CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT,ODISHA

SCHOOL OF PARAMEDICS & ALLIED HEALTH SCIENCES

Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

BACHELORE OF SCIENCE IN MEDICAL RADIATION TECHNOLOGY

2021

SYLLABUS

BACHELOR OF SCIENCE IN MEDICAL RADIATION TECHNOLOGY
Programme Structure

BASKET 1	BASKET 2	BASKET 3	BASKET 4	
School Core Courses	**Discipline Core Courses**	**Ability Enhancement Compulsory Courses (AECC)** To be selected from University Basket	**Skill Courses** (To be selected from University Basket)	
SC-1 SC-2 SC-3 SC-4	DC-1 DC-2 DC-3 DC-4 DC-5 DC-6 DC-7 DC-8 DC-9 DC-10 DC-11 DC-12 DC-13 DC-14 DC-15 DC-16 DC-17 DC-18 DC-19 DC-20 DC-21	AECC-I AECC-II	SFS-1 SFS-2 SFS-3 SFS-4 SFS-5	**TOTAL CREDITS**
19 Credits	**95 Credits**	**6 Credits**	**20 Credits**	**140 Credits** (Minimum Credits Required)

BASKET I
School Core Courses

Sl. No.	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
	CUTM1760	Biology		
SC-4	CUTM1729	Cell Biology	3+0+1	4
	CUTM1761	Mathematics		
		TOTAL CREDITS		**19**

BASKET II

Discipline Core Courses

Sl. No.	CODE	SUBJECT	SUBJECT TYPE (T+P+Pj)	CREDITS
DC-1	CUTM1762	Basic Radiation Physics	3+0+1	4
DC-2	CUTM1763	Fundamental Medical Imaging	4+2+0	6
DC-3	CUTM1764	Principles of Radiation Therapy	3+0+1	4
DC-4	CUTM1765	Basic Medical Instrumentation & Technique	3+0+1	4
DC-5	CUTM1766	Applied Radiation Physics & Radiation Protection	3+0+1	4
DC-6	CUTM1767	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	CUTM1770	Applied Equipment of Radio Diagnosis	3+0+1	4
DC-10	CUTM1771	Radiotherapy and Brachy Therapy in Malignant & Non-malignant Disease	3+0+1	4
DC-11	CUTM1772	Radiographic Technique – 2	3+2+0	5
DC-12	CUTM1773	Physics of CT & MRI	3+0+1	4
DC-13	CUTM1774	Interventional Radiology and Drug Diagnostic Radiology	3+2+0	5
DC-14	CUTM1775	Computerized Tomography (CT Scanning)Method & Procedure	3+0+1	4
DC-15	CUTM1776	Basic of Magnetic Resonance Imaging	3+0+1	4
DC-16	CUTM1777	Image Interpretation of X-Ray Mammography, CT & MRI	3+2+0	5
DC-17	CUTM1734	Medical Law and Ethics	2+0+1	3
DC-18	CUTM1778	Orientation in Clinical Sciences Course Contents	3+0+1	4
DC-19	CUTM1742	Basic Computer andInformation Science	0+2+0	2
DC-20	CUTM1779	Project	NA	18
DC-21	CUTM1780	Internship	NA	18

NOTE: Along with the School core and Disciple core subjects, the students need to opt for AECC Courses, Skill/ Domain/ Elective courses and value- added courses from the University Basket, as per the norms of the University.

Basket-1 School Core Courses

General Anatomy

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

Course Objectives:

- To obtain Knowledge about the general anatomy – the structure of different organs and positionof 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

Course outcome:

- 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

Introduction to Anatomy: Sub division of anatomy, terms and terminology, systems of the Body. Skeleton: **Bones:** function of bones, classification of bones, parts of young bone, development of bone, ossification of bones, blood supply bone, cartilage, clinical anatomy

Module –2 MUSCLES &JOINTS

Muscle: types of muscles, structure of striated muscle, naming of muscle, fascicular architecture of muscle, actions of muscle, nerve supply.

Joints: Classification, structures of joints, movements, mechanism of lubrication, biomechanics, levers, blood supply, nerve supply, and applied anatomy.

Practice: - Identification of different joints and bones from Charts and Human Skeleton.

Module -3 CIRCULATOTY SYSTEM, LYMPHATIC SYSTEM & SKIN

Circulatory system: Types of circulation of blood, arteries, veins, capillaries, end arteries, applied aspect.

Lymphatic system : components, lymph nodes, clinical anatomy

Skin: structure of skin, superficial facia, deep facia, clinical aspects

Module -4 UPPER LIMB &LOWER LIMB

(A) Upper extremity: Bony architecture Joints–structure, range of movement Muscles–origin,insertion, actions, nerve supply Major nerves – course, branches and implications of nerve injuries Development of limb bones, muscles and anomalies Radiographic identification of bone and joints Applied anatomy

(B) Lower extremity: Bony architecture Joints – structure, range of movement Muscles – origin, insertion, actions, nerve supply Major nerves – course, branches and implications of nerve injuries Development of limb bones, muscles and anomalies Radiographic identification of bone and joints Applied anatomy

Module -5 THORAX, ABDOMEN & BACK MUSCLES

Thorax: skeleton of thorax, intercoastal spaces, pleura, lung, mediastinum, heart: morphology, blood supply, interior of heart, general information about upper respiratory tract (trachea, esophagus, pharynx and larynx) clinical anatomy.

