CURRICULUM FOR
B.Sc. IN RADIOGRAPHY
DEGREE PROGRAMME

Department of Radiography /Radiotherapy

Faculty of Allied Health Sciences

University of Peradeniya

JUSTIFICATION

B.Sc. in Radiography awarded by Department of Radiography/ Radiotherapy, Faculty of Allied Health Sciences, University of Peradeniya is the only degree offered in this discipline in Sri Lanka.

Radiography is a branch of medicine that uses ionizing and non ionizing radiation to produce high-quality images of internal structures of human body to assist in the diagnosis and treatment of diseases. As a profession, radiography involves the use of highly sophisticated equipment and direct patient contact in clinical and hospital settings.

The need for diagnostic radiographers will continue for the foreseeable future across Sri Lanka and internationally. Especially with the expansion in the number of diagnostic imaging facilities and advancement in medical imaging, there was a necessity to revise the curriculum.

The revised curriculum consists of 120 credits including hospital based training and a research project.

The programme is designed not only to produce competent diagnostic radiographers equipped with knowledge and professional skills to provide safe, effective and compassionate care but also to expand the role and provide a career ladder for diagnostic radiographers. This degree will ensure students have the ability to produce standard images for diagnostic purposes, the provision of a high standard of patient care, good inter-personal skills, and the ability to adapt and respond to the individual needs of the patient.

ADMISSION REQUIREMENTS

The admission of undergraduate students to follow B.Sc. Radiography/ Radiotherapy degree programme offered by the Faculty of Allied Health Sciences (FAHS) is made by the University Grants Commission. Selection for admission is based on the results of the GCE (Advanced Level) examination conducted by the Department of Examinations, Ministry of Education according to the demand for vacancies.

*Examination by- laws will be adapted from the Faculty of Allied Health Sciences existing prospectus.

List of Abbreviations

AC - Alternating Current

ANOVA - Analysis of Variance

AP - Antero Posterior

CPR - Cardio Pulmonary Resuscitation

CT - Computed Tomography

CTA - Computed Tomography Angiogram

CTU - Computed Tomography Urogram

DC - Direct Current

DEXA - Dual Energy X-ray Absorptiometry

DFT - Discrete Fourier Transform

DICOM - Digital Imaging and Communications in Medicine

DM - Digital Mammography

DSA - Digital Subtraction Angiography

EBP - Evidence Based Practice

ECG - Electro Cardio Gram

ERCP - Endoscopic Retrograde Cholangio Pancreatography

FPD - Flat Panel Detector

HRCT - High Resolution Computed Tomography

IOPA - Intra Oral Peri Apical

IAM - Internal Auditory Meatus

IV drip - Intra Venous drip

KUB - Kidney Ureter Bladder

MRCP - Magnetic Resonance Cholangio Pancreatography

MRI - Magnetic Resonance Imaging

NG tube - Naso Gastric Tube

OOP - Object Oriented Programming

OPG - Orthopantomogram

OSPE - Objective Structured Practical Examination

PACS - Picture Archiving and Communication System

PET - Positron Emission Tomography

PNS - Para Nasal Sinus

PPM - Permanent Pace Maker

QC - Quality Control

SPECT - Single Positron Emission Tomography

TACE - Trans Arterial Chemo Embolization

TM joint - Temporal Mandibular joint

TPM - Temporary Pace Maker

Level	Course Code	Course Title	Credits
1000 Level – Semester 1			
1000	AH 1101	English and Communication Skills - I	Non credit
	AH 1102	Information Technology	Non credit
	AH 1103	Basic Human Anatomy	2
	AH 1106	Introduction to Psychology	2
	RA 1101	Human Physiology	2
	RA 1102	Basic Biochemistry	1
	RA 1103	General Physics	2
	RA 1104	Mathematics - I	2
	RA 1105	Introduction to Electronics and Instrumentation	2
	1000 Level – Semester 2		
	AH 1201	English and Communication Skills - II	Non credit
	AH 1203	General Pathology	2
	RA 1201	Atomic and Radiation Physics	2
	RA 1202	Radiobiology and Radiation Protection	2
	RA 1203	Applied Anatomy - I	2
	RA 1204	Medical Imaging Equipment	3
	RA 1205	Plain Radiography - I	2
	RA 1206	Medical Image Processing - I	3
		Total No. of Credits for 1000 Level	**29**
2000 Level - Semester 1			
2000	AH 2101	English and Communication Skills - III	Non credit
	RA 2101	Programming Techniques	3
	RA 2102	Fluoroscopy - I	2
	RA 2103	Computed Tomography - I	3
	RA 2104	Mathematics - II	2
	RA 2105	Modern Physics	2
	RA 2106	Care of Patient - I	2
	RD 2101	Mammography - I	1
	RD 2102	Plain Radiography - II	2
	2000 Level – Semester 2		
	AH 2201	English and Communication Skills - IV	Non credit
	RA 2201	Ethics in Medical Radiation Sciences	1
	RA 2202	Medical Image Processing - II	3
	RA 2203	Common Systemic Diseases	2
	RA 2204	Magnetic Resonance Imaging - I	3
	RD 2201	Fluoroscopy - II	3
	RD 2202	Plain Radiography - III	3
Total No. of Credits for 2000 Level			**32**

3000 Level - Semester 1			
3000	RA 3101	Nuclear Imaging - I	3
	RD 3101	Computed Tomography - II	2
	RD 3102	Dental Radiography	2
	RD 3103	Plain Radiography - IV	2
	RD 3104	Applied Anatomy - II	1
	RD 3105	Radiation Protection in Radiography	2
	RD 3106	Care of patient - II	2
	RD 3107	Pharmacology for Medical Imaging	1
	3000 Level - Semester 2		
	RA 3201	Statistics	2
	RD 3201	Magnetic Resonance Imaging - II	2
	RD 3202	Imaging in Common Systemic Diseases - I	1
	RD 3203	Fluoroscopy - III	2
	RD 3204	Paediatric Imaging	2
	RD 3205	Mammography - II	2
	RD 3206	Computed Tomography - III	3
		Total No. of Credits for 3000 Level	**29**
4000 Level - Semester 1			
4000	RA 4101	Research Methodology	2
	RD 4101	Maintenance of Medical Imaging Equipment	2
	RD 4102	Nuclear Imaging - II	2
	RD 4103	Applied Anatomy - III	2
	RD 4104	Radiation Dosimetry and Applications	2
	RD 4105	Magnetic Resonance Imaging - III	3
	RD 4106	Quality Assurance in Radiography	2
	4000 Level - Semester 2		
	RA 4201	Research Project	6
	RA 4202	Medical Data Communication	1
	RD 4201	Imaging in Common Systemic Diseases- II	2
	RD 4202	Ancillary Imaging Techniques	2
	RD 4203	In Service Training	4
		Total No. of Credits for 4000 Level	**30**
		Total No. of Credits for B.Sc Radiography Degree	**120**

AH - Common module in Allied Health Sciences degree programmes
RA- Common module for Radiography and Radiotherapy degree programmes
RD-Module in Radiography degree programme

LEVEL 1000 – SEMESTER 1

Course Code : AH1103 **Course Title** : Basic Human Anatomy **Credits** : 02 **Prerequisite** : None	
Compulsory/ Optional : Compulsory	
Time Allocation : Lectures- 25 hrs, Practical/ Demonstrations- 10 hrs	
Intended learning outcomes: At the successful completion of the course, the students will be able to**:** 1. Define various terminology used in anatomy and its sub divisions 2. Explain the organization of human body at different levels, namely cell, tissues and organs forming systems 3. Explain briefly the normal structure of cell tissues, organs, systems and their inter-relationships 4. Identify the structures of human body in diagrams, models and specimens	
Course syllabus/ Course Description The structure and function of the cell, Organization of the body , Embryology, Structure of Cardiovascular system, Lymphatic system, Respiratory System, Digestive System, Genito- Urinary System, Endocrine System, Musculoskeletal System, Nervous System, Sensory Organs.	
Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Seeley, R., Stephens, T. and Tate, P. (2007) *Anatomy and Physiology*, 8th ed. McCraw-Hill Science
2. Waugh, A. and Grant, A. (2006)*Ross and WilsonAnatomy and Physiology in Health and Illness*, 10th ed. Churchill Livingstone

* Continues Assessment for each course includes practical, assignments, quizzes and mid semester examination where applicable.

* End Semester Examination will be held in the form of a written examination, OSPE, practical examination and viva where applicable.

Course Code : AH 1106
Course Title : Introduction to Psychology
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Explain the major perspectives in psychology
2. Identify different sources of evidence in psychology
3. Discuss the psychological influences in healthcare
4. Apply and relate the psychological concepts to health care

Course syllabus/ Course Description

Introduction to psychology with an emphasis on health-related issues, Major perspectives in psychology, Psychology applied to nursing and health care in general, Coping with stressful situations, Promotion of attachment and bonding between infant and care giver

Assessment	Percentage Mark
Continuous Assessment	40%
End Semester Examination	60%

Recommended References:

1. Russell, G. (1999) *Essentail Psychology for nurses and other health professionals*, 1st ed. Routledge
2. Atkinson, R.L., Atkinson, R.C., Smith, E.E., Bem, D.J. and Nolen-Hoeksema, S. (1999) *Hilgard's introduction to psychology*, 13th ed. Cengage Learning
3. Marks, D.F., Murray, M. and Evans, B. (2011) *Health Psychology : Theory, Research and Practice*,3rd ed. SAGE Publications Ltd

Course Code : RA 1101
Course Title : Human Physiology
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30hrs

Intended learning outcomes:

At the end of the module, the student should be able to describe**:**

1. The functions of different systems of the body
2. Their integration and control mechanisms to maintain homeostasis

Course syllabus/ Course Description

Organization of the body for function, Homeostasis, Body fluids, Blood, Temperature regulation, Growth and development, Ageing, Cardiovascular system, Lymphatic system, Respiratory system, Digestive system, Endocrine system,Nerve, Muscle, Nervous system, Special senses, Urinary system, Reproductive system, ECG- Fundamental concepts.

