CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT, ANDHRA PRADESH

SCHOOL OF ALLIED & HEALTHCARE SCIENCES

Centurion UNIVERSITY

Shaping Lives...
Empowering Communities...

BACHELOR OF SCIENCE IN

RADIOLOGY & IMAGING TECHNOLOGY

SYLLABUS

2025

Preface: Bachelor of Science in Radiology and Imaging Technology is a three year graduate programme. Medical Radiography and Imaging is the health profession concerned with the direct administration of radiation, primarily x-rays, in disease diagnosis and injury assessment. Medical imaging studies have been a cornerstone in medical diagnosis for decades; however, technological advances and the addition of new imaging modalities now place medical imaging among the most dynamic, expanding and high demand fields in clinical medicine.

Medical Imaging clinical practice includes: general radiography such as orthopedics, pediatrics and mammography, vascular imaging, cardiac catheterization studies, computerized tomography, and Magnetic Resonance Imaging. Medical imaging professionals are employed in medical centers, community and private hospitals, clinics, and physicians' offices.

Programme: B.Sc. in Radiology & Imaging Technology

Duration: Three years (Six semesters) full-time programme with 6 months internship in the last semester.

Eligibility: +2 Science with Physics, Chemistry & Biology or DRIT from any recognized.

Examination: Examination rules will be as per guideline of CUTM Examination hand book**.**

Internship: A candidate will have to undergo internship for a period of six calendar months in a hospital/Diagnostics Centre equipped with modern Radiology & Imaging laboratory facility or in a fully equipped, which fulfills the norms decided by the University.

Degree: The degree of B.Sc. in Radiology & Imaging Technology (B.Sc.-RIT) course of the University shall be conferred on the candidates who have pursued the prescribed course of study for not less than three academic years and have passed examinations as prescribed under the relevant scheme and completed 6 months of compulsory internship in the last semester.

On successful completion of three year programme, the candidate will be awarded with **"Bachelor of Science in Radiology and Imaging Technology (B.Sc.-RIT)"** from Centurion University

BACHELOR OF SCIENCE IN RADIOLOGY AND IMAGING TECHNOLOGY
Course structure

	BASKET 1		BASKET 2	BASKET 3	
SEMESTER	**School Core Courses**	**Ability Enhancement Compulsory Course (AECC)**	**Discipline Core Courses**	**Domain/ Non-Domain (Generic Elective and Skill Courses) ***	**Semester-wise Cumulative Credits**
I	SC-1 SC-2 SC-3 SC-4	**University Basket**	DC-1	**University Skill Basket**	Maximum Credits 32
II			DC-2 DC-3 DC-4		Maximum Credits 21
III			DC-5 DC-6 DC-7 DC-8 DC-9		Maximum Credits 24
IV			DC-10 DC-11 DC-12 DC-13		Maximum Credits 28
V			DC-14 DC-15 DC-16 DC-17 DC-18		Maximum Credits 30
VI			DC-19 DC-20		Maximum Credits 20
Total Credits					**Minimum Credits 140** **Maximum Credits 155**

BASKET - 1 School Core Courses				
Sl.No.	**Subject Code**	**Subject**	**Subject Type (T - P- Pj)**	**Credits**
SC-1	CUTM1757	General Anatomy	3 2 0	5
SC-2	CUTM1758	General Physiology	3 2 0	5
SC-3	CUTM1759	Basic Biochemistry	3 2 0	5
SC-4	CUTM1760 /1729/1761	Biology / Cell Biology / Mathematics	3 0 1	4
		Total Credits		**19**

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1757	**General Anatomy**	**3 2 0**	**5**

Course Objectives:

- To obtain Knowledge about the general anatomy – the structure of different organs and position of the organ.
- To familiarize the student with the different anatomical terminology and positions of the body.
- To develop the students to identify the structural reinforcement of the anatomical structures of human body, which would help the student to develop 3D images of the organs

Learning Outcomes:

- Can acquire knowledge about the general anatomy – the structure of different organs and position of the organ.
- The student get familiarize with the different anatomical terminology and positions of the body.
- One can technically identify the structural reinforcement of the anatomical structures of human body, which would help the student to develop 3D images of the organs.

Module -1: INTRODUCTION TO ANATOMY AND SKELETON

Sub division of anatomy, terms and terminology, body cavities and membranes, directional terms, abdominal regions, types of body movements systems of the Body. Classification of bones & anatomy of long bone.

Module –2: RESPIRATORY & DIGESTIVE SYSTEM

Respiratory system: Anatomy of nose, pharynx, trachea, bronchi, lungs, broncho-pulmonary segments, ribcage & intercostals muscles

Digestive system: Anatomy of mouth, pharynx, oesophagus, stomach, small intestine, large intestine, rectum, anus. Anatomy of liver, gall bladder & pancreas

Module -3: CARDIOVASCULAR SYSTEM & LYMPHATIC SYSTEM

Anatomy of heart, systemic circulation, anatomy of artery, vein & capillary,major blood vessels of the body.

Anatomy of lymphatic system – lymphatic vessels, lymphatic nodes, spleen, thymus, tonsils,

peyer’s patches

Module -4: EXCRETORY & INTEGUMENTARY SYSTEM

Anatomy of kidneys, ureters, urinary bladder, urethra

Anatomy of skin, nails & hair

Module -5: MUSCULAR SYSTEM

Structure of muscle fibre, head and neck muscles (frontalis, orbicularis occuli, orbicularis oris, buccinators, zygomaticus, chewing muscles, platysma, sternocleidomastoid), trunk muscles (pectoralis major, intercostals muscles, muscles of the abdominal girdle, trapezius, latisimus dorsi, erector spinae,

quadrates lumborum, deltoid), muscles of upper & lower limb (major muscles)

Module -6: NERVOUS SYSTEM & SPECIAL SENSE ORGANS

Nervous system: classification and parts of nervous system, anatomy of brain, spinal cord, meninges,

structure of neuron, spinal nerves, cranial nerves & nerve plexus

Special sense organs: Structure and function of Visual system, auditory system, gustatory system, olfactory system.

Module -7: SKELETAL SYSTEM & NECK ANATOMY

Structure of long bone, Development Of Bone, Classification Of Bones. Classification of joints with examples

Anatomy of neck & neck triangles, muscles of mastication, temparo-mandibular joint

Module -8 (Only for optometry)

OCULAR ANATOMY: orbit and its contents, ocular muscles- origin, insertion. Action and its nerve supply, movements.

Only for radiographers:

Surface anatomy of all systems

PRACTICE

1. Identification and description of all anatomical structures.
2. The learning of Anatomy is by demonstration only through dissected parts, slides, models, charts, etc.
3. Demonstration of dissected parts (upper extremity, lower extremity, thoracic & abdominal viscera, face and brain).
4. Demonstration of skeleton- articulated and disarticulated.
5. During the training more emphasis will be given on the study of bones, muscles, joints, nerve supply of the limbs and arteries of limbs.
6. Surface anatomy: Surface land mark-bony, muscular and ligamentous. Surface anatomy of major nerves, arteries of the limbs. Points of palpation of nerves and arteries

Suggested Readings

1. Text book Anatomy & Physiology for nurses by Evelyn Pearce, Publisher Faber& Faber.
2. Text book Anatomy and Physiology for nurses by Sears, Publisher Edward Arnold.
3. Anatomy & Physiology- by Ross and Wilson, Publisher Elsevier.