Abdomen: Anterior and posterior abdominal wall, general information about viscera: stomach, liver, pancreas, duodenum, kidney, ureter, urinary bladder, uterus and its adenexa.

Practice: -identification of structure, position, and different parts of Lungs, Heart, Kidney from charts, Models.

Back muscles: Superficial layer, Deep muscles of back, their origin, insertion, action and nerve supply. Vertebral column – Structure & Development, Structure & Joints of vertebra Thoracic cage Radiographic identification of bone and joints. Applied anatomy

Practice: - Radiography identification of different architecture joins, structure and position of Bonesfrom Skeleton, Model or PPT.

Module -6 NERVOUS SYSTEM & SPECIAL SENSE ORGANS

Nervous system: parts of nervous system, neurons, peripheral nerves, spinal nerves, summary of cranial nerves, parasympathetic nervous system.

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

Module -7 HEAD AND NECK & CENTRAL NERVOUS SYSTEM

Head and neck: scalp, facial muscles, cranial skeleton , triangles of neck, parotid region, temparomandibular joint, muscles of mastication, applied.

Central nervous system: General idea aboutspinal cord, brainstem, cerebrum, cerebellum, ventricular system, diencephalon, blood supply of brain and its applied, meninges and cerebrospinal fluid.

Practice: -Identification of structure and different parts of Central nervous system from chart.

Identification of different blood supply in brain from PPT.

Demonstration of dissected parts (upper extremity, lower extremity, thoracic & abdominal viscera,face and brain).

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, faceand 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 ofthe limbs and arteries of limbs.
6. Surface anatomy: Surface land mark-bony, muscular and ligamentous. Surface anatomy of majornerves, 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

General Physiology

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

Course Objectives:

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

Course outcome:

- Can acquire knowledge about the general physiological systems and physiological terminology.
- Thestudent get femiliarize with the functionality of different physiological systems
- One can technically identifythe 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 ofvarious 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.

Practice: - Examination of pulse, B.P, Respiratory rate, Heartbeat, impulses etc. Identification of different artery and Venous supply from chart or PPT.

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– pathwaysand 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.

Basic Biochemistry

Subject Code	Name of the Subject	T - Pr- 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.

Course outcome:

- 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
- Understand the fundamental chemical principles that govern complex biologicalsystems

Module-1

Enzymes - Introduction, definition, classification, coenzymes, isoenzymes, properties, factors affecting enzyme action, enzyme inhibition, diagnostic value of serum enzymes - Creatinine kinase, Alkaline phosphatase, Acid phosphatase, LDH, SGOT, SGPT, Amylase, Lipase, Carbonic anhydrase etc.

Module-2

Chemistry of carbohydrates & their related metabolism - Introduction, definition, classification,biomedical importance & properties.

Module-3

Brief outline of metabolism: Glycogenesis & glycogenolysis (in brief), Glycolysis, citric acid cycle &its significance, HMP shunt & Gluconeogenesis (in brief), regulation of blood glucose level.

Module-4

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

Module-5

Metabolism: Transformation, Decarboxylation, Ammonia formation & transport, Urea cycle, metabolic disorders in urea cycle, catabolism of amino acids especially Phenylalanine, Tyrosine & Tryptophan, Creatine, Creatinine, Proteinuria.

Module-6

Chemistry of Lipids & their related metabolism - Introduction, definition, classification, biomedical importance, essential fatty acids. Brief out line of metabolism: Beta oxidation of fatty acids, fatty liver, Ketosis, Cholesterol & it's clinical significance, Lipoproteins in the blood composition & their functions in brief, Atherosclerosis.

Module-7

Diabetes mellitus - definition, types, features, gestation diabetes mellitus, glucose tolerance test,glycosuria, Hypoglycemia & its causes

Biochemistry practical

Quantitative exercises:

- Detection of abnormal constituents in urine, sugar, proteins, ketones, blood and bilesalts Bens Jones protein.

  Phlebotomy equipments
- Identification of Blood Collection Tubes & Centrifugal Separation of Blood Plasmaand 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.

Biology

Subject Code	Name of the Subject	T - Pr- Pj	Credits
CUTM1760	**Biology**	3 01	**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

Course outcome:

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

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

MATHEMATICS

Subject Name	Code	Type of course	T+P+Pj	Credits
MATHEMATICS	CUTM1761	Theory	**3+0+1**	4

Objectives

- To understand the concepts matrices, progressions, trigonometry, two-dimensionalgeometry and calculus.
- To solve linear equations representing physical systems.
- To understand the importance of calculus and their applications.

Course outcome

- To represent linear systems by matrices and solve them for unknown variables.
- To evaluate nth terms, trigonometric ratios, locus and to solve differential equations.

Module I: MATRICES

Introduction, types of matrices, Scalar multiple of a matrix and multiplication of matrices, Transpose of a matrix, Determinants,

Module II

Adjoint of a matrix, Inverse, Application of determinants to solve simultaneous equations (Cramer'sRule)

Module III: ARITHMETIC AND GEOMETRIC PROGRESSION:

Introduction, Arithmetic Progression, Sum of n terms of an arithmetic progression, Geometric Progression, Sum of n terms of Geometric Progression.