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Seeley, R., Stephens, T. and Tate, P. (2007) *Anatomy and Physiology*, 8th ed. McCraw-Hill Science

Course Code : RA 1102
Course Title : Basic Biochemistry
Credits : 01
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 15 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Explain the normal biochemical and physiological processes in the human body
2. Compare the deviations from norms, related to biochemical and nutritional status

Course syllabus/ Course Description

Structure and Function of cell organelles, Structure and Function of carbohydrates, lipids, proteins and nucleic acids, pH and buffers. Enzymes, properties and kinetics, Biological oxidation, Metabolism of carbohydrate, lipids, proteins and nucleic acids, Integration and regulation of metabolic pathways, Calcium metabolism, Cell cycle and Regulation

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Bhagavan, N.V. (2001) *Medical Biochemistry,* 4th ed. Academic Press
2. Harvey, R.A. and Ferrier, D.R. (2010) *Biochemistry (Lippincott's Illustrated Reviews Series*), 5th ed. Lippincott Williams & Wilkins
3. Murray, R., Rodwell, V. and Bender, D., Weil, P.A. and Kennely, P.J. (2009) *Harper's Illustrated Biochemistry*, 28th ed. McGraw-Hill Medical

Course No : RA 1103
Course Title : General Physics
Credits : 02
Prerequisite : None

Compulsory / Optional : Compulsory

Time Allocation : Lectures- 30hrs

Aims and/ or Objectives and/ or Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Explain the motion and equilibrium of objects using principles of Physics
2. Describe the behavior of static and dynamics of charge particles placed in electric and magnetic fields
3. Identify different types of waves and explain their behavior in different media
4. Discuss the properties of solids and liquids
5. Apply principle of modern Physics to solve problems in radiography

Course syllabus/ Course Description

Units and dimensions, significant figures, Mechanics: Kinematics in one and two dimensions, Newton's Laws of motion, Friction, Energy, work and power, System of Particles, Rotational motion, Wave Mechanics: Longitudinal and transverse waves, superposition of waves, progressive and stationary waves, vibrations of strings and air columns, resonance, speed of sound in a media, Doppler effect, Electric and Magnetic Fields: Coulomb forces on charges, electric field intensity and electric potential, magnetic fields due to current carrying conductors, Magnetic force on current carrying conductors, electromagnetic induction, Solid and Fluids: Inter-atomic and inter-molecular forces, state of matter, Solids: elastic properties, Hook's law, Young's modulus, bulk modulus and modulus of rigidity, Liquids: Cohesion application, viscosity, Stoke's law, terminal velocity, Modern Physics: Atomic nucleus, alpha, beta and gamma radiation, low of radioactive decay, binding energy and its calculations, fission and fusion processes.

Assessment	**Percentage Mark**
Continuous Assessment	50%
End Semester Examination	50%

Recommended References:

1. Serway, R.A. and Beichner, R.J. (2000) *Physics for Scientists and Engineers*, Saunders College pub
2. Resnik, R., Haliday, D. and Walker, J. (2000) *Fundamentals of Physics*, John Wiley & Sons, Inc.
3. Tipler, P.A.(2000)*Physics for Scientists and Engineers*,Worth Pub

Course Code : RA 1104
Course Title : Mathematics - I
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Utilize mathematical concepts to solve the problems in Physics
2. Explain the behaviour of the physical variables using functions and graphs
3. Solve linear and quadratic equations
4. Describe and apply various trigonometric, exponential and logarithmic functions to solve problems in Physics
5. Apply basic rules of derivatives and partial derivatives to solve problems

Course syllabus/ Course Description

Cartesian coordinate system, Sets and inequalities, Introduction to vectors, Matrices and determinants, Complex numbers, Linear equations, Quadratic equations, Functions and graphs, Trigonometric Functions, Limits, Derivatives, Exponential and logarithmic functions, Techniques of integration, Areas and volumes, Partial derivatives

Assessment	**Percentage Mark**
Continuous Assessment	50%
End Semester Examination	50%

Recommended References:

1. Arya, J.C., Lardner R.W., and Pearson (1979) *Mathematics for Biological Sciences*, 1st ed.
2. Zill, D.G. (2012) *The first course in Differential equations*, 10th ed. Brooks Cole
3. Plumpton, C. (1981) *New Tertiary Mathematics*, Oxford : Pergamon

Course Code : RA 1105
Course Title : Introduction to Electronics and Instrumentation
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 25 hrs, Practical/ Demonstrations - 10 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Analyze simple electrical and electronic circuits
2. Describe the operations of different circuits constructed with operational amplifiers
3. Use modern electronic equipment and measuring devices effectively, with an understanding of the transducers and data conversion systems
4. Explain errors, signal acquisition and demodulation in medical imaging equipment

Course syllabus/ Course Description

Fundamentals of electricity: DC circuits and AC circuits; Analog electronics: diodes, transistors and operational amplifiers; Digital electronics; Instrumentation: errors, digital instruments, sensors and transducers, calibration; Applications: signal acquisition, demodulation and hardware in Medical imaging.

Assessment	Percentage Mark
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Boylestad, R.L. and Nashelsky, L. (2001), *Electronic Devices and circuit theory*, 6th ed. Prentice-Hall of India
2. Malvino, A.P. (1999) *Electronic Principles*, 6th ed. Glencoe/McGraw-Hill
3. Sawhney, A.K. (2002) *A course in Electrical and Electronic Measurements and Instrumentation*, 17th ed. Dhanpat Rai & Co

LEVEL 1000 – SEMESTER 2

Course Code : AH 1203
Course Title : General Pathology
Credits : 02
Prerequisite : AH 1103, RA 1101, RA 1102

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Define the terminology and describe the basic concepts of general pathology for the purpose of reading, learning and working in teams of medical care personal
2. Use and integrate the knowledge of basic pathological process underlying the diseases of tissues for
3. Define the involvement of immune system in pathogenesis of diseases

Course syllabus/ Course Description

Introduction to Pathology, Inflammation and Repair (Acute Inflammation, Chronic Inflammation, Wound healing and complications, Principles of fracture healing and complications),Growth disturbances (Hypertrophy, Atrophy, Hyperplasia, Metaplasia, Dysplasia), Degeneration and necrosis (Cell damage, Apoptosis, Necrosis, Gangrene), Circulatory disturbances (Ischemia and Infarction, Thrombosis, Embolism, Atherosclerosis, Oedema, Congestion and Heart failure), Tissue deposits and Pigments, Immunology, Neoplasia (Types of Neoplasia, Tumour markers and Molecular basis of carcinogenesis), Genetic basis of diseases

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Reid, R., Roberts, M. E., Callander, R. and Ramsden, I. (2011) *Pathology Illustrated*

Course Code : RA 1201
Course Title : Atomic and Radiation Physics
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 25 hrs, Practical/ Demonstrations - 10 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Explain the model of Bohr's theory of Hydrogen like atoms using principles of Physics
2. Describe the behaviour of alpha, beta, gamma, and their interaction with matter
3. Identify different types of radiation interaction with matter
4. Discuss the general properties of electromagnetic waves
5. Solve problems applying principles of Atomic Physics, Nuclear and Radiation Physics

Course syllabus/ Course Description

Bohr's theory of Hydrogen like atoms, Angular momenta, Nuclear properties, , Magnetic resonance, Radioactive decay, Fission, Fusion, Electromagnetic radiation, Properties of electromagnetic waves, Electromagnetic spectrum, Intensity of radiation, X-ray Production, Breaking radiation, Characteristic X-Rays, Interactions of X-Rays, Types of X-Ray interactions, Photo electric effect, Attenuation, Ionizing radiation : alpha, beta, gamma rays, interactions of radiation with matter

Assessment	**Percentage Mark**
Continuous Assessment	40%
End Semester Examination	60%

Recommended References:

1. Ball, J., Moore, A.D. and Turner, S. (2008) *Ball and Moore's Essential Physics for Radiographers*, 4th ed. Wiley-John & Sons
2. Curry, T.S., Dowdey, J.E. and Murry, R.E. (1990) *Christensen's Physics of Diagnostic Radiology*, 4th ed. Lippincott Williams & Wilkins
3. Grahm, D.T. and Cloke, P. (2003**)** *Principles of Radiological Physic***s,** Churchill Livingstone
4. Hay, J.A. and Hiyes, D.J. (1997) *1st year Physics for Radiographers*, 3rd ed. W.B.Saunders Company

Course Code : RA 1202
Course Title : Radiobiology and Radiation Protection
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Relate different types of biological effects following exposure to ionizing radiation with the mechanisms
2. Use radiation for beneficial practices observing / adhering to internationally recognised guidelines to optimize radiation protection of workers, patients and general public

Course syllabus/ Course Description

Background Radiation, Quantities and Units in radiation dosimetry, Radiation Interactions at cellular and tissue levels, Biological basis of radiation cell killing, Biological, physical and chemical factors affecting cellular radiosensitivity, Radiation effects on normal tissues, Radiation carcinogenesis, Genetic effects of radiation, Radiation effects on developing embryo, External and Internal hazards of radiation and methods of evaluation, Basic Principles of Radiation Protection, Elements of a Radiation Protection Programme, National and International regulations and Standards

Assessment	**Percentage Mark**
Continuous Assessment	40%
End Semester Examination	60%

Recommended References:

1. Hall, E.J. and Giaccia, A. *(*2011) *Radiobiology for the Radiologist*; 7th ed. Lippincott Williams and Wilkins
2. Kogel, A.V. and Joiner, M. (2009) *Basic Clinical Radiobiology*, 4th ed. Macmillan Publishers
3. Martin, A. and Harbison, S.A. (2006) *An Introduction to Radiation Protection*, 5th ed. Hodder Arnold
4. Sherer, M.A.S., Visconti, P,J. and Ritenour, E.R.(2006) *Radiation Protection in Medical Radiography*, 5th ed. Mosby Elsevier