Reference Books

1. Anatomy& Physiology: Understanding the human body by Clark, Publisher Jones & Bartlett.
2. Anatomy and Physiology for nurses by Pearson, Publisher Marieb & Hoehn.
3. Anatomy and Physiology by N Murgesh, Publisher satya.

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1758	General Physiology	3 2 0	5

Course Objectives:

- To obtain Knowledge about the general physiological systems and physiological terminology.
- To familiarize the student with the functionality of different physiological systems.
- To develop the technical skills in identifying the Biopotential and their recording and advanced systems.

Course Outcomes:

- CO1:Can explore about the general physiological systems and physiological terminology.
- CO2: The student familiarize with the functionality and applications of different physiological systems
- CO3: One can technically identify the Biopotential signals, their recording and advanced systems.

Module -1

Scope of physiology. Definition of various terms used in physiology.
Structure of cell, function of its components with special reference to mitochondria and microsomes.
Elementary tissues: Elementary tissues of the body, i.e. epithelial tissue, muscular tissue, connective
tissue and nervous tissue.

Module -2

Cardiovascular System: Composition of blood, functions of blood elements.
Blood group and coagulation of blood
Brief information regarding disorders of blood
Heart: myocardium–innervations– transmission of cardiac impulse- Events during cardiac cycle–cardiac output. Structure and functions of various parts of the heart

Module-3

Circulation: General principles, Peripheral circulation: peripheral resistances–arterial blood pressure–
measurements–factors, Regulation variations–capillary circulation–venous circulation.
Special circulation: coronary cerebral–miscellaneous, Arterial and venous system with special reference to the names and positions of main arteries and veins. Brief information about cardiovascular disorders.

Module -4

Respiratory system: Various parts of respiratory system and their functions, physiology of respiration.
Mechanics of respiration–pulmonary function tests–transport of respiratory gases-neural and chemical
regulation of respiration–hypoxia, –asphyxia.

Module-5

Urinary System: Various parts of urinary system and their functions, structure and functions of kidney,
structure of nephron– mechanism of urine formation, composition of the urine and abnormal constituents, urinary bladder & micturition. Patho-physiology of renal diseases and edema.

Module-6

Digestive System: names of various parts of digestive system and their functions. structure and functions of liver, physiology of digestion- functions and regulations of Salivary digestion, Gastric pancreatic digestion, Intestinal digestion and absorption.
Lymphatic system: Name and functions of lymph glands, Reticulo endothelial system: Spleen, lymphatic tissue, Thymus

Module-7
Nervous System: Neuron–Conduction of impulse– synapse–receptor. Sensory organization– pathways and perception, Reflexes–cerebral cortex– functions. Thalamus–Basal ganglia Cerebellum, hypothalamus. Autonomic nervous system– motor control of movements. Reproductive system. Structure and function of Male reproductive system–control & regulation, Female reproductive system– uterus–ovaries–menstrual cycle–regulation–pregnancy & delivery–breast–family planning

PRACTICE
1. Identification of different organs and systems from charts
2. Identification of different blood cell, their normal and abnormal morphology from slides.
3. Examination of pulse, B.P., Respiratory rate.
4. Reflexes
5. Spirometry to measure various lung capacities & volumes, Respiratory rate, Tidal volume, IRV, IC,
6. ERV, EC, residual volume on Spirometry.
7. Estimate of Hemoglobin, R.B.C., W.B.C., TLC, DLC, ESR count.
8. Blood indices, Blood grouping, Bleeding & Clotting time

Text books
1. Text book Anatomy & Physiology for nurses by Evelyn Pearce, Publisher Faber& Faber.
2. Text book Anatomy and Physiology for nurses by Sears, Publisher Edward Arnold.
3. Anatomy & Physiology- by Ross and Wilson, Publisher Elsevier.
Reference Books
1. Anatomy& Physiology: Understanding the human body by Clark, Publisher Jones & Bartlett.
2. Anatomy and Physiology for nurses by Pearson, Publisher Marieb & Hoehn.
3. Anatomy and Physiology by N Murgesh, Publisher satya.

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1759	Basic Biochemistry	3 2 0	5

Course Objectives:
- Biochemistry is the study of biological phenomena at the molecular level.
- Its aim is to understand the fundamental chemical principles that govern complex biological systems.
- The program is an interdepartmental major between biology and chemistry that emphasizes the importance of a solid foundation in the natural sciences.
- The major focuses, however, on disciplines within biology and chemistry, ranging from cell biology and molecular biology to analytical chemistry and physical chemistry.

Learning Outcomes:
- Biochemistry helps in clinical diagnosis, understanding pathology of diseases, treatment of diseases, designing of drugs and understanding their metabolism and manufacture of various

biological products like amino acids, proteins, antibiotics, hormones, enzymes, nutrients, etc.

- It is expected that the students become conversant with the Fundamentals of Biochemistry which can be applied in clinical diagnosis of the metabolic disorders

Module-1

Enzymes - Introduction, definition, structure of enzyme, classification, coenzymes, isoenzymes, importance of enzyme inhibition

Module-2

Chemistry of carbohydrates - Introduction, definition, classification, biomedical importance & properties Brief outline of metabolism and significance of Glycogenesis, glycogenolysis, Gluconeogenesis, Glycolysis, citric acid cycle, HMP shunt

Module-3

Amino acids - Definition, classification, essential & non-essential amino acids
Chemistry of Proteins - Introduction, definition, classification, biomedical importance

Module-4

Ammonia formation & transport, Urea cycle, metabolic disorders in urea cycle
Importance substances derived from Phenylalanine, Tyrosine & Tryptophan, glycine

Module-5

Chemistry of Lipids & their related metabolism - Introduction, definition, classification, biomedical importance, brief description about essential fatty acids
Fatty liver, Ketosis, Cholesterol & its clinical significance, Lipoproteins and their importance

Module-6

Blood glucose levels, HbA1C, glucose tolerance test, glycosuria,
Hyperglycemia & Hypoglycaemia & their causes

Module-7

Diagnostic value and importance of Cardiac markers, LFT, RFT, Pancreatic markers, serum electrolytes, lipid profile, serum markers

Biochemistry practical

Quantitative exercises:

Detection of abnormal constituents in urine, sugar, proteins, ketones, blood and bile salts Bens Jones protein.
Phlebotomy equipments
Identification of Blood Collection Tubes & Centrifugal Separation of Blood Plasma and Serum

Techniques:

Colorimeter, blood chemistry analyzer.
Demonstration:
Estimation of blood cholesterol
Estimation of alkaline phosphate
Salivary amylase test (effect of PH and Temperature)
Estimation of Serum creatinine
Estimation of Serum uric acid
Estimation of total protein.

Text books

1. Text book of Medical Laboratory Technology, P.B. Godkar 2nd Edn. 2003 Bhalani Publication.
2. Text book of Biochemistry, M. A. Siddique 8th Edn.1993 Vijay Bhagat Scientific Book Co., Patna.

3. Medical Biochemistry by AC Dey.
4. Handbook of Christen Medical Association, India Medical Laboratory Technology- Robert H. Carman.