Module IV: TRIGONOMETRY

Introduction, Trigonometric ratios and the relations, Trigonometric ratios of compound angles, (Sin (A+B), Cos (A+B), Tan (A+B) formulae only), Trigonometric ratios of multiple angle (Sin 2A, cos2A, tan 2A), Heights and distances.

Module V: CO –ORDINATE GEOMETRY

Distances between points-Area of a triangle, Co-ordinates of a point dividing a given segment in a given ratio – locus -equation to a straight line in different forms-Angle between straight lines-point of intersection.

Module VI: DIFFERENTIAL CALCULUS

Simple concepts of functions, limits, Continuity and Differentiation, Differentiation, First order derivatives of elementary functions.

Module VII: INTGRAL CALCULUS Indefinite integrals, Integration as on inverse process of differentiation, integration by substitution, integration by parts, integration of algebraic function. Definite integrals.

Differential equations: Formation of a differential equation, order and degree, solution of first order differential equations (Variables separable method).

Projects: Matrices Trigonometry, co-ordinate Geometry

TEXT BOOKS

- Intermediate first- and second-year mathematics by Telugu Akademi, A. P State in Institute of Telugu language, Hyderabad.
- Higher Engineering Mathematics by DR. B. S. Grewal. 44th Editi

Cell Biology

Subject Name	Code	Type of course	T-P-Pj	Prerequisite
Cell Biology	CUTM1729	Theory+ Project	3-0-1	Fundamental Science

Objective

- Determine the parts of the cell membrane and the cell wall
- Distinguish the types and mechanism of mutation
- Compare and contrast the events of cell cycle and its regulation
- Understand the dynamic character of cellular organelles

Course outcome

- Describe the fundamental principals cellular biology
- Develop a deeper understanding of cell structure and how it relates to cellfunctions.
- Understand how cells grow, divide, and die and how these important processes areregulated.
- Understand cell signaling and how it regulates cellular functions. Also how its dis-regulation leads to cancer and other diseases.

Course Outline Module –I (12 Hr)

An Overview of Cells: History, Cell theory, Structure and Function of Cell and its Organelles: Biological membranes - Nucleus - Nuclear envelope, Nucleolus, Mitochondria, Chloroplasts, Lysosomes, Gloxysomes and Peroxisomes, endoplasmic reticulum, ribosomes, Golgi complex (Structural organization, function, marker enzymes of the above organelles), Cell types: prokaryotes vs.

eukaryotes; from single cell to multi-cellular organism; Different molecules of cell- water, salt and mineral ions etc.

Module- II (14 Hr)

Cell cycle and its regulation, Cellular communication and cell mobility: Cell cycle: G0/G1, S, G2 and M phages (Cell Division: Mitosis, meiosis and cytokinesis); regulation of cell cycle; cell adhesion and roles of different adhesion molecules, gap junctions, Extra- Cellular Matrix (ECM), Cell-cell interaction and cell-ECM interaction, The cytoskeleton, Microtubule- based movement and microfilament -based movement.

Module-III (14 Hr)

Cell signaling, Programmed Cell Death (Apoptosis) and Cancer: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors (G-PCR), Tyrosine Kinase, signal transduction

pathways, second messengers, regulation of signaling pathways, bacterial and plant two- component systems, bacterial chemotaxis, Intrinsic and Extrinsic apoptotic pathway, Caspase enzyme, Biology and elementary knowledge of development and causes of cancer; Tumor viruses, Oncogenes and tumor suppressor genes.

Suggested Readings:

5. The Cell a Molecular Approach (4th Edition) by Cooper & Hausman https://www.thebiomics.com/books/cell-biology/cell-molecular-approach-cooper-and-hausmn- 4th-ed.html

6. Molecular Biology by Friefelder David, Publisher Narosa www.alibris.com/Molecular-Biology-David

7. Introduction to Cell biology by John K Young, World Scientific publishing company www.overdrive.com/.../introduction-to-cell-biology

8. Introduction to biology,3rd tropic edition by D G Maackean www.amazon.com/Introduction-Biology-D-G-Mackean/.

BASKET – 2 DETAILED SYLLABUS

Basic Radiation Physics

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

Course Objectives:

- At the end of the course, the student should be able to comprehend the following:
  1. Production of x rays
  2. Quality and quantity of radiation and its application in radiology
  3. Application of radiation in Imaging technology
  4. Factors affecting the image quality.

Course outcome:

- Through practical demonstrations, assignments, orals, presentations, practical examination byexternal faculty.
- Proper use of radiation monitoring devices.
- Performance of different techniques with minimal exposure.

Module-1

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

Module-2

X- ray tube and Generators: 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;

Module-3

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, timer.

Module-4

Heat radiation, perfect black body, Stefan law, application in Diagnostic Radiology (Heat dissipation in both stationary and rotating X-ray tubes).