Course Code : RA 1203
Course Title : Applied Anatomy - I
Credits : 02
Prerequisite : AH 1103

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 25 hrs, Practical/ Demonstrations - 10 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Identify the component parts of the different systems of the body
2. Relate their knowledge with the radiological anatomy of the systems

Course syllabus/ Course Description

Anatomy of Appendicular skeleton, Axial skeleton, Muscles, Joints, Surface anatomy, abdomen, Identification of muscles and tendons in appendicular skeleton with cross sectional anatomy, Anatomy of vascular, nervous and lymphatic systems, Cross sectional anatomy of brain, chest, abdomen, pelvis and upper & lower limbs

Assessment	**Percentage Mark**
Continuous Assessment	40%
End Semester Examination	60%

Recommended References:

1. Kumar, S. (2006*) Surface & imaging anatomy*, 1st ed. CBS Publishers and Distributors
2. Netter, F.H. (2010) *Atlas of Human Anatomy*, 5th ed. Elsevier Health Sciences

Course Code : RA 1204
Course Title : Medical Imaging Equipment
Credits : 03
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 40 hrs, Practical/ Demonstrations - 10 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Identify the components of X-ray equipment
2. Describe the structure of X-ray equipment and explain their mechanism

Course syllabus/ Course Description

X-ray machine, Stationary anode x-ray tube, Rotating anode X-ray tube, X-ray production, Bremsstrahlung, Characteristic radiation, Transformers, X-ray generators, Exposure switches and timers, X-ray tube rating charts, X-ray interaction with matter, X-ray filters, X-ray beam restrictors, Grids, Grid performances, Grid cut off, Construction and operation of isocentric skull equipment, Tomography, OPG, Intraoral and Cephalostat, Mobile equipment, Digital equipment

Assessment	**Percentage Mark**
Continuous Assessment	40%
End Semester Examination	60%

Recommended References:

1. Carter, P.H., Paterson, A.M. and Thornton, M.L. (1994) *Chesney's Equipment for student Radiographers,* 4th ed. Wiley-Blackwell
2. Bushberg, J.T. et al (2011) *The Essential Physics of Medical Imaging*, 3rd ed. Lippincott Williams and Wilkins
3. B. Podgorsak, E.B. (2010) *Radiation Physics for Medical Physicists*, 2nd ed. Springer

Course Code : RA 1205 **Course Title** : Plain Radiography - I **Credits** : 02 **Prerequisite** : None	
Compulsory/ Optional : Compulsory	
Time Allocation : Lectures- 25hrs, Practical/ Demonstrations - 10 hrs	
Intended learning outcomes: At the successful completion of the course, the students will be able to**:** 1. Correctly position the patient for basic radiographic techniques 2. Evaluate the quality of the various radiographic projections	
Course syllabus/ Course Description Physical principles of radiography, Terminology, Technical evaluation and anatomy of the images of: Upper limb, Lower limb, Spine, Pelvis AP, Single Hip AP, Skull, Chest and Abdomen	
Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Aitchison, F. (2009*) Chapman and Nakielny: a guide to radiological procedures,* 5th ed.Elsevier Health Sciences
2. Ball, J.L. and Price T. (1995) *Chesney's Radiographic Imaging,* 6th ed. Wiley-Blackwell
3. Bryan, G.J. and Davies, E.R. (1987) *Diagnostic Radiography Practical Manual,* 4th ed. Churchill Livingstone
4. Frank, E.D., Long, B.W. and Smith, B.J. (2007) *Merrill's Atlas of RadiographicPositioning and Procedures* (vol. 1,2,3), 11th ed. Mosby
5. Unett, E.M. and Royle, A.J. (1997) *Radiographic Technique and Imaging evaluation,* Nelson Thornes
6. Whitley, A.S. *et al* (2005) *Clark's Positioning in Radiography*, 12th ed. Hodder Arnold

Course Code : RA 1206
Course Title : Medical Image Processing - I
Credits : 03
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30 hrs, Practical/ Demonstrations - 30 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Distinguish image formation in conventional radiography vs. digital radiography
2. Describe manual and automatic film processing in conventional radiography
3. Evaluate sensitometry and its application in film processor quality control

Course syllabus/ Course Description

Image Recording Medium used in Conventional Radiography: Photographic Films, Intensifying screens, Matching spectral emission to spectral sensitivity, Latent image formation,Conventional film processing: manual & automatic, Sensitometry, Film processor maintenance, Dark room procedures: film handling, processing & film Storage conditions, Radiographic image artefacts, Digital Radiography, An Overview, Digital Image Processing Concepts, Computed Radiography: Physics and Technology, Effective Use of Computed Radiography, Flat-Panel Digital Radiography, Picture Archiving and Communication Systems, Medical Image Informatics: An Overview, Quality Control for Digital Radiography

Assessment	**Percentage Mark**
Continuous Assessment	40%
End Semester Examination	60%

Recommended References:

1. Ball, J.L. and Price T. (1995) *Chesney's Radiographic Imaging,* 6th ed. Wiley-Blackwell
2. Seeram, E. (2010) Digital Radiography : an introduction for technologists, 1st ed. Cengage Learning

LEVEL 2000 – SEMESTER 1

Course Code : RA 2101
Course Title : Programming Techniques
Credits : 03
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30hrs, Practical/ Demonstrations - 30 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Develop GUI based applications
2. Manipulate digital images with computer programs

Course syllabus/ Course Description

Syntax and Semantics of programming, Structured data (lists, stacks, queues, ordered binary trees), Storing and accessing data structures, Object Oriented Programming (OOP) concepts, Graphical User Interface (GUI) designs, Digital image manipulation in GUI applications.

Assessment	**Percentage Mark**
Continuous Assessment	40%
End Semester Examination	60%

Recommended References:

1. Dietel, P.J.andDietel, H.M. (2011) *Java: How to Program,* 9th ed. Prentice Hall

Course Code : RA 2102
Course Title : Fluoroscopy - I
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 26 hrs, Practical/ Demonstrations - 08 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Identify the components of conventional and digital fluoroscopy equipment
2. Describe conventional and digital fluoroscopy image formation

Course syllabus/ Course Description

Basic Principles of fluoroscopy image formation, Fluoroscopic X-ray tube setup and cooling chart, Image intensifier, Camera system and Viewing of fluoroscopy image, Fluoroscopy Image recording, Fluoroscopy table assembles and accessories, Image quality and quality assurance, C arm equipment, Digital Fluoroscopy with Image Intensifier, Video Camera, Analog-to-Digital Converter, Computer System, Digital Fluoroscopy with Flat-Panel Detectors (FPDs), Limitation of Image Intensifier Technology, Equipment Configuration, Types of Dynamic FPDs, Characteristics of Dynamic FPDs, Operating Principles and Advantages, Connectivity, Digital Image Post-processing, Gray-scale Image Manipulation, Last-Image Hold, Temporal Frame Averaging, Edge Enhancement, Proprietary Post-ProcessingTechniques, Temporal Subtraction, Energy Subtraction, Advanced Techniques

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Bushberg, T.J. **(**2011**)** *The Essential Physics of Medical Imaging*, 3rd ed.

Course Code : RA 2103
Course Title : Computed Tomography- I
Credits : 03
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 40 hrs, Practical/ Demonstrations - 10 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to explain**:**

1. The physical principles of CT
2. The structure & functioning of CT equipment
3. Advantages & disadvantages of the technique
4. Different types of CT imaging

Course syllabus/ Course Description

Principles of CT, Data acquisition concepts, Image reconstruction, Basic instrumentation, Image post processing and visualization tools, Spiral/Helical CT, 3-D CT, Image quality, Positron Emission Tomography/Computed Tomography scanners, Cardiac CT, CT angiography, CT fluoroscopy, Breast CT, Virtual endoscopy, Applications of CT in radiation therapy, Radiation dose in CT, Quality control of CT scanners

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Hagga, J.R. and Boll, D. (2008) *CT and MRI of the whole body*, 5th ed. Mosby
2. Karthikeyan, D. and Chegu, D. (2007) *Step by Step CT scan*, Jaypee Brothers Medical Publishers Pvt Ltd
3. Romans, L. E. (2011) *Computed Tomography for Technologists –A Comprehensive Text*, 1st ed. Lippincott, Williams & Wilkins
4. Seeram, Euclid, (2009) *Computed Tomography: Physical Principles, Clinical Applications and Quality Control*, 3rd ed.Saunders

Course Code :RA 2104
Course Title : Mathematics - II
Credits : 02
Prerequisite :RA 1104

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Utilize mathematical concepts to solve the problems in Physics
2. Explain the method of Legendre transformations to solve problems
3. Solve ordinary and partial differential equations related to Physics problems
4. Describe and apply Laplace and Fourier transformation to solve problems in Physics
5. Apply mathematical concepts to explain the function of radiation therapy equipment and procedures

Course syllabus/ Course Description

Lagrange Multipliers, Infinite series, Vector analysis, First-order differential equation, Higher-order lenear differential equations with constant coefficients, Partial differential equations: Laplace, Heat and wave equation, Fourier series, Integral transformations: Laplace at Fourier transformations, special functions: Legendre, Bessel, Hermite and Laguerrer, Monte Carlo methods.