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1760	Biology	3 0 1	4

Course Objectives:

- The course defines the basic biological concepts and processes.
- It enables the student to study the levels of organization and related functions in plants and animals.
- It helps to identify the characteristics and basic needs of living organisms.

Learning Outcomes:

- Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
- They will understand how these cellular components are used to generate and utilize energy in cells

Module-1

Biology & Its Branches; Scientific methods in Biology; Scope of biology and career options in Medical Laboratory Sciences; Characters of living organisms (elementary idea of metabolism, transfer of energy at molecular level, open and closed systems, homoeostasis, growth and reproduction, adaptation, survival, death).

Module -2

Origin and Evolution of life - Theories of Evolution; Evidence of Evolution; Sources of Variations (mutation, recombination, genetic drift, migration, natural selection); Concept of species; Specification and Isolation (geographical and reproductive); Origin of species.

Module -3

Diversity of living organisms, Systematic; Need, history and types of classification (artificial, natural, polygenetic); biosystematics; binomial nomenclature; Two kingdom system, Five kingdom System, their merits and demerits, status of bacteria and virus.

Module -4

Cell as a basic unit of life - discovery of cell, cell theory, cell as a self - contained unit; prokaryotic and eukaryotic cell; unicellular and multicellular organisms;

Module -5

Ultrastructure of prokaryotic and eukaryotic cell - cell wall, cell membrane - unit membrane concept (Fluid-Mosaic model); membrane transport; cellular movement (exocytosis, endocytosis);

Module -6

Cell organelles and their functions- nucleus, mitochondria, plastids, endoplasmic reticulum, Golgi complex, lysosomes, microtubules, centriole, vacuole, cytoskeleton,

Module 7

Cilia and flagella, ribosomes. Molecules of cell; inorganic and organic materials - water, salt, mineral ions, carbohydrates, lipids, amino acids, proteins, vitamins, hormones and steroids.

Text books

1. Molecular biology of the cell by Alberts Bruce, publisher Garland Science

2. Molecular Biology by Friefelder David, Publisher Narosa
3. Introduction to Cell biology by John K Young, World Scientific publishing company
4. Introduction to biology ,3rd tropic edition by D G Maackean
5. A Term wise Text book on biology by VIDYA

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1729	Cell Biology	3 0 1	4

Course Objectives

- To make the student understand all type of cells and cellular components, and how cell works in healthy and diseased states

Learning Outcomes

Students will understand:

- The structures and purposes of basic components of prokaryotic and eukaryotic cells.
- How the cellular components are organized and perform specific functions.
- The cellular components underlying mitotic and meiotic cell division.
- The cellular abnormalities and variations

Module- 1 (11 Hrs)

Overview of Cells; Cell theory; Prokaryotic and Eukaryotic cells; Virus; Viroids; Mycoplasma; Prions

Module- 2 (10 Hrs)

Plasma Membrane: Various models of plasma membrane structure; Transport across membranes: Active and Passive transport, Facilitated Transport; Cell junctions: Tight junctions, Gap junctions, Desmosomes, Hemidesmosomes

Module- 3 (6 Hrs)

Endomembrane System: Structure and Functions of Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Module- 4 (8 Hrs)

Mitochondria: Structure and function, Semi-autonomous nature, Endosymbiotic hypothesis, Chemiosmotic hypothesis, Mitochondrial electron transport chain; Peroxisomes: structure and function.

Module- 5 (10 Hrs)

Cytoskeleton: Structure and Functions: Microtubules, Microfilaments and Intermediate filaments; Nucleus: Structure of Nucleus: Nuclear envelope, nuclear pore complex, Nucleolus, Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)

Module 6

Cell Division and Cell cycle: Mitosis, Meiosis; Regulation of cell cycle

Module- 7 (10 Hrs)

Cell Signalling: Overview of cell signalling, signalling molecules and receptors, GPCR, Second messengers, Role of second messenger (cAMP) in cell signalling, Activation of gene transcription by GPCR

Text Books:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI John Wiley and Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins

Reference Books:

1. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.

2. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San
3. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London

BASKET - 2 **Discipline Core Courses**				
Sl.No.	**Subject Codes**	**Subject**	**Subject Type** **(T - P- Pj)**	**Credits**
DC-1	CUTM1762	Basic Radiation Physics	3 0 1	4
DC-2	CUTM1763	Fundamental Medical Imaging	3 2 0	5
DC-3	CUTM2636	Principles of Radiation Therapy	3 0 1	4
DC-4	CUTM1765	Basic Medical Instrumentation & Technique	3 0 1	4
DC-5	CUTM2637	Applied Radiation Physics & Radiation Protection	3 0 1	4
DC-6	CUTM2638	Radiographic Technique - 1	3 2 0	5
DC-7	CUTM1768	Basic Equipment in Radiotherapy	3 0 1	4
DC-8	CUTM1769	Mammography and Ultrasound	3 0 1	4
DC-9	CUTM2639	Applied Equipment of Radio Diagnosis	3 0 1	4

DC-10	CUTM1772	Radiographic Technique - 2	3	2	0	5
DC-11	CUTM2640	Physics of CT & MRI	3	0	1	4
DC-12	CUTM1774	Interventional Radiology and Drug Diagnostic Radiology	3	2	0	5
DC-13	CUTM2643	CT Protocols	3	0	1	4
DC-14	CUTM2646	MRI Protocols	3	0	1	4
DC-15	CUTM1777	Image Interpretation of X-Ray Mammography, CT & MRI	3	2	0	5
DC-16	CUTM1734	Medical Law and Ethics	2	0	1	3
DC-17	CUTM2649	Basic concepts in clinical sciences	3	0	1	4
DC-18	CUTM1779	Project	NA			18
DC-19	CUTM1780	Internship	NA			18
		Total Credits				**112**

NOTE: Total No.of credits Minimum to be completed is 140 { Basket 1 – 25 Credits + Basket 2 – 95 Credits (Including Internship and Project together 36 Credits) + Basket 3 – 20 Credits}

BASKET – 2

DETAILED

SYLLABUS

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1762	Basic Radiation Physics	3 0 1	4

Module-1

Modern Atomic Physics: Constituents of matters & atomic structure, orbits and orbital, binding energy and mass defect, isotopes, isotones and isobars, electromagnetic and particle radiations.

Module-2

Introduction of X-ray tube : Features of X-ray tube, anode, cathode and filament, characteristics of target materials, cooling system, insulation and tube housing, filters, rating of tubes, faults of X-ray tubes; Interaction of radiation with matter – coherent, Compton, Photoelectric, pair production and photon disintegration.

Module-3

TYPES OF X RAY TUBES & GENERATORS : Gas tube, Hot cathode tube, fixed anode and rotating anode tube, line-focus tube, dual focus tube, Mammography X-ray tube; X-ray generators, power supply: transformers, Half-wave and full-wave rectifications, Exposure timer.

Module-4

Heat radiation, perfect black body, Stefan law, application in Diagnostic Radiology (Heat dissipation in both stationary and rotating X-ray tubes). Beam limiting devices, Absorption co-efficient, grids, cones and filter.