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. 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 X-rays, Energy spectrum, characteristic radiations, 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

Fundamental Medical imaging

Subject Code	Name of the Subject	(T - Pr-Pj)	Credits
CUTM1763	**Fundamental Medical imaging**	**420**	**6**

Course Objectives:

To enable the students to understand image processing & dark room techniques.Should be able to

- Select the cassette size
- Insert image plate for processing
- Taking the images & doing post-processing

Course outcome

Through practical demonstrations, assignments, orals, presentations, practical examination by Fundamentals of Medical Image Processing Page 2 of 5external

faculty.

Students perform listed tasks under the guidance of hospital supervisors

- Read the requisition slip
- Make entries in the register
- Understand the quality of the film
- Practice film processing

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; non-screen film; dental films; occlusal film; duplicating films; single coated and double coated films;speed of the film; antia abrasive supercoating; Base material; substratum; coating; emulsion, 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 developerdevelopment; effects on development of time; temperatureagitationdeveloper 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

Module-7: LASER Printer:

Introduction, work and function of LASER Printer, LASER characteristics day light films, dry film and wet film processing steps, Scintillation detectors – scintillation crystal, photomultiplier tubes, Photo diodes, Photocell, photocathode.

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 K

Principles of Radiation Therapy

Subject Code	Name of the Subject	(T - Pr-P	Credits
CUTM1764	Principles of Radiation Therapy	3 0	4

Course Objectives:

- Radiotherapy technology is one of the treatment lines for cancer.
- The process involves the deposition of energy in the targeted cells through ionizing radiationcausing destruction of the cells and ceasing their growth.

Course outcome:

- Students will learn with Radiotherapy that can be used as a primary treatment option for cancerbefore surgery to shrink cancerous tumors.
- It can also be used after surgery to stop the growth of any remaining cancer cells or incombination treatment with chemotherapy or to alleviate symptoms caused by cancer.

Module-1

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

Books:Micro wave Enggby 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 Books: S.K. Bhargava. Sumeet Bhargava.Text Book of Radiology (CBS Publications-2016)

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, Cancerof 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

Generation and properties of X-Rays; Production of X-Rays. Characteristics of Radiation, X-Ray Tube.Basic circuit or X-Ray Generation, Tube Rating Charts, Types of tubes.

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, personal monitoring Cyclotron

Module-6

Nuclear Medicine: Basic atomic and Nuclear Physics. Radioactive Decay, Radioactive Detection Nuclear Medicine Imaging System. Production of Radio Isotopes. Technetium -99M.Radio nuclide Scanning. Radio nuclide Agents used in Neuro Imaging

Books: Hariqbal Singh, Amol Sasane, Roshan Lodha. Text book of Radiology Physics, Health Science Bulletin, Delh1-20 16

Module-7

Radiation Dosimetry: OSLD; Biological Dosimetry; Chemical Dosimetry. Dose Estimation, Computed Tomography Fluoroscopy, mammography.Interventional Radiology,Angiography, Catheters, Stents, Embolus Therapy.

Text books:

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

Basic Medical Instrumentation and Techniques

Subject Code	Name of the Subject	(T - Pr-P	Credits
CUTM1765	Basic Medical Instrumentation and Techniques	3 0	4

Course Objects:

- To obtain Knowledge about the basic electronic sensor systems.
- To familiarize the student with the construction, working, and principles Biomedicalinstrumentation systems.
- To develop the technical skills in handlingBiopotential records and advanced Medicalinstrumentation.

Course outcome:

- Can acquire knowledge about the basic electronic sensor systems.
- One can technically know the functionality of the Biopotential records and advanced Medical instrumentation to work with the patient in real-time.

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, Cryogenic Surgery, 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

Applied Radiation Physics & Radiation Protection

Subject Code	Name of the Subject	(T - Pr-Pj)	Credits
CUTM1766	Applied Radiation Physics & Radiation Protection	3 0	4

Course Objective:

- To understand the importance of the X Rays in medical field.

- To study the application of radiotheraphy sources.
- To develop an understanding of radiation measurements.
- To understand how to follow radiation protection rules.
- To study the physical properties and application of x- ray machine techniques.

Course outcome

- Know what it takes a career in physics in X – ray techniques.
- Understand the need to increase physics in radiology
- Know the radiation protection rules and measurements.
- Know the application of physical parts in x- ray machines.

RADIATION PHYSICS

Module -1

Effects of variation of tube voltage current, filtration, III waveform and target material on X-ray production lows of radioactivity and decay schemes of different alpha, Beta, gamma ray.

Module -2

Megatron and position emitters as used in medicine especially in radiotherapy. Artificial radionuclide generators employed in medicine in general and radiotherapy sources in particulars.

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.

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.

RADIATION PROTECTION

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 practicein teletherapy and brachytherapy. Shielding materials Radiation survey 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

Radiographic technique -1

Subject Code	Name of the Subject	(T - Pr-Pj)	Credits
CUTM1767	**Radiographic technique -1**	**320**	**5**

Course Objectives

To enable the students to understand different imaging techniques & procedures & to take X - rays of optimum quality as required by the radiologist.Should be able to

- Develop/process x-ray film
- Change the position of the tube
- Give instructions to the patient
- Select the cassette size
- Insert image plate for processing
- Taking the images & do the post-processing
- Perform radiology procedures

Course outcome:

Through practical demonstrations, assignments, orals, presentations, practical examination byexternal faculty.

