique Male pelvis
	CT Technique Cervical spine
	CT Technique Thoracic spine
	CT Technique Lumbar spine
	CT Technique Lower Limbs
	CT Technique Upper Limbs
	CR: Equipment nomenclature and Introduction
	CR: Procedures and Documentation
	CR : Artefacts and Errors
	CR: Limitations
	CR: Radiation Safety Features
	DR: Equipment Nomenclature and Introduction
	DR: Procedure of Image Acquisition and Parameters
	DR: Artifacts and Errors
	DR: Radiation Safety Factors
	Ultrasound : Introduction and Terminology
	Ultrasound: Patient Preparation
	Ultrasound: Regions and Techniques

Paper III: Administration, Quality Assurance and Radiation Safety	
	Image Quality : Terminology and Principles
	Image Quality: Analysis of Image Quality in Film Screen System
	Image Quality: Basic Testing Procedures in Conventional Radiography
	Quality Assurance in Film Processing
	The Digital Image : Fundamental Principles
	Occupational Health: Hazards in Radiographic and Imaging Technology
	Electrical Safety
	Radiation Safety : Principles of Radiobiology
	Radiation Safety : Current Regulations and Standards
	Radiation Safety : Indian Regulations and Procedures
	Radiation Safety : Administrative Aspects
	Radiation Safety : Practical Aspects (Protective Equipment and Procedural Techniques)
	Administration: Record Keeping and Documentation
	Administration: Inventory Management
	Administration: PNDT Act
	Digital Images: Basic Principles
	Administration: Care and Maintenance of Equipment. Log Books
	Disposal of Used Chemicals
	Bio-waste Disposal in Radiology Department

3rd Year Syllabus

Paper	Subject Title	Lectures	Seminars	Demo Lectures	Clinical Attachment	Total Hrs
Paper I	Physics & Technology (Colour Doppler, Advanced CT, MRI, DSA) Image Processing and Recording (Advanced)	60		5		
Paper II	Radiography (Advanced Radiography and Sectional Anatomy) Imaging (Advanced CT, MRI, Colour Doppler, DSA) Procedures and Patient Care in Interventional Radiology	105	35	15		
Paper III	Administration and Radiation Safety in Interventional Procedures, MR Safety, DICOM and PACS, Quality Assurance in Imaging.	140	45	35		
	Total				**800**	**460**

Total Hours: 1260 for a total of 210 working days

Examiners - One Internal Examiner of the institute
One External Examiner outside the institute

Internal Assessments - One Mid Term / Term End
- One Preliminary

Paper I : Physics & Technology (Colour Doppler, Advanced CT, MRI, DSA)	
	CT Technology: Resolution In CT
	CT Technology: Disadavantages of MDCT
	CT Technology: MDCT Technology and its influence on Radiation Safety
	MRI Technology : The Magnetic Resonance Phenomenon
	MRI Technology : Basics of MR Image Formation
	MRI Technology : Design and Construction of Components of The MR Scanner
	MRI Technology : RF Coils
	MRI Technology : Image Formation Process
	MRI Technology : The Basic MR Sequences
	MRI Technology : Advanced MR Sequences
	MRI Technology : Parallel Processing
	MRI Technology : BOLD imaging and Functional MRI
	MRI Technology : Perfusion Imaging
	MRI Technology : MR Spectroscopy
	MRI Technology : Imaging Parameters and Their effect on Image acquired
	Colour Doppler : Fundamental Principles
	Colour Doppler : Pulse Wave and Continuous Wave
	Colour Doppler : Colour Map
	Colour Doppler : Advanced Applications
	Digital Subtraction Angiography : Basic Principles
	Digital Subtraction Angiography : The Subtraction Process in application
	Digital Subtraction Angiography : Advanced Fluoroscopic Functions
	Digital Subtraction Angiography : Rotational Angiography principles
Paper I : Image Processing and Recording (Advanced)	
	Image Documentation: Types of Printers and Cameras
	Multiformat Cameras
	Thermal Printers
	DICOM Laser Printers for Films : Wet Type
	DICOM Lser Printers for Films : Dry Type
	Non- DICOM Printers
	Archiving on Removable Media
	Archiving Systems for Large Capacity Storage and archiving
	Image Processing Basics
	Image Processing : Reformations
	Image Processing : 3 D reconstructions and Display Modes