Assessment	**Percentage Mark**
Continuous Assessment	40%
End Semester Examination	60%

Recommended References:

1. Arfken, G.B. (1995) *Mathematical Methods for Physicists*, 2nd ed. Academic press
2. Bose, M. L. (1993) *Mathematical Methods in the Physical Sciences*, 2nd ed. John Wiley & Sons

Course Code : RA 2105
Course Title : Modern Physics
Credits : 02
Prerequisite : RA 1103

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Explain the phenomena of Photoelectric effect and Compton effect in modern Physics
2. Describe the behavior of electromagnetic waves in different media
3. Solve basic problems in Quantum mechanics applying Schrödinger equation
4. Use Hydrogen atom wave functions to explain energy levels
5. Solve problems applying principles of modern Physics

Course syllabus/ Course Description

Electromagnetic theory, Quantum Physics, Plank's theory, Photoelectric effect, Compton scattering and pair production, Dual nature of electromagnetic radiation, Electromagnetic waves in free space, Maxwell's equation, Electromagnetic waves in dielectric and conducting media, Schrödinger equation, Electron spin and fine structures, spin orbit coupling, Quantum states, Hydrogen atoms energy levels, Hydrogen atoms waves function

Assessment	**Percentage Mark**
Continuous Assessment	40%
End Semester Examination	60%

Recommended References:

1. Krane, K.S. (2012) *Modern Physics*, 3rd ed.
2. Ball, J., Moore, A.D. and Turner, S. *(2008) Ball and Moore's Essential Physics for Radiographers,* 4th ed. Wiley-John and Sons

Course Code : RA 2106
Course Title : Care of Patient- I
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Describe basic patient care rules and infection control methods in radiographic procedures

Course syllabus/ Course Description

Routine patient care in an X-ray Department/Radiotherapy unit, Effective communication and team work, First Aid, Infections and basics of microbiology, Care of patients with tubes and catheters (Urinary catheters, Colostomy, NG tubes, IV drips, drainage bags), Care of paediatric and elderly patients, Psychology of illness

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Culmer, P. (1995) *Chesneys' Care of the Patient in Diagnostic Radiography*,7th ed.Wiley-Blackwell
2. Ehrlich, R.A. and Darly, J.A. (2008) *Patient Care in Radiography*,7th ed. Mosby
3. Torres, L.S., and Dutton, A.G. (2003) *Basic Medical Techniques and Patient Care in Imaging Technology*, 6th ed. Lippincott Williams and Wilkins

Course Code : RD 2101
Course Title : Mammography-I
Credits : 01
Prerequisite : RA 1201, RA 1205, RA1206

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 12 hrs, Practical/ Demonstrations- 06 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Identify the anatomy of human breast
2. Identify the components of mammography equipment
3. Describe basic techniques and special techniques in mammography
4. Describe other methods of breast imaging and breast biopsies
5. Describe Application of radiation protection and quality control procedures
6. Evaluate the quality of various mammographic projections

Course syllabus/ Course Description

Introduction, Anatomy and Physiology of the breast, Physics of mammography and basic principles, Equipment and accessories, Demonstration of mammography unit, Image recording system and processor, Image recording system, Terminology, Basic projections, Positioning of the patient and exposure factors, Supplementary projections, Breast biopsy and localization, Radiation protection, Other methods of breast imaging, Quality Assurance, Epidemiology of Breast Cancer

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Etta, D.P., Martin J.Y. and Cherie, M.K. (2003) *Digital Mammography*, 5th ed. Lippincott Williams & Wilkins
2. Tucker, A.K. and Ng, Y.Y. (2005) *Text book of Mammography*, 2nd ed. Churchill Livingstone
3. Ulrich B. and Felix, D. (2011) *Digital Mammography (Medical Radiology / Diagnostic Imaging)* 1st ed. springer

Course Code : RD 2102 **Course Title** : Plain Radiography - II **Credits** : 02 **Prerequisite** : AH 1103, RA1205	
Compulsory/ Optional : Compulsory	
Time Allocation : Lectures- 20 hrs, Practical/ Demonstrations - 20 hrs	
Intended learning outcomes: At the successful completion of the course, the students will be able to**:** 1. Describe the required position for different special techniques in Radiography 2. Identify the factors required to evaluate special projections	
Course syllabus/ Course Description Special radiography projections for Upper limb, Lower limb, Spine, Chest, Skull, PNS and Mandible, Pelvis, Facial Bones, Abdomen and Hip Lateral	
Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Aitchison, F. A. (2009*) Chapman and Nakielny: a guide to radiological procedures*,5th ed. Elsevier Health Sciences
2. Ball, J.L. and Price, T. (1995) *Chesney's Radiographic Imaging,* 6th ed. Wiley-Blackwell
3. Bryan, G.J. and Davies, E.R. (1987) *Diagnostic Radiography Practical Manual,* 4th ed. Churchill Livingstone
4. Frank, E.D., Long, B.W. and Smith, B.J. (2012) *Merrill's Atlas of Radiographic Positioning and Procedures* (vol. 1,2,,3),12th ed. Mosby
5. Unett, E.M. and Royle, A.J. (1997) *Radiographic Technique and Imaging evaluation,* NelsonThornes
6. Whitley, A.S. *et al* (2005) *Clark's Positioning in Radiography*, 12th ed. Hodder Arnold
7. Whitley, A.S., Moore, A.D. and Alsop, C.W. (1999) *Clark's Special Procedures in Diagnostic Imaging,,* CRC Press
8. Carver,E. and Carver,B. (2012)*Medical Imaging Techniques, reflection & Evaluation* , 2nded.Churchill Livingstone

LEVEL 2000 – SEMESTER 2

Course Code : RA 2201
Course Title : Ethics in Medical Radiation Sciences
Credits : 01
Prerequisite : None

Compulsory/ Optional :Compulsory

Time Allocation : Lectures- 15 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Identify different types of values that have an impact on the ethical decision making
2. Identify the conditions used to assess the proportionality of good and evil in anaction
3. Provide patients relevant information to ensure their participation in decision making

Course syllabus/ Course Description

Ethical Issues- Values, Ethical schools of thought, Principles of Beneficence and Non maleficence, Patient Autonomy and Informed Consent, Truthfulness and Confidentiality,
Student Rights, Diversity and Caring, and Challenges

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Thiroux, J. (1998) *Ethics Theory and Practice*, 6thed, Prentice Hall
2. Cook, D.M.T.,Young,T.A. (1998) *Ethical and Legal issues for imaging professionals*, Mosby

Course Code : RA 2202
Course Title : Medical Image Processing - II
Credits : 03
Prerequisite : RA 1206, RA 2101

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30 hrs, Practical/ Demonstrationsl- 30 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to:

1. Operate digital image processing tools and programming languages.
2. Process digital images using frequency domain techniques and spatial domain techniques
3. Detect various types of lesions on medical images

Course syllabus/ Course Description

Introduction to digital medical images: Why digital images, Analog images vs. digital images, Medical image modalities, DICOM image format and its attributes, data types and 2D, 3D and higher dimensional representations, fundamental steps in digital image processing, elements of visual perception, light and electro-magnetic spectrum, image sensing and acquisition, sampling and quantization, relationships between pixels, Image transformations: histogram processing, spatial filtering, Filtering in the frequency domain: Fourier transform, Discrete Fourier Transform (DFT), Morphological image processing: erosion , dilation , opening, closing, gray scale morphology, Image segmentation: point, line and edge detection, thresholding, region based segmentation, watersheds, Representation and description: boundary descriptors, regional descriptors, Digital image compression : lossy and lossless, Object recognition: patterns, pattern classes, classification, introduction to wavelets

Assessment	Percentage Mark
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Gonzalez,R.C.and Woods, R.E. (2007) *Digital Image Processing*, 3rd ed.Prentice Hall
2. Gonzalez,R.C., Woods, R.E. and Eddins, S.L. (2003) *Digital Image Processing using MATLAB*, 1st ed. Prentice Hall

Course Code : RA 2203
Course Title : Common Systemic Diseases
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to**:**

1. Recognize the diseases based on history and examination of the dysfunctional systems of a patient
2. Select appropriate investigations for respective disease condition.

Course syllabus/ Course Description

Overview of common diseases; Cardiovascular Diseases, Respiratory Diseases, Diseases of the Liver and Biliary tract, Diseases of Gastrointestinal Tract, Diseases of Loco motor system, Diseases of Nervous System and Muscle Disorders, Renal Diseases, Hematological Diseases

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Boon, N.A., Colledge, N.R.andWalker, B.R. (2010) *Davidson's Principles and Practice of Medicine*, 21st ed.Churchill Livingstone

Course Code : RA 2204
Course Title : Magnetic Resonance Imaging I
Credits : 03
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 45 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to**:**

1. Describe the physical basis of MRI and common MRI sequences used in the clinic and for research
2. Acquire, manipulate and post-process MR images, comprehend and explain the post-processing tools
3. Describe the instrumentation and safety issues related to MRI.

Course syllabus/ Course Description

Magnetic Resonance Imaging: A preview, Classical Response of a Single Nucleus to a Magnetic Field, Rotating Reference Frame and Resonance, Magnetization, relaxation and the Bloch equation, The Quantum Mechanical Basis of Precision and Excitation, The Quantum Mechanical Basis of Thermal Equilibrium and Longitudinal Relaxation, Signal Detection Concepts, Introductory Signal Acquisition Methods: Free Induction Decay, Spin Echoes, Inversion Recovery and Spectroscopy, One-Dimensional Fourier Imaging, k-space and Gradient Echoes, Multi-Dimensional Fourier Imaging and Slice Excitation

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Bushong, S.C. (2003) *Magnetic Resonance Imaging: Physical and Biological Principles*, 3rd ed.Mosby Year Book Inc
2. Brown, M. A. and Richard, C. S. (2003) *MRI: Basic Principles and Applications*, 3rd ed.John Wiley & Sons Inc
3. Hagga, J.R. and Boll, D. (2008) *CT and MRI of the whole body*, 5th ed. Mosby
4. McRobbie, D.W.,Moore, E.A., Graves, M.J. and Prince, M.R.(2007) *MRI From Picture to Proton*, 2nd ed. Cambridge University Press
5. Moeller, T.B. and Reif,E. (2003) *MRI Parameters and Positioning*; 1st ed.Thieme
6. Weishaupt, D., Kochi, V.D.andMarincek, B.(2006) *How does MRI work*,2nd ed. Springer
7. Westbrook, C. (1999) *Handbook of MRI Technique*; 2nd ed. Blackwell Science
8. Westbrook, C.,Carolyn, K. and John, T. (2005) *MRI in Practice*, 3rd ed. Blackwell Science Ltd

Course Code : RD 2201
Course Title : Fluoroscopy - II
Credits : 03
Prerequisite : RA 2102

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30 hrs, Practical/ Demonstrations - 30 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to:

1. Select the proper contrast media and equipment for contrast studies
2. Describe techniques of various fluoroscopic procedures
3. Describe fluoroscopy procedures carried out in theatre and catheterization laboratory (Cath Lab)

Course syllabus/ Course Description

Introduction to contrast media**,** Techniques used in investigating Gastrointestinal system, Urinary system and Reproductive system, Introduction to Cath lab and Cath lab equipment, Care of Patient in Cath lab, Radiation protection in Cath lab, Cath lab procedures: Coronary angiogram and angioplasty, Left ventriculogram, DSA- Cerebral, Renal, Thoracic, Abdominal, Peripheral angiogram & angioplasty, Trans Arterial Chemo Embolization (TACE), PPM (Permanent Pace Maker), TPM (Temporary Pace Maker), ASD closure, PDA, Percutaneous Transvenous Mitral Commissurotomy (PTMC).Introduction to theatre procedures & role of the radiographer, Preparation for theatre procedures: Sterilization, Theatre procedures:Orthopaedic Surgery, Neuro Surgery, Urological Procedures, General Surgery: ERCP, Vascular Surgery.