Students perform listed tasks under the guidance of hospital supervisors

- Read the requisition slip
- Make entries in the register
- Position the tube
- Give instructions to the patient
- Assist radiologist in various procedures

Module -1: Skeletal System:

Upper Limb, Lower Limb, Shoulder girdle &thorax ,Vertebral column, Pelvic girdle and hip region, Skeletal survey, Skeletal survey, Skull

Module-2: Dental Radiography:

Technique for intra oral, Occlusal projections, Extra oral projections including ortho pantomography, Supplementary techniques

Module-3: Cardiovascular system:

Routine projections for heart and vessels, (without the uses of contrast agent), Supplementary views forabove.

Module-4: Upper respiratory system:

Technique for post nasal airways, Larynx, Trachea, thoracic inlet, valsalvamanoeuvre

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 supire& Erect, Technique for plain film examination supire& Erect, Projection for acute abdomen patients for ambulant & non ambulant patients, Decubitus viewpositioning 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

Basic Equipment in Radiotherapy

Subject Code	Name of the Subject	(T - Pr-Pj)	Credits
CUTM1768	**Basic Equipment in Radiotherapy**	**3 0 1**	**4**

Course Objective

- To understand the importance of the X Rays in medical field.
- To study the application of radiotheraphy sources.
- To develop an understanding of radiation measurements & dosimetry .
- To understand how to follow radiation protection rules.
- To study the physical properties and application of Cobalt 60, Orthovoltage, Linear Accelerator. etc

COURSE OUTCOME

- Able to explain working principle & application of Orthovoltage
- Importance of cobalt 60 magnetron and klystron in radiotherapy
- Use & handle the radiotherapy equipment's like magnetron and klystron,
- Handling and maintenance of Linear Accelerator.

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, klystron.

Module-6

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

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

Mammography and Ultrasound

Subject Code	Name of the Subject	(T - Pr-Pj)	Credits
CUTM1769	**Mammography and Ultrasound**	**3 0 1**	**4**

Course Objects:

- To obtain Knowledge about the preparation and positioning of the patient during the imaging.
- To familiarize the student with the requirements and principles of imaging of the breast usingX-ray mammography.
- To develop the technical skills of ultrasound, and doppler techniques to bring good qualityimages for better analysis.

Course outcome:

- Can acquire knowledge to perform the positions of the patient during the imaging
- One can technically know the functionality of the mammography, Ultrasound, and Dopplertechniques to work with the patient in real-time.

- Knowledge about the patient preparatrion, positioning and patient care during different USG and mammography scans

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 Ultrasound, 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)

Applied Equipment of Radio diagnosis

Subject Code	Name of the Subject	(T - Pr-Pj)	Credits
CUTM1770	Applied Equipment of Radio diagnosis	3 0 1	4

Course Objectives:

- To enable the students to understand different imaging techniques & procedures to take X -rays, DEXA, USG & PET Scan of optimum quality as required by the radiologist.
- Should be able to: Preparation of patient, Preparation of contrast media, Give instructions tothe patient, Perform radiology procedures

Course outcome:

- Through practical demonstrations, assignments, orals, presentations, practical examination byexternal faculty.
- Students perform listed tasks under the guidance of hospital supervisors: Read the requisitionslip,
- Make entries in the register, Give instructions to the patient, Assist radiologist in variousprocedures

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

Module-2

Principles of catheterization and intubation, pre-medication, its uses and methods.

Module-3

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

Module-4

Equipments and description, Color Doppler, Flow Imaging,Indication, Clinical Application

Module-5

CT SCAN-Advancement in CT, Spiral CT, Preparation opt Patient, Contrast Media, Indication andContraindication, Technical Aspects of various procedures in CT

Module-6

Nuclear Medicines -Nuclear medicines,

a. Definition, **b.** Characteristic of Radio Nuclide, **c.** Commonly used Radio Nuclides

Module-7

PET Scan- PET scan and Mammography,Definition, Characteristic and Descriptionof 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 Hariqbal

Radiotherapy & Brachy -Therapy Technology in Malignant and non-Malignant Diseases

Subject Code	Name of the Subject	(T - Pr-Pj)	Credits
CUTM1771	Radiotherapy & Brachy Therapy in Malignant and Non-Malignant Diseases	3 0 1	4

Objectives

- Basic knowledge about different radiotherapy treatment's and planning's
- Knowledge about radio- therapeutic approaches for treating different diseases
- Understand difference between malignant and non -malignant Diseases

Course outcome

- Able to explain Application of Orthovoltage applications in treatment different tumours
- Assist Physicist with the different treatment's approaches and planning's
- Use and handle the Radiotherapy equipment's required for treatment purpose

Module-1

Orthovoltage techniques in skin tumors, and cancers of the breast Advantages and disadvantages oforthovoltage in radiotherapy.

Module-2

Tele isotope cobalt therapy techniques in skin and deep sealed tumors parallel opposed fields and smallbeam directed therapy and wedge field techniques in head and neck tumors especially cancers of larynx

Treatment techniques for cancer of maxillary antrum and pituitary tumors.