Module-5

Heat Definition of heat, temperature, Heat capacity, specific heat capacity, Heat transferconduction, convection, radiation, thermal conductivity, equation for thermal conductivity (k), the value of k of various material of interest in radiology, thermal expansion, Newton's law of cooling,

Module-6

Physical Principles of X-ray Diagnosis: Radiological images: Photon fluence, Unsharpness, resolution, Contrast, scattered radiation, grids,fluoroscopy. Introduction & Handling of Portable x-ray & Mobile X-Ray machine.

Module-7

Radioactivity: Radioactivity decay, half-life & mean-life, decay series, modes of decay: alpha, beta and gamma radiation, electron capture, internal conversion, isomeric transition, production of radioisotopes.

Production of X-Rays: Discovery and origin of X-rays, Production of X-rays, Nature and properties of Xrays, Radiation safety, Energy spectrum, characteristic radiations & bremsstrahlung radiation, X rays interaction with matter, Absorption, scattering and quality of X-rays, HVT and TVT, Angular distribution

Text books

1. Textbook of Radiological Safety by K. Thalayan, Publisher Jaypee brothers
2. Advance Medical Physic by Rehani, Publisher Jaypee brothers
3. Basic of Radiological Physics by K.Thalayan,Publisher Jaypee brothers

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1763	Fundamental Medical imaging	3 2 0	5

Module -1 :
Photographic aspects in Radiography: Light sensitivity salts of silver; photographic emulsion; Emulsion preparation, Formation of the latent image, x-ray film; construction of X-ray film; characteristics and control; screen films; nonscreen film; dental films; occlusal film; duplicating films; single coated and double coated films;speed of the film; Fogs; types of fogs

Module -2:
Intensifying screens: Fluorescence; application of fluorescence to radiography, construction of an intensifying screen; Intensifying factor; relative speeds of intensifying screen; factor affecting the speed of screens; Mounting, Un-sharpness relative to the speed of the screens, Identification; cleaning and general care of intensifying screens.

Module-3:
X-ray cassette: Basic construction and functional requirements, Types of cassettes, Identifying of cassettes; records necessary for cassettes; general care of cassettes and storage; testing a cassette for light leakage; Testing for film screen contact, Sensitometry: Principles of sensitometry, Characteristic curve; Measurements from the characteristic curve;

Module-4:
The X-ray dark room: Layout plan of a dark room for a small medium and big hospital; Size of darkroom; light proof entrances; cassette hatches, General construction of room to provide light-proofing, Chemical; Radiation; disposition of equipment; loading-bench-design; film hoppers; safe light types; test for safe light; hangers types Care of hangers; ventilation; darkroom illumination and colour schemes; testing safety of illumination; Darkroom procedure

Module-5:
Chemistry of processing: X-ray developers; basic constituents, types of developer for manual processing; automatic processing; rapid theatre processing, fine grain developer development; effects on development of time; temperature agitation developer activity; x-ray fixers; basic constituents and function of fixer; inclusion of hardening and other agents; Fixing

Module-6:
Silver recovery: Methods of silver recovery; economic reasons, Advantages and disadvantages of silver recovery.

Module-7:
Dry camera – Thermal and Laser camera construction, processing , its uses, Heat sensitive film and light sensitive films and companies. Automatic film processor(wet camera) and its construction, processing and uses. Scintillation detectors – scintillation crystal, photo-multiplier tubes, Photo diodes, Photocell, photo-cathode.

Textbooks:
1. Basic Radiologic Physics – K.Thayalan ,
2. Radiographic Imaging – D.N & M O Chesney,
3. Textbook of Radiology for Residents & Technicians (English, Paperback, Bhargava Satish

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM2636	Principles of Radiation Therapy	3 0 1	4

Module-1

Radiation sources of Different Frequencies, Micro wave frequency Generation Reflex Klystron. Magnetrons; Travelling Wave tube. Backward Wave Oscillator

Books: Micro wave Engg by G.S.N.Raju, I.K. International. New Delhi; 2009

Module-2

Radio Therapy Radiation Dose, Measurements- Dosimetric Instruments, quantity of Radio activity, Radiation Sources. Modes of Administration, Gamma Radiations, Tele Therapy. Radio Surgery and treatment planning , Difference between Benign & Malignant tumors.

Books: S.K. Bhargava. Sumeet Bhargava. Text Book of Radiology (CBS Publications-201o)

Module-3

Principles of Treatment. Modes or treatment. Radio Biology, Breast Cancer, Techniques of Artificial Menopause or Ovarian Irradiation. Lung Cancer. Cancer of Lower Pharynx. Larynx and post cricoids, Head and neck Cancer. Tumors of Central nervous systems, Tumors of Eye. Tumors of Kidney, Cancer of Urinary Bladder, Skin Cancer, Carcinoma of the prostate

Books: Text book of Radiology; S. K. Bhargava, Sumeet Bhargava, Text Book of Radiology (CBS Publicatinns-20l6)

Module-4

Radiation protective devices – Lead apron, Thyroid shield, Gonad shield, Lead gloves, Mobile Lead barrier, Lead Glass & Its thickness.

Introduction and brief history - Computed Tomography, Fluoroscopy, mammography. Interventional Radiology, DEXA, Ultrasound, Doppler, Magnetic Resonance imaging, PET CT, PET MRI, Gamma camera.

Text book of Radiology; S.K. Bhargava, Sumeet Bhargava, Text Book of Radiology (CBS Publications.2016)

Module-5

Radiation, Detection and Measurement: Radiation Detection-Types of Detectors Practical Dosimeters, Area of monitoring and personal monitoring Devices

Books: The Physics of Radiology and Imaging, By K Thayalan 2014; Jaypee Brothers Medical Psychology, New Delhi.

Module-6

Nuclear Medicine: Basic atomic and Nuclear Physics. Radioactive Decay, Radioactive Detection Nuclear Medicine Imaging System. Production of Radio Isotopes., Radio nuclide Scanning. Radio nuclide Agents used in PET & Gamma camera. (Technetium -99M)

Books: Hariqbal Singh, Amol Sasane, Roshan Lodha. Text book of Radiology Physics, Health Science Bulletin, Delh1-2016

Module-7

PACS, Teleradiology and DICOM – Introduction, Advantages and How to upload Radiological information into cloud.

Text books:

1. Text book of Radiology; S. K. Bhargava, Sumeet Bhargava, (CBS Publications-2016),
2. Radiological Procedures, A Guide line, Arya Publications,2016

Subject Code	Name of the Subject	T - P- Pj	Credits

CUTM1765	Basic Medical Instrumentation and Techniques	3 0 1	4

Module-1 (9 Hrs.): Biopotential Electrodes and Transducers: -

Introduction, Design of Medical Instruments, Components of the biomedical instrument system, Electrodes, Transducers

Module-2 (9 Hrs.): Biopotential Recorders: -

Introduction, Characteristics of the recording system, Electrocardiography (ECG), Electroencephalography (EEG), Electromyography (EMG), Electroretinography (ERG), Electrooculography (EOG)

Module-3 (7 Hrs.): **Physiological Assist Devices: -**

Introduction, Pacemakers, Pacemaker batteries, Artificial Heart Valves, Defibrillators, Nerve and Muscle Simulators, Heart-Lung Machine, Kidney Machine,

Module 4: (8 Hrs.) Operation Theatre Equipment: -

Introduction, Surgical diathermy, Microwave diathermy, Ultrasonic diathermy, Therapeutic effect of heat, Ventilators, Anesthesia Machine, Blood Flow meters, Cardiac Output Measurements, Blood Gas Analysers, Oximeters,

Module 5: (6Hrs) Specialized Medical Equipment: -

Introduction, Blood Cell Counter, Electron Microscope, Radiation Detectors, Photometers and Colorimeters, Digital Thermometer, Audiometers, Radiography and Fluoroscopy, Angiography,

Module 6: (6 Hrs.) Safety Instrumentation: -

Introduction, Radiation safety instrumentation,
Physiological effects due to 50Hz current passage, Micro shock and Macro shock, Electrical Accidents in Hospitals

Module 7: (14 Hrs.) Advances in Biomedical Instrumentation: -

Introduction, Computers in medicine (Tele-Radiology), Computer Tomography (CT), Thermography, Ultrasonic Imaging Systems, Magnetic Resonance Imaging (MRI),
Biofeedback instrumentation, Biomaterials.