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Whitley, A.S., Moore, A.D. and Alsop, C.W. (1999) *Clark's Special Procedures in Diagnostic Imaging* ,CRC Press

Course Code : RD 2202 C**ourse Title** : Plain Radiography - III **Credits** : 03 **Prerequisite** : RA 1205	
Compulsory/ Optional : Compulsory	
Time Allocation : Hospital based training- 150 hrs, Practical/ Demonstrations - 15 hrs	
Intended learning outcomes: At the successful completion of the course the students will be able to**:** 1. Perform and evaluate basic techniques of plain radiography	
Course syllabus/ Course Description Basic Techniques of : Upper limb, Lower limb, Vertebral column, Chest, Skull, Shoulder, Abdomen and Pelvis	
Assessment	**Percentage Mark**
Continuous Assessment	50%
End Semester Examination	50%

Recommended References:

1. Aitchison, F. (2009*) Chapman and Nakielny: a guide to radiological procedures*,5th ed.Elsevier Health Sciences
2. Ball, J.L.and Price, T. (1995) *Chesney's Radiographic Imaging,* 6th ed. Wiley-Blackwell
3. Bryan, G.J.and Davies, E.R. (1987) *Diagnostic Radiography Practical Manual,* 4th ed. Churchill Livingstone
4. Frank, E.D., Long, B.W. and Smith, B.J. (2007) *Merrill's Atlas of RadiographicPositioning and Procedures*, (vol. 1,2,,3),11th ed. Mosby
5. Unett, E.M..andRoyle, A.J. (1997) *Radiographic Technique and Imaging evaluation,*NelsonThornes
6. Whitley, A.S., Sloane, C., Hoadley, G. and Moore, A.D. (2005) *Clark's Positioning in Radiography*, 12th ed. Hodder Arnold
7. Carver,E. and Carver,B. (2012)*Medical Imaging Techniques,reflection& Evaluation* ,2nd ed.Churchill Livingstone

LEVEL 3000 – SEMESTER 1

Course Code : RA 3101 **Course Title** : Nuclear Imaging - I **Credits** : 03 **Prerequisite** : None	
Compulsory/ Optional : Compulsory	
Time Allocation : Lectures- 40 hrs, Practical/ Demonstrations - 10 hrs	
Intended learning outcomes: At the successful completion of the course, the students will be able to**:** 1. Describe Radioactive decay, decay equation. 2. Describe the principles of nuclear imaging.	
Course syllabus/ Course Description Radioactive decay, Decay equation, Successive decay equation, Dose calibrator, Geiger Muller detector, Scintillation detector, Gamma camera, SPECT imaging, PET imaging, Cyclotron produced radio nuclides, Reactor produced radio nuclides, Radionuclide generators, Radiopharmaceuticals, Production of radiopharmaceuticals,Quality control of radiopharmaceuticals, Design of a nuclear pharmacy, Operation of a nuclear pharmacy, Radioactive waste disposal, Internal radiation dosimetry, Radioimmunoassay, Radiation protection in nuclear medicine, Quality assurance in nuclear imaging; Quality control of nuclear medicine equipment, Techniques of nuclear medicine imaging	
Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Barnier, D.R., Christein, P.A. and Langan, J.K. (2005) *Nuclear Medicine: Technology and Techniques*,3rd ed.Mosby
2. Shackett, P. (2008) *Nuclear Medicine Technology: Procedures and Quick Reference*, 2nd ed. Lippincott Williams & Wilkins

Course Code : RD 3101
Course Title : Computed Tomography-II
Credits : 02
Prerequisite : RA 2103

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 25 hrs, Practical/ Demonstrations - 10 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to**:**

1. Describe the CT techniques used for different parts of human body including special protocols
2. Correctly position the patient for applying above techniques

Course syllabus/ Course Description

Technique of CT: Head (brain, orbits, IAM, PNS, TM joints), Chest, Abdomen and pelvis, Spine, Extremities, Respiratory system(routine &HRCT), Alimentary Tract(Larynx, Pharynx, Esophagus, CT enteroclysis, colonography),Urinary system(KUB &CTU),Reproductive system, Cardiovascular system & peripheral angiography,Endocrine System(Pituitary gland, adrenal glands & thyroid glands), Spine,Lymphatic System,Paediatric CT, CT guided biopsy

Assessment	Percentage Mark
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Hagga, J.R.and Boll, D. (2008) *CT and MRI of the whole body,* 5th ed. Mosby
2. Karthikeyan, D.and Chegu, D. (2007) *Step by Step CT scan*, Jaypee Brothers Medical Publishers Pvt Ltd
3. Romans, L.E. (2011) *Computed Tomography for Technologists –A Comprehensive Text,* 1st ed. Lippincott Williams & Wilkins
4. Seeram, E. (2009) *Computed Tomography: Physical Principles, Clinical Applications and Quality Control*, 3rd ed.Saunders

Course Code : RD 3102
Course Title : Dental Radiography
Credits : 02
Prerequisite :None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 15 hrs, Hospital based training- 60 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to:

1. Prepare the patient for dental radiography
2. Carryout intra/extra oral radiography
3. Carryout film processing using manual and/ or automatic processing techniques
4. Identify the common faults associated with dental radiography techniques
5. Identify the methods of minimizing faults

Course syllabus/ Course Description

IOPA, Occlusal, Bite wing techniques, OPG, Cephalogram, Other extra oral radiograph

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Whaites, E., Nicholas,D.(2013) *Essentials of Dental Radiography and Radiology* ,5th ed. Churchill Livingstone

Course Code : RD3103 **Course Title** : Plain Radiography - IV **Credits** : 02 **Prerequisite** : RD 2102, RD 2202	
Compulsory/ Optional : Compulsory	
Time Allocation : Hospital based training- 100 hrs, Practical/ Demonstrations - 10 hrs	
Intended learning outcomes: At the end of the course the students should be able to**:** 1. Correctly position the patient for special radiographic techniques 2. Select the correct exposure factors 3. Evaluate the quality of the film	
Course syllabus/ Course Description Wrist, Shoulder Y view, Lower limb, Knee,Spine: Cervical spine, Dorsal spine, Lumbar spine,Chest, Skull, Cranial bones, Facial bones, Pelvis and Abdomen	
Assessment	**Percentage Mark**
Continuous Assessment	50%
End Semester Examination	50%

Recommended References:

1. Aitchison, F. (2009*) Chapman and Nakielny: a guide to radiological procedure*,5th ed.Elsevier Health Sciences
2. Ball, J.L.and Price, T. (1995) *Chesney's Radiographic Imaging,* 6th ed. Wiley-Blackwell
3. Bryan, G.J.and Davies, E.R. (1987) *Diagnostic Radiography Practical Manual*, 4thed. Churchill Livingstone
4. Frank, E.D., Long, B.W.and Smith, B.J. (2007) *Merrill's Atlas of RadiographicPositioning and Procedures* (vol. 1,2,,3),11th ed. Mosby
5. Unett, E.M., and Royle, A.J. (1997) *Radiographic Technique and Imaging evaluation*,Nelson Thornes
6. Whitley, A.S., Sloane, C., Hoadley, G. and Moore, A.D. (2005) *Clark's Positioning in Radiography*, 12th ed. Hodder Arnold
7. Carver,E. and Carver,B. (2012)*Medical Imaging Techniques,reflection & Evaluation* ,2nd ed.Churchill Livingstone

Course Code : RD 3104
Course Title : Applied Anatomy - II
Credits : 01
Prerequisite : AH 1103, RA 1203

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 15 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to :

1. Identifyradiographicanatomy in commonly performed views of plain radiography, mammography and contrast studies.

Course syllabus/ Course Description

Identify the radiographic anatomy in :Basic and special techniques of skull, spine, abdomen, pelvis, chest, upper limb and lower limb, Mammographic projections, Contrast studies of GIT, Urinary, Hepatobiliary, Cardiovascular, Respiratory and Reproductive systems.