Module-3

Treatment techniques in cancer of breast by telecobalt and low energy megavoltage X-rays and electron beam. Tele and brachy-therapy techniques of treatment of different stages of carcinoma cervixuteri with special emphasis on HDR and LDR brachytherapy.

Module-4

Three field techniques in cancer of esophagus and bladder. Radiotherapy technique in medulo blastoma. Whole body and hemi body radiation techniques.

Module-5

Treatment techniques of malignant and non-malignant conditions in ovarian and kidney tumors. Radiation treatment techniques of lymphomas with special emphasis on mantle field irradiation radiotherapy techniques in head and neck cancer.

Module-6

Salient features of computers in radiotherapy and its application. Introduction to computer, Hardware and software component. Input and output data systems computerized treatment planning systems in tale, brachytherapy and documentations.

Module-7

Radiological protection- 1. Dose limits of occupational workers & Publics, **2**. Principle & MethodofProtection**, 3**. Monitoring devices.

Text books

1. A Textbook of Radiation Oncology by Mohanty.
2. Textbook of Radiological Safety by K.Thalayan.

Reference Books

1. Textbook of Radiotherapy and Treatment Planning by Faiz M Khan.
2. Textbook of Radiation Oncology, by Ballinger.

Radiographic Technique-2

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

Course Objectives:

- To enable the students to interpret the radiographic images & find out the abnormalities ifany like fractures, tumors etc.
- To train and inform students about special investigative techniques in imaging because after completion of this course if they are working as CT/MRI/Cath Lab technologist.
- To upgrade students about all tools and techniques in these imaging modalities to competently assist the radiologist.
- To help students to produce better images and understand the images when produced.

Course outcome:

At the end of course

- They will have basic knowledge of techniques & investigations available.
- Apply those in day to day activities.
- The students will be able to diagnose abnormalities, diseases, physiological and pathological conditions on X-Ray, C-Arm CT& MRI.

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: anaesthetized 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 density and 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 anaesthetic; reactions, treatment.

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

Barium meal, Barium swallow, Small bowel enema, Barium enema,

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 cholangiography (T-tube Cholangiography)

Module-7: Special procedures in diagnostic Radiology: Gynecology

Hysterosalpingography, Central nervous system: Myelography, Other: Sialography

Textbooks:

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

Physics of CT & MRI

Subject Code	Name of the Subject	(T - Pr-P	Credits
CUTM1773	**Physics of CT & MRI**	**3 0**	**4**

Course Objects:

- To obtain Knowledge about the basic physical Principles of CT and MRI.
- To familiarize the student with the working principles and components involved in constructionof the equipment.
- To develop the technical skills in image reconstruction techniques and identifying artifacts.

Course outcome:

- Can acquire knowledge about the basic physical Principles of CT and MRI.
- One can technically know the functionality,physical structure and componential alignments inthe equipment.
- They can reconstruct the MRI images and good in identifying the artifacts.

Module-1:Introduction to CT & MRI:

History & Principles, Advantages & Disadvantages of CT & MRI, X-Ray vs CT, CT vs 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, Concept of Windowing, WW, WL, Concept of Voxel, Pixel

Module-3: Physics of MRI:

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: MRI Instrumentation:

Basic instrumentation of Coils Gradient Coils, RF Coils: Surface coil, Pair Saddle Coil, Helmholtz Pair Coil, Bird, Cage Coil.

Module-5: MRI Pulse sequences

T1, T2, Proton Density, Spin Echo, Inversion Recovery, Gradient echo.

Module-6: CT & MRI Image Reconstruction

Image Reconstruction, Back projection, Filter Back projection, Iterative method, Analytical method, CT-Number, Storage - Floppy, hard disc, magnetic tape, optical disc. Fourier transformation, Half- Fourier

Module -7: Artifacts of CT & MRI

CT-Metal artifacts, Steak artifacts, Beam Hardening artifacts & Ring Artifacts

MRI-Aliasing, Chemical shift, Motion, Point , Gibbs , Magic Angle , Slice overlap , Zipper , Array Processing , Coil Selection ,Susceptibility

Text Books:

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

Interventional Radiology& Drugs used in Diagnostic Radiology

Subject Code	Name of the Subject	(T - Pr-Pj)	Credits
CUTM1774	Interventional Radiology & Drug Diagnostic Radiology	3 2 0	5

Course Objectives:

- Basic introduction to interventional radiology is to acquaint the students with various interventional procedures, to important studies , knowledge about various interventional options.
- Interventional radiology not only includes diagnostics but also therapeutic aspects also so it's essential for students to learn theoretical as well as practical aspects of interventional radiology so that they can assist the radiologist properly in interventional procedures.

Course outcome:

- Basic principles of Cath-Lab equipments
- Contrast media
- C-Arm
- Pressure injector
- Defibrillator
- IVUS
- Image quality
- Radiopharmaceutical and procedures

Module-1: Equipment:

Equipment in Cath lab units; C-Arm,Digital

Subtraction Angiographic Units, Pressure Injectors, Contrast media, Introduction to Stents, Endoscopes, pacemakers

Module -2: Access, Equipment's used in Access

Arterial and Venous access (Femoralapproach, Arm approach), Equipment and Instruments

used for access (Catheters, Guide wires, Dilators, Balloons) Seldinger technique.