Text books:

1. Biomedical Instrumentation by Dr. M. Arumugam

Reference books:

1. Biomedical Instrumentation and Measurements by L Cromwell, FJ Weibell, EA Pfeiffer
2. Handbook of Biomedical Instrumentation, R S Khandpur, 2003, 1987, Tata McGraw-Hill Publishing Company Limited.

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM2637	Applied Radiation Physics & Radiation Protection	3 0 1	4

Module -1:

National & international regulatory agency Principles, history & development- National & international agencies, AERB, BARC, ICRP, WHO, IAEA and their role.

Module -2:

Planning of diagnostic equipment installation Planning of x-ray equipment installation, layout, design as per regulatory guidelines. 8 Barrier design barrier materials-concrete, brick & lead. Primary & secondary barrier design calculations. Design of doors. protection from primary, secondary radiation Leakage and scattered radiation.

Module -3:

Physical requirements of beam defining devices e.g. cones, diaphragm, collimators etc. Units of radiation measurements specification of quality and half- valve thickness (HLV) and its measurements, filters and filtration. Effects of variation of tube voltage (KV & mAs)

Module -4:

Measurement of radiation and dosimetry procedures. Radiation detectors and their principles of working. Definition of Bragg-peak, percentage depth dose, peak scatter factor, tissue air-ratio, tissue maximum ratio, scatter air ratio, isodose curves and radiation penumbra of different beams.

Module -5:

Wedge filters, wedge angle, hinge angle. Compensator beams flattering filters, scattering foils. Physical properties of phantom materials, bolus and substitutes. Factor used for treatment dose calculations, Daily treatment time and monitor unit's calculation method physical aspects of electron and neutron therapy.

Module -6:

Definition of radiation hazards maximum permissible dose and annual limit of intake (ALI) permissible dose levels on and around sealed source housing and installation principles of radiation protection and MPD of different ICRP rules, stochastic and non-stochastic effects.

Module -7:

Importance of 'ALARA' physical principles of design and planning of installation safe work practice in teletherapy and brachytherapy. Shielding materials Radiation survey (Radiation Protective devices) and personnel monitoring devices film badge, TLD badges pocket dosimeters.

Text books:

1. Advance Medical Physics by Rehani, publisher jaypee brothers
2. Radiation Physics by Faiz M Khan, publisher Lippincott Williams & Wilkins

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM2638	Radiographic technique -1	3 2 0	5

Module -1: Contrast media Ionic monomers, ionic dimers, Non-ionic monomers, Non-ionic dimmers, Barium – its excretion, Mechanism of action, Advantages, Disadvantages, Complications. Enhancement Tissue. Difference between Plain and contrast images.

Module-2: Dental Radiography: Technique for intra oral, Occlusal projections, Extra oral projections including ortho pantomography, CBCT (Cone beam computer tomography), Supplementary techniques

Module-3: Cardiovascular system: Routine projections for heart and vessels, (without the uses of contrast agent), Supplementary views for above.
Upper respiratory system: Technique for post nasal airways, Larynx, Trachea, thoracic inlet, valsalva manoeuvre
Module-4: Skeletal System: Upper Limb, Lower Limb, Shoulder girdle & thorax , Vertebral column, Pelvic girdle and hip region, Pelvic girdle, AP Pelvis, Frog Lateral, AP axial for pelvic outlet, Skeletal survey, Skeletal survey, Skull , Burman and Folio method, ulnar deviation projection, Carpal tunnel view, Ball catcher's view, mortise view Foot- AP,LAT.
Cervical spine - Related radiological anatomy, Basic projection- AP open mouth (C1 and C2) , AP axial, Oblique, Lateral, Erect, Trauma lateral(horizontal beam), Cervicothoracic junction (swimmers view),Special views, Lateral- hyperflexion and hyperextension, AP (fuchs method) or PA (judd method),AP wagging jaw (ottonello method),AP axial (pillars)

Module-5: Lungs and Mediastinum: Technique for routine projections – PA & Lateral, Supplementary projections: Antero-posterior, Obliques, apical projection use of penetrated, postero-anterior projection, Expiration technique, Technique for pleural fluid levels and adhesions.

Module-6: Abdominal viscera: Technique for plain film examination supine & Erect, Technique for plain film examination supine& Erect, Projection for acute abdomen patients for ambulant & non ambulant patients, Decubitus view positioning and benefits, Technique to demonstrate: Foreign bodies, Imperforated anus

Module-7: Radiography using mobile X-ray equipment: Radiography in the ward, Radiography in the specialized unit, such as: Intensive care unit, Intensive care unit, Coronary care, Neonatal unit, Radiography in the operating theatre, What all the precautions for radiation safety

Text books:
1. Radiology of Positioning and Applied Anatomy for Students and Practitioners and Clarks positioning, Felson chest Radiology, Ram mohan

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1768	Basic Equipment in Radiotherapy	3 0 1	4

Module-1

Orthovoltage equipment with special reference to physical design equipment of tube and its accessories and interlocks

Module-2

Gamma ray sources used radiotherapy especially cobalt 60 source its construction and source housing and handling mechanism.

Module-3

Principles of isocentric Tele-isotope machines, megavoltage x-ray and electron beam accelerators and betatron.

Module-4

Salient features of components of Linear Accelerator like tube design, wake guide, target design, beam bending system.

Module-5

Radio-frequency generators like magnetron and klystron. Basic principle of remote after-loading system/machines and sources used.

Practice: - Demonstration, handling and maintenance of Linear Accelerator. Demonstration, handling and maintenance of cyclotron , betatron. Demonstration, handling and maintenance of magnetron , klestron.

Module-6

Principles of simulators and vacuum forming machines for making casts. Sterofoam template cutting system

Module-7

Introduction to radio-surgery. Equipment and dosimetry equipment.

Practice: - Demonstration , handling and maintenance the instruments used in gamma ray production.