Paper II : Radiography (Advanced Radiography and Sectional Anatomy)	
	Basic Tomography Technique
	Orthopantomography
	Radiography in Orthopedics
	Radiography In Polytrauma
	Radiography In Disaster Situation
	Radiography In ICU
	Radiography In Operation Theater
	C Arm Use in Operation Theater
	Radiography of Scoliosis
	Skeletal Survey
	Mammography Basics
	Mammography Advanced (Including Digital Mammography and Biopsy Procedures)
Paper II : Imaging (Advanced CT, MR, DSA)	
	CT Techniques : Musculoskeletal CT basics
	CT Techniques : Musculoskeletal CT advanced
	CT Techniques: Principles of Contrast Medium Delivery and Scan Timing in MDCT
	CT Techniques : CT Angiography: Lower Limbs
	CT Techniques : CT Angiography Head and Neck
	CT Techniques : CT Venography for Cerebral Veins and Venous Sinuses
	CT Techniques : CT Angiography Thoracic Aorta
	CT Techniques : CT Angiography Pulmonary
	CT Techniques : CT Angiography Upper Limbs
	CT Techniques : CT Venography Lower Limbs
	CT Techniques : CT Venography Abdominal
	CT Techniques : CT Mesenteric- Portography
	CT Techniques : CT Perfusion (MDCT 16/ 40)
	CT Techniques : Triple Phase CT
	CT Techniques : CT Enterography/ Enteroclysis
	CT Techniques : Cardiac CT
	CT Techniques : Coronary CT Angiography Basics
	CT Techniques : Coronary CT Angiography Adavanced
	CT Techniques : MDCT in Polytrauma
	CT Techniques : Introduction to post processing applications for Image Rendering
	CT Techniques : Post Processing for Image rendering: Coronary Angiography
	CT Techniques : Post Processing for Image rendering: Peripehral Angiography
	CT Techniques : Post Processing for Image rendering: Pulmonary CT & CTA
	CT Techniques : Post Processing for Image rendering: Abdominal CT and CTA
	CT Techniques : Post Processing for Image rendering: Musculoskeletal CT
	CT Techniques : Low dose CT for Thorax
	CT Techniques : Radiation Safety : Techniques of minimizing exposure
	CT Techniques : Pediatric CT
	CT Techniques : CT Colonography Introduction, Patient Preparation and Positioning
	CT Techniques : CT Colonography Image acquisition and Processing.Role of Screening CT Colonography
	CT Techniques : CT Guided Biopsies
	CT Techniques : CT Guided Drainage

	CT Techniques : Miscellaneous CT Guided Interventions
	CT Techniques: Patient Monitoring, Procedures under Sedation and General Anaesthesia
	CT Maintenance and Calibrat Procedures
	PET-CT: Introduction
	PET-CT: Basic Equipment and Procedure
	PET-CT: Image Acquisition and Processing
	MRI : Introduction to MRI Procedure
	MRI Technique: Terminology and Parts of Equipment
	MRI Technique: Coils
	MRI Technique: Pressure Injector
	MRI Technique: MR Contrast Media
	MRI Technique: MR Patient Safety procedure
	MRI Technique: MR Equipment Safety
	MRI Technique: Basic MR sequences and Clinical Implications
	MRI Technique: Advanced MR Sequences and Parallel Processing: Clinical Implications
	MRI Technique: Brain Basic
	MRI Technique: Brain for Cerebrovascular Accident
	MRI Technique: Intracranial Neoplasms
	MRI Technique: Perfusion Technique
	MRI Technique: Epiplepsy
	MRI Technique: Inner Ear
	MRI Technique: Orbit
	MRI Technique: Sella
	MRI Technique: Cervical Spine
	MRI Technique: Cranio-vertebral Junction
	MRI Technique: Dorsolumbar Spine
	MRI Technique: Lumbosacral Spine
	MRI Technique: Post-Operative Spine
	MRI Technique: Spinal Trauma
	MRI Technique: Sacroiliac Joints
	MRI Technique: Abdomen, Upper
	MRI Technique: Liver Lesion
	MRI Technique: MRCP (Biliary System)
	MRI Technique: Kidneys and MR Urography
	MRI Technique: Female Pelvis
	MRI Technique: Male Pelvis
	MRI Technique: Rectum and Anal Canal
	MRI Technique: Adrenal Gland
	MRI Technique: Musculoskeletal MRI Introduction
	MRI Technique:Temporomandibular Joints
	MRI Technique: Shoulder Joint
	MRI Technique: Elbow Joint
	MRI Technique: Wrist Joint and Hand
	MRI Technique: Hip Joints
	MRI Technique: Knee Joint
	MRI Technique: Ankle Joint and Foot
	MRI Technique: Introduction MR Angiography techniques : TOF/ PCA