Module-3: Medications & Safety in Cath Lab:

Preparations, Contraindications, Risks and medication, Environmental safety and sterilization in cathlab

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, Endogenous Ablation of Varicose veins, Transjugular Intrahepatic Portosystemic Shunts, Introduction to Vascular Ultrasound

Module-6: Anaesthesia in Diagnostic Radiology

Facilities regarding general Anesthesia in the X-ray Department.

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

Computerized Tomography (CT Scanning) Method and Procedure

Subject Code	Name of the Subject	(T - Pr-Pj)	Credits
CUTM1775	**Computerized Tomography (CT Scanning) Method and Procedure**	**3 0 1**	**4**

Course Objectives:

- The course should help the students have a basic working knowledge of the main imaging

modalities and also help them actually use it in practice.

- It should help them achieve a level so that they can function as technologists. In fact in thiscourse physics of imaging modalities do not exist the course would have no meaning.
- This subject form the basics of the understanding of the course both intellectually as well as professionally. This subject gives an insight into the world of imaging modalities.
- It will help them to work as technologists and not only technicians. It should help them workwith full confidence as compared to the other students taking other courses.

Course outcome:

- At the end of this course students will have fair knowledge of imaging methods and techniques with their common appearances.
- Ability to operate and use all the techniques. While actually performing the studies on patients during the study they have actual working integrated into the system of learning.

Module-1

Introduction to CT scan, current and accurate information of patient about CT at the body and precaution of patient for CT scan, Counseling of the patient abdominal pain or difficulty breathing, current and accurate information for patient about CT Scan of the head, stroke, Perfusion techniques for brain

Module-2

CT Scan position of different organ abdominal and pelvic, head CT, Body CT, chest CT scan, KUB. Precaution of the patient, position, and counseling of the patients before scanning.

Prescription reading and guidelines of Dr. before scanning

Module-3

Introduction to CT Scan protocols, Basic of contrast enhancement CECT, Non-Enhanced CT(NE-CT), Early arterial phase, late arterial phase, late portal phase.

Module-4

Nephrogenic phase, delay phase, Timing of CECT, Amount of contrast, Injection rate, oral contrast, Rectal contrast, Trasent interruption of contrast, overview of CT protocols

Module-5

CT imaging quality and Dose management, Helical and spiral scanning, material and methods quality assurance and assessment. Image quality testes. Quality control of CT systems by automated monitoring of key performance indicators, material methods and position.

Module-6

Base difference between the CT scan and X-Ray, film developing, process difference between x-rayand CT scan.

Module-7

Radiation Hazards safety of CT Scan, Work management of Scan, Data analysis and reportingProcedure.

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

Basic of Magnetic Resonance Imaging

Subject Code	Name of the Subject	(T - Pr-Pj)	Credits
CUTM1776	Basic of Magnetic Resonance Imaging	3 0 1	4

Course Objectives:

On successful completion of this modules, a student will be expected to be able to:-

- The course should help the students have a basic working knowledge of the Imaging modalityof MRI and also help them actually use it in practice.
- The knowledge of proper technical skills of MRI should help them work with full confidencein the MRI unit /department

Course outcome:

- The subject techniques in MRI form the backbone of Radio diagnosis in the MRI modality of imaging sciences.
- The course is relevant in the context that it helps students to understand patient Positioning

- during the MRI procedure of different organ system to obtain well defined images for proper diagnosis of MRI films and images.

Module-1

Introduction to Magnetic Resonance imaging (MRI) strong magnetic fields and radio waves, MRI scan Vs CT scan

Module-2

Indications for MRI, Contra Indications of MRI, Contrast media for MRI and quantity

Module-3

Counseling of patient for MRI, preparation of patient for MRI, prescription reading, Identification of Coils, Operation of MRI, Selection of Protocols, Image Printing and presenting

Module-4

Physiologically controlled imaging: Cardiac triggering, ECG signal, Triggered measurements, tracking SAT, Fat and water saturation

Module-5

MRI Scan of different organ, MRI scan spine, MRI Scan Brain, Cardiac MRI, MRCP, MRI scan side effects, Precaution during MRI Scanning.

Module-6

MRI report format, data analysis, precaution for MRI film, quality engagement of MRI, coordination with Radiologist and team workers during MRI

Module-7

MR Angiography: Flow related Enhancement, Time of flight, Phase contrast MR Angiography, MR Spectroscopy, Magnetization Transfer Contrast, Functional MRI.

Text Books

1. Cross Sectional Anatomy CT and MRI by Chauhan, publisher Jaypee Brothers Medical

Publishers; first edition

2. Step by Step MRI by Jagan Mohan Reddy

Image Interpretation of X-Ray Mammography, CT & MRI

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

Course Objectives:

- Understanding the anatomy and pathology of different body parts.
- Identifying the anatomy and pathology of body parts in different planes and in different imageslike X ray, mammography,Ultrasound,CT and MRI.