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Kumar, S. (2006*) Surface & imaging anatomy*, 1st ed. CBS Publishers and Distributors
2. Netter, F.H.(2014) *Atlas of Human Anatomy*, 6th ed. Elsevier Health Sciences

Course Code : RD 3105
Course Title : Radiation Protection in Radiography
Credits : 02
Prerequisite : RA1202

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 30 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to:

1. Perform diagnostic radiological procedures effectively using radiation protection principles and tools

Course syllabus/ Course Description

Establishment of an occupational public and medical exposure control programme, Safe transport of radiation sources, Safe management of radioactive wastes, Factors affecting doses (in X-rays, CT, Fluoroscopy and Mammography), Methods of dose reduction:guidelinesand recommendations with emphasis on patient protection, Patient dose estimation for exposure to X-ray, Protective Shielding and designing of diagnostic radiology and nuclear medicine facilities,Safety Aspects of MRI, Radiation protection through Quality Assurance of machines(QC testing of X-ray, dark room techniques),Radiation survey instruments and instruments used for patient dose estimation

Assessment	Percentage Mark
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. IAEA, (1996) *International Basic Safety Standards for Protection Against Ionizing Radiation and for the safety of Radiation Sources; Safety Series No 115*, IAEA-Vienna
2. IAEA,*(2005) Regulations on Safe Transport of Radioactive Material; Basic Safety Standards 115*, IAEA
3. IAEA, *Report No. 049 - Structural Shielding Design and Evaluation for Medical Use of X Rays and Gamma Rays of Energies up to 10 MeV*,IAEA
4. Kogel, A.V. and Joiner, M. (2009) *Basic Clinical Radiobiology*, 4thed. CRC press
5. Martin, A., Harbison, S., Beach, K. and Cole, P.(2012) *An Introduction to Radiation Protection*,6th ed. Hodder Arnold
6. Sherer, M.A.S., Visconti, P,J., Ritenour, E.R.and Haynes, K.(2015)*Radiation Protection in Medical Radiography*, 7th ed. Mosby Elsevier

Course Code : RD 3106
Course Title : Care of Patient - II
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 25 hrs, Practical/ Demonstrations - 10 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to:

1. Recognize emergencies in diagnostic imaging
2. Describe optimum patient care during diagnostic imaging procedures
3. Describe optimum patient care under special circumstances

Course syllabus/ Course Description

CPR, Medical emergencies in diagnostic imaging, Trauma and mobile radiography, Surgical asepsis and the role of Radiographer, Care of patients during special contrast study examinations, CT, MRI & Nuclear Imaging, Care of patients with impaired hearing or deafness, Care of patients with burns , Care of isolated patient , Care of patients with cardiac and respiratory problems, Care of patients with mental disorders , Care of patients with head & spinal cord injuries, Care of patients with communicable diseases

Assessment	Percentage Mark
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Culmer, P. (1995) *Chesneys' Care of the Patient in Diagnostic Radiography*,7th ed.Wiley-Blackwell
2. Ehrlich, R.A.and Darly, J.A. (2008) *Patient Care in Radiography*, 7th ed.Mosby
3. Torres, L.S.and Dutton, A.G. and Watson, T.L. (2012) *Basic Medical Techniques and Patient Care in Imaging Technology*, 8th ed. Lippincott Williams and Wilkins

Course Code : RD 3107
Course Title : Pharmacology for Medical Imaging
Credits : 01
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 15 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to:

1. Describe the principles of pharmacology applied in practice of medical imaging
2. Describe properties and use of pharmacological agents in medical imaging including contrast media and radiopharmaceuticals
3. Describe the methods and techniques of administering drugs and contrast media
4. Describe the possible complications of contrast media and management strategies of contrast media reactions
5. Describe the role of radiographer in the use of contrast media for radiological investigations and preparation of patients prior to contrast media administration

Course syllabus/ Course Description

Basic principles of pharmacology, Pharmacokinetic and pharmacodynamic concepts, Contrast media: properties, classification, clinical application, techniques and routes of administration, Proper techniques for venipuncture, Pharmacology of drugs used in medical imaging and interventional procedures, Radiopharmaceuticals, Safety and adverse effects of pharmaceuticals used in medical imaging and interventional procedures.

Assessment	Percentage Mark
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Jensen, S.C. and Peppers, M.P. (2005) *Pharmacology and Drug Administration for Imaging Technologists*, 2nd ed.

LEVEL 3000 – SEMESTER 2

Course Code : RA 3201
Course Title : Statistics
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 20 hrs, Practical/ Demonstrations - 20 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to:

1. Explain the statistical theories.
2. Apply best suited statistical methods and techniques for the problem context

Course syllabus/ Course Description

Introduction to Statistics: Need of Statistics in health sciences, Different types of data, Variables, Data visualization methods, Basic Data Analysis with descriptive measures (Central tendency measures, variability measures, relative position measures and shape measures), Introduction to Probability: Concept of probability, random variables, Binomial, Poisson, Normal and t, chi-square, F distributions. Calculating probability values, Sampling Methods: Definitions of population and sample, parameters and estimates, why sampling?, advantages and disadvantages of sampling over census, probabilistic and non- probabilistic sampling techniques applicable in health related science, sample size selection, Hypothesis testing: Concept of statistical hypothesis, types of errors, decision making, confidence interval, p-values, basic statistical hypothesis tests such as normality tests, one sample and two samples mean, variance, proportion comparison tests, Specific Statistical methods: Correlation and Regression analysis, Categorical data analysis(Chi-square tests, Relative Risks, Odds Ratio measures), One-way and Two-way ANOVA, Basic Medical Demography: Vital statistics, Crude birth and death rates , General and specific fertility rates, Maternal and infant mortality rates , Principles of life table, Life expectancy

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Campbell, M.J., Machin, D. and Walters, S.J. (2007) *Medical Statistics: A Textbook for the Health Sciences*, 4th ed. John Wiley & Sons Ltd.
2. Steel, R. G.and Torrie, J. H. (1960) *Principles and procedures of statistics*, McGraw – Hill, Book Co
3. Campbell, M. J., Machin, D. and Walters, S. J. (2010)*Medical statistics: a textbook for the health sciences*, John Wiley & Sons

Course Code : RD 3201
Course Title : Magnetic Resonance Imaging - II
Credits : 02
Prerequisite : RA 2204

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 25hrs, Practical/ Demonstrations - 10 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to:

1. Discuss the application of routine imaging protocols and its modification in uncommon MR examinations
2. Critically discuss the strengths and weaknesses of applying different image contrast in different body regions
3. Evaluate and optimize the image quality

Course syllabus/ Course Description

Fast Imaging in the Steady State, Segmented k-Space and Echo Planar Imaging, MR Angiography and Flow Quantification, Random Walks, Relaxation and Diffusion Imaging, Cardiac MRI , Dynamic Contrast Enhanced-MRI, Parallel Imaging Techniques, MR Contrast Agents, Sequence Design, Nomenclature, *in vivo* MR spectroscopy, Sampling and Aliasing in Image Reconstruction, Filtering and Resolution in Magnetic Resonance Image Reconstruction, Signal, Contrast and Noise, Water/Fat Separation Techniques

Assessment	**Percentage Mark**
Continuous Assessment	40%
End Semester Examination	60%

Recommended References:

1. Bushong, S.C. (2003) *Magnetic Resonance Imaging: Physical and Biological Principles*, 3rd ed. Mosby Year Book Inc., ISBN 0323014854
2. Brown, M. A. and Richard, C. S. (2003) *MRI: Basic Principles and Applications*, 3rd ed. John Wiley & Sons Inc.
3. Hagga, J.R. and Boll, D. (2008) *CT and MRI of the whole body*, 5th ed. Mosby
4. McRobbie, D.W., Moore, E.A., Graves, M.J. and Prince, M.R. (2007) *MRI From Picture to Proton*, 2nd ed. Cambridge University Press
5. Moeller, T.B. and Reif, E. (2003) *MRI Parameters and Positioning*; 1st ed. Thieme
6. Weishaupt, D., Kochi, V.D. and Marincek, B.(2006) *How does MRI work*, 2nd ed. Springer
7. Westbrook, C. (1999) *Handbook of MRI Technique*; 2nd ed. Blackwell Science
8. Westbrook, C., Carolyn, K. and John, T. (2005) *MRI in Practice*, 3rd ed. Blackwell Science Ltd

Course Code : RD 3202
Course Title : Imaging in Common Systemic Diseases - I
Credits : 01
Prerequisite : RD 3104

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 15 hrs

Intended learning outcomes:

At the end of the course the students should be able to:
Identify radiographic pathology in commonly performed views of plain radiography, mammography and contrast studies.

Course syllabus/ Course Description

Respiratory system pathology, Gastrointestinal tract pathology,Genitourinary tract pathology, Central nervous system pathology, Muscular - skeletal system pathology, Cardiovascular system pathology, Paediatric pathology, Breast pathology

Assessment	Percentage Mark
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Laudicina, P.(1989) *Applied Pathology for Radiographers*, 1st ed.

Course Code : RD 3203
Course Title : Fluoroscopy - III
Credits : 02
Prerequisite : RD 2201

Compulsory/ Optional : Compulsory

Time Allocation : Hospital based training- 80 hrs, Practical/ Demonstrations - 20 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to:

1. Use contrast media (by selecting correct type, volume, and the density) in radiological procedures.
2. Prepare the patient and the equipment for contrast studies.
3. Select the suitable technique for various fluoroscopic procedures.

Course syllabus/ Course Description

Contrast studies of the **:** Gastrointestinal system, Urinary system, Reproductive system, Vascular system and Hepatobilliary system

Assessment	**PercentageMark**
Continuous Assessment	50%
End Semester Examination	50%

Recommended References:

1. Whitley, A.S., Moore, A.D.and Alsop, C.W. (1999)*Clark's Special Procedures in Diagnostic Imaging*, CRC Press

Course Code : RD 3204
Course Title : Paediatric Imaging
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 25 hrs, Hospital based training- 20 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to:

1. Explain the role of paediatric radiographer.
2. Perform paediatric imaging procedures.

Course syllabus/ Course Description

Paediatric Radiology and Applications, Understanding the psychology, Consent and immobilization, Sedation and anaesthesia, Administration of contrast media, Radiation protection in paediatric radiography, Paediatric pathology and radiographic technique: chest and upper respiratory tract, gastro intestinal system, genito urinary system, abdomen, neonates,Radiation protection, Paediatric skeletal trauma, Paediatric orthopaedics, Paediatric non accidental injuries

Assessment	Percentage Mark
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Hardy, M. and Boynes, S. (2003) *Paediatric Radiography*, 1st ed. Wiley-Blackwell
2. Judith, H.(2005) *Radiography of Children: A Guide to Good Practice*, 1st ed. Elsevier

Course Code : RD 3205
Course Title : Mammography - II
Credits : 02
Prerequisite : RD 2101

Compulsory/ Optional : Compulsory

Time Allocation : Lectures-10 hrs, Hospital based training- 60 hrs, Practical/ Demonstrations -10 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to:

1. Explain digital mammography concepts and applications.
2. Accurately perform routine and special mammography projections.
3. Apply radiation protection and standard quality control procedures.