Text books

1. Textbook of Radiotherapy by Faiz M Khan
2. Step by Step Management of Chemo and Radiotherapy by Krishan
3. Principle and Practice of Nuclear Medicine and Correlative Medical Imaging by lele

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1769	Mammography and Ultrasound	3 0 1	4

Module-1: Anatomy and Physiology:

a.. Breast Margins b.. Nipple c.. Areola d.. Montgomery"s glands

Internal anatomy - a..Glandular tissue b.. Parenchyma c..Connective tissue d.. Pectoralis muscle

Module-2: Positioning:

Cranio-caudal, Medio-lateral oblique, 90 degree lateral, medio-lateral and latero-medial , Latero- medial oblique, Caudal-cranial, Exaggerated cranial-caudal, Spot compression, Cleavage, Tangential, Axillary tail

Module-3: Professional ethics and patient care:

patient preparation, care of special patient populations: patient concerns, early detection, patient education, visual inspection- areas of interest (perimeter, nipples, lymph nodes);

Module-4: Technical aspects of mammography:

Breast composition; fundamental of image quality; methods of improving image quality, Image receptor, screen//film combination; cathode (purpose, effect on focal spot, orientation), focal spot size; anode/target (purpose, material, anode angle, line focus principle, heel effect); window material, filtration, source-to-image distance; use of grids, magnification; compression (pressure settings, hand versus foot pedal use),

Module-5: Ultrasound

Principle & history of Ultrasound, advantages and disadvantages of ultrasound, Types of Ultrasounds, Equipment description,

Indication and Clinical Application, Physics of ultrasound imaging, Physics of transducers, Physics of Doppler, Ultrasound tissue characterization, Potential for three-dimensional ultrasound, Artifacts in ultrasound, Comparison of ultrasound equipment Computerization of data, Image recording, Ultrasound jelly & Safety of ultrasound

Module-6: Abdomen and pelvis ultrasound & USG Contrast Media

Pathologies and indications, patient preparation, positioning and scanning technique. Types of Ultrasound Contrast media and its advantages

Module-7: Color Doppler imaging, The obstetric Ultrasound examination

Doppler effect, Doppler ultrasound applications; CWD, PWD, Color Doppler Method of gynecologic ultrasound examination, Assessment of Normal fetal growth, fetal behavior states, fetal breathing movements, fetal cardiac activity

Text Books:

1. Basic Radiology Physics –K.Thayalan,
2. Full Field Digital Mammography [Print Replica] Kindle Edition by A. Jain (Author),
3. Step by Step Ultrasound Hardcover – 1 January 2010 by Satish K. Bhargava (Author)

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM2639	Applied Equipment of Radio Diagnosis	3 0 1	4

Course Objectives:-

- ✧ To demonstrate proficiency in performing a wide range of radiographic techniques used in medical imaging.
- ✧ Understand the importance of research in advancing allied health practice.
- ✧ Provide compassionate and comprehensive patient care.

Course Outcomes:-

CO1: To understand different imaging techniques and procedures of X-ray, DEXA, USG and PET scan

CO2: To be able to execute the ingestion of radiological contrast agents, in patients.

CO3: To examine a patient for general radiologic procedures.

CO4: To be able to evaluate contrast media indications and contra indications.

Module-1

Preparation of patients for general radiological procedures: Departmental instruction to out-patients or ward staff, use of aperients enemas and colonic irrigations, Flatulence and flatus causes and methods of relief. Introduction of Contrast media.

Module-2

Principles of catheterization and intubation, pre-medication, its uses and methods. Cardiac catheterization, Coronary angiogram and Angioplasty.

Module-3

DEXA Scan: History of DEXA, Bone mineral density, indications, Preparation of patient, t-score , z-score , osteopenia , osteoporosis , Units of BMD , Standard deviation

Module-4

All Ultrasound and Doppler protocols – USG Neck, Abdomen, chest, Pelvis, Scrotum, Breast, Small parts. (joints, penile Doppler) Doppler – Carotid, Upper limb arterial & venous, Lower limb arterial & venous, Reno-vascular Doppler

Module-5

CT, MRI SCAN-Advancement in CT & MRI, Spiral CT , Preparation opt Patient, Contrast Media, Indication and Contraindication, Technical Aspects of various procedures in CT& MRI, Precautions for Patient & technician at CT & MRI scan

Sialography, Dacrocystography, Sinogram, Fistulogram, patient preparation for FNAC ,Biopsy with its technique

Module-6

Nuclear Medicines -Nuclear medicines, a. Definition, b. Characteristic of Radio Nuclide, c. Commonly used Radio Nuclides, Cobalt -60,

Module-7

PET Scan, Gama camera, SPECT – Principle, construction, Characteristic and Description of Equipment.

Text books: 1. Principle and Practice of Nuclear Medicine and Correlative Medical Imaging by Reference Books: 1. CT Imaging, Satish K Bhargava 2. Atlas of Human Anatomy on CT Imaging by Singh Hariqba

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1772	Radiographic Technique-2	3 2 0	5

Module-1: Preparation of patients for general radiological procedures:

Departmental instructions to out-patients or ward staff; use of aperients, enemas and colonic irrigations, flatulence and flatus; methods of relief; principles of catheterization and intubations, pre medication;

Special conditions & Care: anaesthetised patients nursing, care before and after special x-ray examination, (for example in neurological, vascular and respiratory conditions, Diabetic patient's special attention to food; hazards of trauma

Module-2: Radiological Contrast agents:

General principles Opaque agents and gases, Relationship of x-ray transmission to densityand atomic number of the elements of contrast medium. Types of Barium sulphate solutions, concentration and its particular uses, additional modifications activators, Routes, Dosage, Double contrast

Module-3: Emergencies in the x-ray department and management

Emergency Equipment: Alarm system, oxygen cylinder, face mask, resuscitation set and their use. External defibrillation, internal defibrillation, direct cardiac massage, respiratory arrest, GI Bleed, local anaesthetics; reactions, treatment.

Module-4: Special procedures in diagnostic Radiology: GI Track

Barium meal, Barium swallow, Small bowel enema, Barium enema, double contrast study, perforation during routine procedures, adverse reaction of barium

Module-5: Special procedures in diagnostic Radiology: Renal Tract

Intravenous urography, Retrograde pyelography, Micturating cystourethrography

Module-6: Special procedures in diagnostic Radiology: Biliary system

Plain film radiography, Intravenous cholangiography Percutaneous cholangiography, post-operative cholangiograpy (T-tube Cholangiography)

Module-7: Special procedures in diagnostic Radiology: Gynecology

Hysterosalpingography,Sonosalpingography, 3D- Ultrasonography, Follicular monitoring

Textbooks:

1. Radiological Procedures - A Guideline, Textbook of Radiology for residents and technicians - BHARGAVA S. K

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM2640	Physics of CT & MRI	3 0 1	4

Module-1 :
History and Basic principle of CT scan, EMI- History, System design etc CT Equipment description & Instrumentation CT gantry, patient table, CT computer & image processing system, image display, storage & recording, CT control console, other accessory.
Basic principle of MRI, Proton imaging, Spin, Precession, Larmours equation, Absolute and Relative contraindications, MRI preparation of Patient, MRI Accidents and Patient Counselling in MRI. Patient Transport system and Electrical supply Of MRI, ACR guidelines for Installation Of MRI. Types of MRI.

Module-2:
Physics of CT: Tomography, Tomography moment and types, Types of CT beams, Detectors efficiency and Detector types, Scintillation Detector, Xenon Gas detectors, Collimators Generations of CT, Hounsfield Units, Grey Scale, Pitch, Concept of Windowing, WW, WL, Concept of Voxel, Pixel, Matrix, Tube warm up procedure.