Course outcome:

- Identifying the Anatomy of body parts in X-ray, Mammography, Ultrasound, CT, and MRI images.
- Identifying Pathology of body parts in X-ray, Mammography, Ultrasound, CT, and MRI images.
- Identifying Anatomy and Pathology in different body parts in different planes.
- Radiological investigations

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 radiologicalinvestigations 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

Medical Law and Ethics

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

Course Objective:

- The course provides an introduction to ethics generally and more specifically to medical ethics,examining in particular the principle of autonomy, which informs much of medical law.
- Thecourse then considers the general part of medical law governing the legal relationship betweenmedical practitioners and their patients. It considers the legal implications of the provision ofmedical advice, diagnosis and treatment.
- Selected medico-legal issues over a human life are alsoexamined.

Course outcome:

- Apply local, state, and federal standards and regulations for the control and use of health information.
- Identify and discuss ethical issues in health care.
- Define general legal terms as they apply to the practice of medicine in ambulatory care settings
- Differentiate between sources and types of law.

Module-1

1. The Indian medical council act, 2. Medical council of India (functions),3. Functions of state medicalcouncils, 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 maloccurrence 3. Contributory negligence4.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.supremecourt 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.

Orientation in Clinical Sciences Course Contents

Subject Code	Name of the Subject	(T - Pr-Pj)	Credits
CUTM1778	Orientation in Clinical Sciences Course Contents	3 0 1	4

Course Objectives:

- Orientation of Clinical Sciences is designed to present students with essential concepts of pathological processes and altered health states.
- The course looks in depth at a wide variety ofcommon pathological conditions.
- Clinical scenarios within each module correlate the anatomicalpathology with major clinical symptoms and signs.
- The Candidates should be skilled andsufficiently qualified with theoretical knowledge and ableto develop skills and abilities todiagnose a specific disorder.

Course outcome:

- Students are expected to demonstrate proficiency in the area in order to apply knowledge ofpathology's role in the diagnosis, staging, and management of disease.
- They will be able toclassify diseases of various body systems and how they manifest clinicallyand histopathologically.
- They acquire the ability to relate these essential basic pathological processes to thepathogenesis ofcommon and important diseases.

Module -1: Cardiovascular disorders

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

Module- 2: Respiratory disorders

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

Module-3: Gastrointestinal disorders

1. Peptic ulcer disease, 2. Achalasia cardia, 3. Intestinal obstruction, 4. chron's disease 5. Ulcerative colitis, 6. Pancreatitis, 7. portal hypertension, 8. ascitis 9. Cirrhosis, 10. Cholecystitis

Module-4 : Renal disorders

1. Glomerulonephritis 2. Nephrotic syndrome 3. Urinary caliculus 4. Poly cystic kidney disease

Module-5: Central nervous system disorders

1. Cerebrovascular disorders 2. Meningitis 3. Encephalitis OBG: 1. Diagnosis of Pregnancy 2. Normal Labour

Module-6: Orthopaedics

1. Fracture 2. Type Mechanism, Healing, Delayed Union, Non- complication 3. Injuries of the shouldergirdle, Dislocation of shoulder 4. Number of Humerus, Elbow Forearm 5. Number of Distal Radius & ulna 6. Injuries of the carpal 7. Dislocation of Hip 8. Femur, Tibia, Ankle, calcaneum 9. Acute & chronic osteo arthritis 10. Rheumatoid arthritis 11. Paget's Disease 12. Ankylosing spondylitis 13. Club foot 14. Bone Tumor-Benign Malignant

Module-7: Surgery

1. Incisions 2. Cholelithiasis 3. Peritonitis 4. Supraphrenic Abscess 5.Appendicitis 6. Benign Hypertrophy prostate 7. Sinusitis

Text Books

1. Textbook of Medicine, Krishna Das
2. Essentials of clinical medicine, Kathale.

Reference Books

1. Handbook of Orthopedics, Gopalan
2. Essential of Orthopedics, Shenoy

CUTM1742- Basic Computer and Information Science

Subject Name	Code	Type of course	T-P-Pj	Prerequisite
Basic Computer and Information Science	CUTM1742	Practice	0-2-0	ıdamentals ofComputer

Objective

- Identify the function of computer hardware components.
- Identify the factors that go into an individual or organizational decision on how topurchase computer equipment.
- Identify how to maintain computer equipment and solve common problems relatingto computer hardware.
- Identify how software and hardware work together to perform computing tasks andhow software is developed and upgraded
- Identify different types of software, general concepts relating to softwarecategories, and the tasks to which each type of software is most suited or not suited.

Course outcome

- Understand the fundamental hardware components that make up a computer'shardware and the role of each of these components.
- Understand the difference between an operating system and an application program,and what each is used for in a computer.
- Describe some examples of computers and state the effect that the use of computer technology has had on some common products

Course Outline

Module- I

Introduction to computer: introduction, characteristics of computer, block diagram of computer, generations of computer. Types of Input output devices. Processor and memory: The Central Processing Unit (CPU), main memory. Storage Devices.

Module- II

Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting,

printing the worksheet, creating graphs. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.

Module- III

Introduction to MS-DOS: History of DOS, features of MS-DOS, MS-DOS Commands (internal and external). Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.). Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid). Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet

Suggested readings:

3. Objective Computer Awareness
4. Computer Networking (Global Edition)

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 inwriting 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 theremaining 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