Course syllabus/ Course Description

Digital mammography (DM): Basic Physics DM, Advantages of DM and limitations of conventional mammography, Film Response, Fixed Display Characteristics, Characterizing Imaging Performances, Digital Image Acquisition, Image Display, Properties of Digital Images, Sampling, Some Spatial Sampling Concepts, Sampling of Signal Levels, Noise, Quantum Noise, Structural Noise, Signal Difference-to-Noise Ratio, Del Size, Dynamic Range, Radiation Dose in DM, Clinical Dose Levels in DM, Technical Requirements for DM, Data Acquisition, Analog-to Digital Conversion, Digital Image Processing, Image Display, PACS Integration, Detectors of DM, Detector Sensitivity, Noise, Detector Correction, Types of Digital Detector System for DM, Digital Image Post-Processing Techniques, Specific Image-Processing Algorithms for DM, Computer-Aided Detection, Digital Tomosynthesis, Contrast-Enhanced DM, Artifacts in DM. Quality Control in DM and Clinical Trials, Practice of basic and special mammographic projections (conventional & digital), Demonstration of Localization biopsies, Evaluation criteria for various mammographic projections, Processing and handling artifacts, Application of quality control procedures

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Etta, D.P., Martin, J.Y. and Cherie, M.K. (2003) *Digital Mammography*, 5th ed. Lippincott Williams & Wilkins
2. Tucker, A.K. and Ng, Y.Y. (2005) *Text book of Mammography*, 2nd ed. Churchill Livingstone
3. Ulrich, B. and Felix, D. (2011) *Digital Mammography (Medical Radiology / Diagnostic Imaging)* 1st ed. Springer

Course Code : RD 3206 **Course Title** : Computed Tomography - III **Credits** : 03 **Prerequisite** : RA 2103, RD 3101	
Compulsory/ Optional : Compulsory	
Time Allocation : Hospital based training- 180 hrs	
Intended learning outcomes: At the successful completion of the course the students will be able to: 1. Perform routine and special CT examinations 2. Integrate theoretical knowledge with evidence based clinical practice	
Course syllabus/ Course Description CT examinations of: Head (brain, orbits, IAM, PNS, TM joints), Chest (Routine and HRCT), Abdomen and pelvis (Routine and three phase study), Angiography (CTA), Urinary system, Extremities (shoulder joint, elbow joint, wrist joint, hip joint, knee joint, ankle), CT guided biopsy, Spine, Paediatric CT.	
Assessment	**PercentageMark**
Continuous Assessment	50%
End Semester Examination	50%

Recommended References:

1. Hagga, J.R. and Boll, D. (2008) *CT and MRI of the whole body*, 5th ed. Mosby
2. Karthikeyan, D. and Chegu, D. (2007) *Step by Step CT scan*, Jaypee Brothers Medical Publishers Pvt Ltd
3. Romans, L. E. (2011) *Computed Tomography for Technologists –A Comprehensive Text*, 1st ed. Lippincott Williams & Wilkins
4. Seeram, Euclid, (2009) *Computed Tomography: Physical Principles, Clinical Applications and Quality Control*, 3rd ed.Saunders

LEVEL 4000 – SEMESTER 1

Course Code : RA 4101
Course Title : Research Methodology
Credits : 02
Prerequisite : None

Compulsory / Optional : Compulsory

Time Allocation : Lectures -30 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to:

1. Describe the value of evidence based practice and the role of research
2. Describe the principles of biostatistics and research methodology as applied in various fields of medical imaging

Course syllabus/ Course Description

Evidence based practice (EBP); usefulness and obtaining the relevant information from scientific literature for EBP; primary and secondary scientific information and the sources of scientific information; systematically organizing searched literature/information for the purpose of utilizing such information in research and EBP; scientific method and process of research. Scales of measurements; data reduction and methods of presenting data; basics in descriptive statistics(measures of central tendency and variation); probability and distributions; the basics of hypothesis testing(p value and confidence interval approaches) and inferential statistics; comparing two means, comparing proportions and exploring associations(correlation and regression) as examples for hypothesis testing; Parametric and non-parametric methods. Conceiving a good research question; an introduction to research designs; generalizing from sample to population; sampling and sample size; structure and function of research; quantitative and qualitative approaches; principles of questionnaire design; specificity, sensitivity, reliability and validity (accuracy and precision) in relation to a test or measurements, Sources of error in research and methods of minimizing errors
Writing a research proposal

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Polgar, S., Thomas, S.A. (2013) *Introduction to Research in the Health Sciences*, 6th ed.

Course Code : RD 4101
Course Title : Maintenance of Medical Imaging Equipment
Credits : 02
Prerequisite : None

Compulsory / Optional : Compulsory

Time Allocation : Lectures- 25 hrsPractical/ Demonstrations - 10 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to**:**

1. Identify the importance of proper maintenance program , safety in maintenance, the basics of electricity and electronics and necessity of preventive and corrective maintenance
2. Explain basic preventive and corrective maintenance procedures of radiography equipment

Course syllabus/ Course Description

Introduction to the module, Health and safety in maintenance works, management of medical equipment definitions and necessity of Preventive and corrective maintenance, Basic Electricity and Electronics, Instrumentation. Corrective and preventive Maintenance of X-ray generators & high tension cables, X-ray tube and its components, fluoroscopy equipment, mobile radiography equipment, capacitor discharge C-Arm equipment , films, intensifying screens & cassettes, and automatic film processors

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Meclelland, I.R. (2004) *X-ray equipment maintenance and repairs Workbook for Radiographers and Radiological Technologists*, World Health Organisation (WHO)
2. Panichello, J.J.(2004) *X-Ray Repair: A comprehensive Guide to the installation & servicing of radiographic Equipment,* 2nd ed. Charles C Thomas Pub Ltd

Course Code : RD 4102
Course Title : Nuclear Imaging - II
Credits : 02
Prerequisite : RA 3101

Compulsory / Optional : Compulsory

Time Allocation : Lectures- 15 hrs, Hospital based training- 60 hrs

Intended learning outcomes:

At the successful completion of the course, the students will be able to:

1. Select the suitable radiopharmaceutical for required imaging procedure
2. Perform nuclear imaging procedures applying validated protocols
3. Perform image data processing
4. Perform standard quality control procedures

Course syllabus/ Course Description

Radiopharmaceuticals and methods of radiolabeling, Characteristics of specific radiopharmaceuticals, , Nuclear imaging procedures for thyroid gland, parathyroid gland, Genito- urinary system, cardiovascular system, respiratory system, skeletal system, central nervous system, hepato biliary system, gastro intestinal system and special procedures: Red cell labelling technique, White cell labelling technique, Myocardial stress imaging, infections & tumour imaging, Nuclear imaging procedures in emergency, Therapeutic uses of radiopharmaceuticals in nuclear medicine.

Assessment	Percentage Mark
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Barnier, D.R., Christein, P.A. and Langan, J.K. (2005) *Nuclear Medicine: Technology and Techniques* 3rd ed. Mosby
2. Shackett, P. (2008) *Nuclear Medicine Technology: Procedures and Quick Reference*, 2nd ed. Lippincott Williams & Wilkins

Course Code : RD 4103 **Course Title** : Applied Anatomy - III **Credits** : 02 **Prerequisite** : RD 3104	
Compulsory / Optional : Compulsory	
Time Allocation : Lectures- 30 hrs	
Intended learning outcomes: At the successful completion of the course the students will be able to**:** 1. Identify radiographic anatomy in cross sectional images of CT and MRI	
Course syllabus/ Course Description CT: Brain, Para nasal sinuses, Pituitary, Orbits, temporal bone, Abdomen & Pelvis **,**Chest,Musculo skeletal, Angiography MRI:Brain, spine, Para nasal sinuses, Pituitary, Orbits, temporal bone , Musculo skeleton, Abdomen & Pelvis, Angiography , Breast, MRCP	
Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Kumar, S. (2006*) Surface & imaging anatomy*, 1st ed. CBS Publishers and Distributors
2. Netter, F.H.(2014) *Atlas of Human Anatomy*, 6th ed. Elsevier Health Sciences

Course Code : RD 4104 **Course Title** : Radiation Dosimetry and Applications **Credits** : 02 **Prerequisite** : None	
Compulsory / Optional : Compulsory	
Time Allocation : Lectures- 25 hrs, Practical/ Demonstrations - 10 hrs	
Intended learning outcomes: At the successful completion of the course the students will be able to: 1. Apply basic principles of radiation dosimetry for medical imaging	
Course syllabus/ Course Description Principles of radiation dosimetry (Interactions and energy deposition by ionizing radiation in matter; concepts, quantities and units in radiological physics, principles and methods of radiation dosimetry), Applications in radiography (calibration in diagnostic equipment, measurement of scattered radiation, measurement of dose to patient, dose to radiation workers)	
Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Attix, F.H. (2004) *Introduction to Radiological Physics and Radiation Dosimetry*, Wiley
2. Bushberg, T.J. **(**2011**)** *The Essential Physics of Medical Imaging*, 3rd ed.
3. Greening, J.R.(1985) *Fundamentals of Radiation Dosimetry*,2nd ed. Adam Hilger, Bristol
4. Khan, F.M.(2003) *The Physics of Radiation therapy*, Lippincott Williams and Wilkins
5. Gerald, J.H., Gordon, L., Brownell, (2013) *Radiation Dosimetry*, Elsevier
6. Orton, C.G.(1986) *Radiation Dosimetry; Physical and Biological Aspects*, Springer