	MRI Technique: MRA Techniques CEMRA
	MRI Technique: MRA Head and Neck
	MRI Technique: MRA Thorax
	MRI Technique: MRA Pulmonary Artery
	MRI Technique: MRA for Abdominal Aorta and renal Arteries
	MRI Technique: MRA for Aortoiliac and Lower Extremity arteries
	MRI Technique: MR Venography for Lower Limbs
	MRI Technique: MR Mesenterico-Portography
	MRI Technique: MR Spectroscopy
	MRI Technique: Functional MRI
	Newer MR Contrast Media
	MRI Maintenance procedures
	Colour Doppler Imaging Basics
	Colour Doppler Techniques for Arterial Disease
	Colour Doppler Techniques for Venous Disease
	Colour Doppler in Obstetrics
	3D Ultrasound
	Digital Subtraction Angiography System: Fluroscopy techniques and Procedures
	DSA: Post Processing
	DSA: Rotational Angiography and Post Processing
	Interventional Radiology: Introduction
	Patient Care : (i) Patient preparation (ii) Patient reception (iii) Patient care during and after procedure
	Intra-Procedural Management : (i) Patient positioning, cleaning and draping (ii) Trolley and disposables (iii) Drug administration and recording (iv) Managing the equipment and assisting the radiologist
	Equipment Related (i) Basic Hardware (ii) Fluoroscopy and DSA
	Patient Monitoring & Sedation
	Common Drugs in Interventional Procedures
	Procedures : (i) Seldinger Technique (ii) Guided FNAC/ Biopsies (iii) Abscess/ Collection Drainage (iv) Angiography (v) Percutaneous Transhepatic Biliary Drainage (vi) Percutaneous Nephrostomy (PCN) (vii) Introduction to Vascular Interventions (viii) Advanced Vascular Procedures (Revascularisation and Embolisation) (ix) Neurointerventional Procedures (x) Venous Procedures (TIPS) (xi) Miscellaneous Procedures
	Maintaining Patient Records

Paper III : Administration and Radiation Safety in Interventional Procedures, MR Safety, DICOM and PACS, Quality Assurance in Imaging.	
	Radiation safety In The Fluoroscopy Suite
	Radiation Dosage Monitoring and TLD Service Methodology
	MR Safety Considerations
	MR Safety for Patients
	MR Compatibility of Implants
	DICOM Standard : Introduction
	Components of the DICOM standard
	DICOM Compatibility of Equipment and DICOM Licensing
	DICOM Functions
	PACS : Introduction
	PACS : Components
	PACS: Types and Architecture
	PACS: Maintenance and Security
	PACS: Future Directions
	PACS: How to assess a PACS system
	PACS and EMR : Electronic Medical Records Standards
	Quality Assurance in CT scanning
	Quality Assurance in MRI
	Quality assurance in Imaging Informatics
	Medico- legal issues in Medical Record Keeping

List of Books Recommended:

Physics and Technology

Christensen's Physics of Diagnostic Radiology
Chesney D.N. *et al.* (1994), *Chesney's Equipment for Student Radiographers*

Anatomy and Radiography

Ryan S., McNicholas M. and Eustace S. (2004), Anatomy for Diagnostic Imaging
Bontrager K.L. (2001), Textbook of Radiographic Positioning and Related Anatomy
Ehrlich R.A., McCloskey E.D. and Daly J.A. (2004), Patient Care in Radiography
Chesney D.N. (1995), Chesney's Radiographic Imaging
Kindlen S. (2003), Physiology for Health Care and Nursing
Weir J. and Abrahams P.H. (2003), Imaging Atlas of Human Anatomy
Whitely A.S. et al. (2005), Clark's Positioning in Radiography
Raby N. (2003), Accident and Emergency Radiology - A Survival Guide
Stephen Chapman and Richard Nakielny: A Guide to Radiological Procedures
Merrill's Atlas of Radiographic Positions and Procedures, (Vol. I, II, III), by Philip W. Ballinger & Eugene D. Franks, 11th ed., Mosby
Radiographic Anatomy and Positioning and Procedures
Workbook, 3rd ed., (Vol.I & II), by Steven G. Hayes Sr.Mosby

Radiographic Image Analysis, 2nd edition, Kathy McQuillen,
Saunders 2006

Workbook for Radiographic Image Analysis, 2nd edition,
Kathy McQuillen, Saunders 2006

Basic Medical Techniques & Patient Care for
Radiologic Technologists, 6th Ed., Torres, J.B.

Lippincott, 2003

Imaging

Carter C. and Veale B. (2008), Digital Radiography and PACS
Gonzalez R.C. and Woods R.E. (2001), Digital Image Processing
Oakley J. (2006), Digital Imaging, A Primer for Radiographers, Radiologists and Health Care Professionals
Catherine Westbrook: Handbook of MRI Technique
Computed Tomography, Seeram, 3rd Edition, Saunders
Introduction Sectional Anatomy (Workbook), 2nd Edition,
Madden, 2008, Lippincott, Williams & Wilkins
Introduction Sectional Anatomy (Workbook), 2nd Edition,
Madden, 2008, Lippincott, Williams & Wilkins

Interventional Radiology

Advanced Radiographic & Angiographic Procedures, with an
Introduction to Specialized Imaging Marianne R. Tortorici,
F.A. Davis Company, 1995

Krishna Kandarpa: Handbook of Intervention