Module-3:
Physics of MRI: Longitudinal and Transverse magnetization, Longitudinal and Transverse relaxation, T1 relaxation, T2 relaxation, T2* relaxation, T1 wt image, T2 wt image, FID, Time to repeat (TR), DWI Time to Echo (TE), Parllel imaging Techniques, Magnetic Transfer. Basics of magnetism, Types of magnetism: Ferromagnetism, Para magnetism, Super para magnetism, Diamagnetism, Superconductivity, strength of external magnet, Tesla unit, Concept of proton unit, Larmour Frequency, Concept of resonance.

Module-4:
RF coils and its types - Surface coil, Volume coils, Phased array coils, Pair Saddle Coil, Helmholtz Pair Coil, Bird, Cage Coil. Gradient coils and its types – Slice encoding gradient, Frequency encoding or read out gradient, Phase encoding gradient Advantages and Disadvnatages. Shimming, Ramping, Quench, Fringe field.

Module-5:
Pulse Sequences - Introduction of spin Echo pulse sequence-conventional, Fast spin echo, Inversion recovery, Gradient pulse sequence Conventional gradient echo, The steady state, Coherent residual transverse magnetization, incoherent gradient pulse sequence, SSFP, EPI – Echo planar imaging , Balanced gradient in detail.

Module-6:
CT & MRI Image Reconstruction: Image Reconstruction, Back projection, Filter Back projection, Iterative method, Analytical method, CTNumber, Storage - Floppy, hard disc, magnetic tape, optical disc, DICOM, Tele radiology. Fourier transformation, Half-Fourier. K – Space in MRI. Image manipulation & Post processing in CT & MRI : Introduction, clinical use, advantages, disadvantages of MPR, MIP, SSD, CPR, VR, Scanning parameters.

Module -7:
MRI Artifacts: Introduction, Ghost or Motion artifacts, aliasing artifact, chemical shift artifacts, chemical misregistration artifact, truncation artifact, magnetic susceptibility artifact, zipper artifact, shading, cross excitation or cross talk artifacts – Definition, Reasons, Corrective measures, Image interpretation of Artifacts. CT Artefacts: Definition, manifestation & Remedy Motion artefact, metal artefact, out of field artefact, beam hardening artefact, partial volume averaging artefact, ring artefact, pitch artefact, stair step artefact indetail.

Text Books:

1. Christensen's Physics of Diagnostic Radiology, Basic Radiological Physics-K.Thayalan

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1774	Interventional Radiology& Drugs used in Diagnostic Radiology	3 0 1	4

Module-1: Equipment:

Need for interventional procedures, Informed consent, patient care, patient preparation, Patient monitoring, role of technologist in interventional procedure, method of administration of contraindication, contrast reaction management, emergency crash cart.

Equipment in Cath lab units; C-Arm , Digital Subtraction Angiographic Units, Pressure Injectors, Contrast media, Introduction to Stents, Endoscopes , pacemakers

Module -2: Access, Equipments used in Access

Arterial and Venous access (Femoral approach , Arm approach), Equipment and Instruments used for access (Catheters, Guide wires, Dilators, Balloons) Seldinger technique. Single and biplane angiographic equipment, Angiographic Table, Image intensifier, Flat panel detector, electromechanical injectors,

Module-3: Medications & Safety in Cath Lab:

Preparations, Contraindications , Risks and medication, Environmental safety and sterilization in cath lab

Module-4: Angiography:

Coronary angiography, Peripheral angiography, Carotid angiography, Renal angiography, Cerebral angiography,Selective Aortography, Catheter Embolization, CT Angiography, MR Angiography, Vertebroplasty

Module-5: Biopsy & Special Procedures:

CT Guided Biopsy, MR Guided Biopsy, US Guided Biopsy, Endovenous Ablation of Varicose veins, Trans jugular Intrahepatic Portosystemic Shunts, Introduction to Vascular Ultrasound **Module-6: Anaesthesia in Diagnostic Radiology**

Facilities regarding general Anesthesia in the X-ray Department. regional and local anaesthesia and its types, sedation and its types, cryoablation

Module-7

Anesthetic Problems associated with specific technique-

a. Vascular Studies, **b.** Venography, **d.** NMR

Textbooks:

1. Radiological Procedures - A Guideline, Textbook of Radiology for residents and technicians - BHARGAVA S. K

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM2643	CT protocols	**3 0 1**	**4**

Module-1 : NCCT & CECT Brain, Face, Sinuses, Mastoid - Indications. Contraindications, Patient preparation, Parameters, Protocols, Filming and patient care.Emergency drugs used in CT scan. Bone window, soft tissue window images.

Module-2: NCCT & CECT Pituitary, Neck - Indications. Contraindications, Patient preparation, Parameters, Protocols, Filming and patient care. Perfusion study.

Module-3: NCCT & CECT Abdomen and pelvis - Indications. Contraindications, Patient preparation, Parameters, Protocols, Filming and patient care. Triple phase, Dual phase and its procedure. Smart prep or ROI and Bolus Triggering. Colonoscopy and Urography in CT.

Module-4: CT – Chest protocols , Coronary angiography & its technique Indications. Contraindications, Patient preparation, Parameters, Protocols, Filming and patient care and Calcium scoring, Cardiac gating, Types of Gating & its image reconstruction & Bronchoscopy.

Module-5: CT – Upper extremities protocols - Indications. Contraindications, Patient preparation, Parameters, Protocols, Filming and patient care.

Module-6: CT – Lower extremities protocols - Indications. Contraindications, Patient preparation, Parameters, Protocols, Filming and patient care.

Module -7: CT - Angiography & its technique Cerebral angiography carotid angiography Pulmonary angiography Abdominal angiography Renal angiography Peripheral angiography - Indications. Contraindications, Patient preparation, Parameters, Protocols, Filming and patient care.

Text Books

1. CT scan (step by step) by Karthikeyan & Chegu, Publisher Anshan Ltd; 1 Min Pap/ edition
2. Atlas of Human anatomy on CT imaging by Singh Hariqbal, Khandelwal Anubhav, Kachewar Sushil, Publisher jaypee

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM2646	**MRI Protocols**	3 0 1	4

Module-1: MRI Brain plain, contrast, Epilepsy protocol, Orbits protocol, DBS protocol, Indications, Contraindications, preparation, Sequences, Planning, Parameters of different sequences and Window period.

Module-2: Advanced MRI techniques: MR Angiography, venography(TOF, phase contrast and dynamic contrast MR angiography), Functional MRI, MR Spectroscopy, Recent advancement in MRI and open MRI, MRCP, DWI, SWI, perfusion etc.

Module-3: MRI spine imaging – C spine, D spine, L spine, DL spine, CD spine, Whole spine Protocol Indications, Contraindications, preparation, Sequences, Planning, Parameters of different sequences

Module-4: MRI joint imaging – Shoulder, Hand with wrist, Knee joint, Ankle , foot, Hip joint Indications, Contraindications, preparation, Sequences, Planning, Parameters of different sequences

Module-5: MR abdomen & pelvis imaging – MRCP, Enterography, Fistulogram, prostate, Cervix, Uterus imaging Indications, Contraindications, preparation, Sequences, Planning, Parameters of different sequences.