Course Code : RD 4105
Course Title : Magnetic Resonance Imaging - III
Credits : 03
Prerequisite : RA 2204, RD 3201

Compulsory / Optional : Compulsory

Time Allocation : Hospital based training- 180 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to:

3. Perform routine and special MRI examinations
4. Perform evidence based clinical practice integrating theoretical knowledge

Course syllabus/ Course Description

MRI examinations of: Central nervous system (Brain & Spine), Abdomen and pelvis, MRCP, Joints (knee, shoulder, ankle, hip), Cardiac MRI, MR Angiography, Extremities, Prostate, Breast, Endocrine system, Fistulogram, Paediatric MRI, MR contrast studies, MR spectroscopy, Whole body MRI

Assessment	Percentage Mark
Continuous Assessment	50%
End Semester Examination	50%

Recommended References:

1. Bushong, S.C. (2003) *Magnetic Resonance Imaging: Physical and Biological Principles*, 3rd ed. Mosby Year Book Inc.
2. Brown, M. A. and Richard, C. S, (2003) *MRI: Basic Principles and Applications*, 3rd ed. John Wiley & Sons Inc.
3. Hagga, J.R. and Boll, D. (2008) *CT and MRI of the whole body*, 5thed. Mosby
4. McRobbie, D.W.,Moore, E.A., Graves, M.J. and Prince, M.R.(2007) *MRI From Picture to Proton*, 2nd ed. Cambridge University Press
5. Moeller, T.B. and Reif,E. (2003) *MRI Parameters and Positioning*; 1st ed. Thieme
6. Weishaupt, D., Kochi, V.D. and Marincek, B.(2006) *How does MRI work*,2nd ed. Springer
7. Westbrook, C. (1999) *Handbook of MRI Technique*; 2nd ed. Blackwell Science
8. Westbrook, C., Carolyn, K. and John, T. (2005) *MRI in Practice*, 3rd ed. Blackwell Science Ltd

Course Code : RD 4106
Course Title : Quality Assurance in Radiography
Credits : 02
Prerequisite : None

Compulsory / Optional : Compulsory

Time Allocation : Lectures- 25 hrs, Practical/ Demonstrations - 10 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to:

1. Explain the Standards of acceptable image quality
2. Analyze reasons for retakes
3. Relate the image quality with dose to patient
4. Explain the effects of poor quality images.
5. Perform QA tests with the relevant equipment, identify the errors and take necessary steps to correct whenever possible

Course syllabus/ Course Description

Quality System, Quality Assurance and Quality Control, Acceptance Testing, Radiographic Quality control routine performance:X-ray tube Quality control (Filament, Collimation ,Focal spot size, kVp correction, Light beam diaphragm alignment, Grid, alignment, Exposure timer accuracy, Exposure linearity & reproducibility), Image Recording system: Films and Cassettes (Screen contact testing, Screen cleaning etc),Processor Quality Control (Processor Sensitometer ,Processor Cleaning ,Processor Maintenance , Processor Quality control test, Dark room safelight and light leakage test),Quality control for Fluoroscopy (Exposure rate, Spot-film Exposure,Automatic Exposure System)

Assessment	Percentage Mark
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. AAPM, (1977) *Report No.4; Basic Quality control in Diagnostic Radiology; American Association of Physicists in Medicine*
2. AAPM,(2002) *Report No.74; Quality control in Diagnostic Radiology; American Association of Physicists in Medicine*

LEVEL 4000 – SEMESTER 2

Course Code : RA 4201
Course Title : Research Project
Credits : 06
Prerequisite : RA 4101

Compulsory/ Optional : Compulsory

Time Allocation : Research- 360 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to:

1. Create hypothesis
2. Conduct literature survey on a given topic
3. Collect, analyse, interpret and summarize data
4. Identify and optimally utilize available resources
5. Write a scientific report
6. Present the findings of the conducted research

Course syllabus/ Course Description

Problem identification and project formulation, search and retrieve information required such as conducting literature surveys, identification and optimal utilization of available resources, project execution, socio-economic, ethical and safety evaluation when applicable, data analysis, scientific report writing and presentation.

Assessment	Percentage Mark
Project proposal formulation and presentation	20%
Dissertation evaluation	40%
Final presentation	20%
Viva	20%

Recommended References:

1. Polgar, S., Thomas,S.A. (2013) *Introduction to Research in the Health Sciences*, 6th ed.

Course Code : RA 4202
Course Title : Medical Data Communication
Credits : 01
Prerequisite : RA 2101

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 10hrs, Practical/ Demonstrations -10hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to:

1. Operate data communication systems
2. Troubleshoot communication data errors

Course syllabus/ Course Description

Microsoft Windows and Unix-based operating systems, networking essentials, data communication protocols, system and network monitoring tools.

Assessment	**Percentage Mark**
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Johnson, D. and Ed, T. (1999) *Guide to Networking Essentials*, MCSE

Course Code : RD 4201
Course Title : Imaging in Common Systemic Diseases- II
Credits : 02
Prerequisite : RD 4104

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 25 hrs, Practical/ Demonstrations - 10 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to:

1. Identify common manifestations of pathological conditions imaged by CT and MRI

Course syllabus/ Course Description

Manifestations of pathological conditions which may appear on CT brain (pituitary, orbits, temporal bone)spine, chest, abdomen and pelvis, musculo skeletal system, cardiovascular system and CT Angiography,
Manifestations of pathological conditions which may appear on MRI brain, spine, musculo skeletal system, chest, abdomen and pelvis, breast, cardiac MRI and MR Angiography, MRCP

Assessment	Percentage Mark
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Laudicina, P. (1989) *Applied Pathology for Radiographers*, 1st ed.

Course Code : RD4202
Course Title : Ancillary Imaging Techniques
Credits : 02
Prerequisite : None

Compulsory/ Optional : Compulsory

Time Allocation : Lectures- 25 hrs, Practical/ Demonstrations - 10 hrs

Intended learning outcomes:

At the successful completion of the course the students will be able to:

1. Describe veterinary radiological procedures
2. Describe techniques used in trauma radiography and foreign body imaging
3. Describe forensic radiological procedures
4. Describe methods of performing bone densitometry
5. Describe clinical indications, technical requirements and projections taken inskeletal survey
6. Describe macro radiography and xeroradiography
7. Evaluate radiographers role in 'In - ward radiography'

Course syllabus/ Course Description

Veterinary radiological procedures: basic radiographic anatomy of companion and farm animals, restraining techniques of companion animals: manual & chemical restraining, radiography techniques for plain radiography (abdominal, thoracic, muscular skeleton system), fluoroscopy & contrast studies, CT and MRI in companion and farm animals, Trauma radiography & foreign body imaging:guidelines, modification of routine positioning techniques, soft tissue imaging & tomography,Forensic radiological procedures:ante- mortem forensic radiography, radiography in paediatric non accidental trauma/ child abuse, post- mortem forensic radiography,Bone densitometry:DEXA, quantitative ultrasound, quantitative computed tomography,Skeletal survey: clinical indications, technical requirements and projections, Macro radiography & Xeroradiography, In - ward radiography

Assessment	Percentage Mark
Continuous Assessment	30%
End Semester Examination	70%

Recommended References:

1. Lisa, M. L. (2006) *Radiography in Veterinary Technology*, 4th ed.
2. Marg, B., Lois, B. (2013) *Lavin's Radiography for Veterinary Technicians*, 5th ed.
3. Whitley, A.S. *et al* (2005) *Clark's Positioning in Radiography*, 12th ed. Hodder Arnold
4. Hampton J.R, (1997) *The ECG Made Easy*, 5th ed, Churchill livingstone Elsevier
5. Levy A.D., Harcke H.T. (2010) *Essentials of Forensic Imaging*, 1st ed, CRC press

Course Code : RD 4203 **Course Title** : In Service Training **Credits** : 04 **Prerequisite** : RD 2202, RD 3103, RD 3203, RD 3206, RD 4103, RD 4106	
Compulsory/ Optional : Compulsory	
Time Allocation : Hospital based training- 240 hrs	

Intended learning outcomes:

At the successful completion of the course the students will be able to:

1. Perform medical imaging procedures in a professional and ethical manner providing optimum patient care and radiation protection
2. Critically evaluate the application of medical imaging techniques in different clinical set ups and environments
3. Communicate effectively with patients and other healthcare professionals

Course syllabus/ Course Description

Practice of Plain radiography, fluoroscopy and contrast studies, darkroom procedure and film processing, mobile radiography, dental radiography, trauma radiography, radionuclide imaging, CT, MRI, mammography(for female students).

Assessment	**Percentage Mark**
Continuous Assessment	70%
End Semester Examination	30%

Recommended References:

1. Whitley, A.S., Sloane, C., Hoadley, G. and Moore, A.D. (2005) *Clark's Positioning in Radiography*, 12th ed. Hodder Arnold
2. Whitley, A.S., Moore, A.D., and Alsop, C.W. (1999) *Clark's Special Procedures in Diagnostic Imaging*, CRC Press
3. Hagga, J.R. and Boll, D. (2008) *CT and MRI of the whole body*, 5thed. Mosby
4. McRobbie, D.W.,Moore, E.A., Graves, M.J. and Prince, M.R.(2007) *MRI From Picture to Proton*, 2nd ed. Cambridge University Press
5. Karthikeyan, D. and Chegu, D. (2007) *Step by Step CT scan*, Jaypee Brothers Medical Publishers Pvt Ltd
6. Barnier, D.R., Christein, P.A. and Langan, J.K. (2005) *Nuclear Medicine: Technology and Techniques*,3rd ed. Mosby
7. Culmer, P. (1995) *Chesneys' Care of the Patient in Diagnostic Radiography*,7th ed. Wiley-Blackwell
8. Whaites, E. (2007) *Essentials of Dental Radiography and Radiology*, 4thed. Churchill Livingstone