Module-6: Soft tissue imaging: MR Breast ,MR Cardiac , Neck, Tongue, Muscular imaging Indications, Contraindications, preparation, Sequences, Planning, Parameters of different sequences indetail

Module -7: MRI report format, data analysis, precaution for MRI film, counseling with patients and attendants. Coordination with Radiologist and team workers during MRI

Text Books

1. Cross Sectional Anatomy CT and MRI by chavhan, publisher Jaypee Brothers Medical Publishers; first edition

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1777	Image Interpretation of X-Ray Mammography, CT & MRI	3 2 0	5

Module-1: Review of Anatomy & Skeletal System:

General anatomical terminology, surface anatomy, surface landmarks and topography in relation to the organs of the body for radiographic positioning, positioning terms, Anatomical terminology with regard to location.
All major bones and joints of skeleton i.e. extremities, skull, thorax and vertebral column and pathologies/diseases related to them and their radiographic appearance

Module-2: Heart and blood vessels & Respiratory System:

Structure, Function, Blood circulation and Purification, Blood supply to heart, major vessels of circulatory system and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it.
Nasal passage, Accessory nasal sinuses, Pharynx, Larynx, Trachea, Bronchus, Lungs, Pleura, the Blood supply to organs, Nature and function of respiration and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it.

Module-3: Alimentary System:

Function of mouth, tongue, teeth, salivary glands, pharynx and oesophagus, smooth muscle, small intestine, large intestine, liver and biliary tract, pancreas, digestion and absorption of food, metabolism and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it.

Module-4 : Urinary Tract:

Kidneys, Ureters, Bladder, urethra, Urinary secretion and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it.

Module-5:Reproductive System: Male and Female genitalia, Mammary glands, Menstruation, Pregnancy, Lactation and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it.

Module-6: Endocrine System & Nervous Systems

Anatomical location of pituitary, thyroid, parathyroid, adrenal, thymus, pancreas, gonads and their function and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it.
Main subdivision, lobes of ventricles of brain, spinal cord, meninges and CSF and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it.

Module-7: Breast Imaging & Skill Development:

Normal, SOL, PreOp, Post Op

Deciding on quality of radiograph, Methods of troubleshooting for Image Quality Improvement, Recognizing and demarking bones and organs on a radiograph, Ability to detect major pathological changes and abnormalities Image Appreciation

TEXT BOOKS:

1. Radiology & Imaging for students & Practitioners – Gupta & Gupta
2. Radiology Interpretation Made Easy-G.Balachandiran

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM1734	**Medical Law and Ethics**	**2 0 1**	**3**

Module-1

1. The Indian medical council act, 2. Medical council of India (functions),3. Functions of state medical councils, 4. The declaration of Geneva

Module-2

1. Duties of medical practioners 2. Regarding red cross emblem 3. Professional secrecy 4. Privileged communication.

Module-3

1. Professional negligence 2. Medical mal occurrence 3. Contributory negligence 4. Criminal negligence

Module-4

1. Corporate negligence 2. Ethical negligence 3. Precautions against negligence 4. difference between professional negligence and infamous conduct.

Module-5

1. Malpractice litigation involving various specialities 2. Prevention of medical negligence 3.supreme court of India guidelines on medical negligence 3. The therapeutic misadventure
4. Vicarious liability

Module-6

1. Products liability 2. medical indemnity insurance 3. Medical records 4. Consent in medical practice

Module-7

1. Euthenesia 2. Deaths due to medical care 3. Malingering

Text books

1. Medical Law and Ethics by Shaun D Pattinson, 5th edition, 2017.

Subject Code	Name of the Subject	T - P- Pj	Credits
CUTM2649	Basic concepts in clinical sciences	3 0 1	4

Module 1: General Microbiology
Introduction and History of microbiology, Disinfection and antiseptics, Sterilization and asepsis, hospital acquired infections, Allergy and Hyper sensitivity related to radiological techniques.

Module 2: General Pathology:
Introduction to Pathology, Concept of Diseases, Acute and Chronic Inflammation, Necrosis, Apoptosis, Neoplasia, gangrene, Haemorrhage, shock, embolism and thrombosis. Atherosclerosis

Module 3: General Pharmacology
Introduction, Routes of Drug Administration, Pharmacokinetics, Pharmacodynamics, , All Emergency drugs used in Radiology procedures. Cardio Pulmonary Resuscitation (CPR) & Basic Life support (BLS).

Module 4: Cardiovascular disorders
1. Pericarditis, 2. Valvular heart diseases 3.RHD 4. Heart failure for each disease etiology, clinical features, diagnosis, treatment.

Module 5: Respiratory disorders
1. Chronic bronchitis, 2. Emphysema, 3. Pneumonia, 4. Tuberculosis, 5. Pulmonary effusion, 6. Spontaneous pneumothorax.

Module 6 : Renal & CNS disorders
1. Glomerulonephritis 2. Nephrotic syndrome 3. Urinary caliculus 4. Poly cystic kidney disease. 5. Cerebrovascular disorders 6. Meningitis 7. Encephalitis

Module 7: Orthopaedics
1. Fracture classification 2. Fracture Healing, Delayed Union, Non union and mal union 3. Shoulder dislocation 4. Fracture Humerus, Fracture radius 5. Fracture ulna 6. Injuries of the carpal 7. Hip dislocation 8. Fracture neck of Femur, Fracture shaft of Tibia, Calcaneal spur 9. Osteoarthritis 10. Spondylitis 11. CTEV

Text Books

1. Textbook of Microbiology by Ananthanarayan & Panicker's, 8th edition-Universities Press (India) PVT LTD.
2. Textbook of Microbiology by C. P. Baveja, 4th edition, Arya Publications.
3. Textbook of Pathology by Harshmohan, 7th edition
4. Textbook of Medicine, Krishna Das
5. Essentials of clinical medicine, Kathale.

INTERNSHIP THESIS GUIDELINE

This Guideline is designed to provide students the knowledge and practice of public health research activity, to enable them to carry out researches and solve research related problems and to help them in writing thesis and defend their work. Upon successful completion of the course, the students shall be able to:

1. Search relevant scientific literature
2. Develop a research proposal
3. Employ appropriate data collection techniques and tools
4. Manage collected data
5. Analyze data with appropriate statistical techniques
6. Write thesis
7. Defend the findings

Proposal Development:

At the ending of third year (Sixth Semester), students individually consultation with designated faculties and extensive literature survey will develop research proposal during the initial 6 months period.

Data Collection/ Thesis Writing:

Students will carry out data collection, data management, data analysis, and thesis writing during the remaining period (Six Semester).

The Dissertation should have following format:

1. Title
2. Introduction
3. Materials and Methods
4. Results
5. Discussion
6. Conclusion
7. Recommendation
8. References
9. Appendix

Subject Code	Name of the Subject	Credits
CUTM1779	**Project**	**18**

Project work: -

Suggested Project title

1. A survey of radiation protection awareness in non-radiation workers.
2. An evaluation of accuracy of ultrasound in the detection of Hepatitis.
3. An assessment of depression among practicing radiographers in Andhra Pradesh.
4. Evaluation of radiation, protection, measure for female patients of child bearing age using many medical colleges in Andhra Pradesh as case study.

Subject Code	Name of the Subject	Credits
CUTM1780	**Internship**	**18**

Internship

1. Case record
2. Lab management and ethics
3. Evaluation -Guide(internal) -Industries guide(external)-University-project report/ Viva