

NIMS UNIVERSITY, JAIPUR



SYLLABUS

BACHELOR OF RADIATION TECHNOLOGY

BACHELOR OF RADIATION TECHNOLOGY

Sl. No.	Subject Code and Subject Name	Theory	Practical
YEAR - I			
1.	ANATOMY & PATHOLOGY	100	100
2.	MICROBIOLOGY	100	100
3.	BIOCHEMISTRY	100	-
4.	PHYSIOLOGY	100	50
5.	PATENT CARE IN PROFESSIONAL PRACTICE	100	-
6.	PRINCIPLES OF MEDICAL RADIATIONS	100	50

Sl. No.	Subject Code and Subject Name	Theory	Practical
YEAR - II			
1.	RADIATION PHYSICS	100	100
2.	RADIATION BIOLOGY	100	100
3.	TREATMENT PLANNING	100	-
4.	MEGAVOLTAGE THERAPY	100	50
5.	RADIATION SAFETY AND BIOLOGY	100	50
6.	PRINCIPLES OF RADIOTHERAPY	100	50

Sl. No.	Subject Code and Subject Name	Theory-T / Practical-P
YEAR - III		
1.	CLINICAL RADIOTHERAPY	T
2.	RADIOTHERAPY PLANNING & PHYSICS	T
3.	COMPUTER ASSISTED TREATMENT PLANNING	T
4.	RADIOTHERAPY EQUIPMENT	T
5.	SPECIALIZED RADIOTHERAPY TECHNIQUE	T

6.	DIGITAL IMAGE PROCESSING & ADVANCED TREATMENT PLANNING	T
7.	PROJECT	T

ANATOMY & PATHOLOGY

UNIT 1	<p><i>Introduction:</i> Overview of the structural organisation of the human body; anatomical terminology as a communicative device.</p> <p><i>Cells:</i> Cell morphology and diversity; introduction to ultrastructure and function of cell organelles and cell inclusions.</p> <p><i>Tissues:</i> Macroscopic and microscopic studies of epithelial tissue, general connective tissue, cartilaginous tissue, bone tissue, muscle tissue, nervous tissue and the integument; major functional advantages of each tissue type.</p> <p><i>Skeletal Muscles:</i> Major skeletal muscles of the head, neck, thorax, abdomen and upper and lower limbs.</p> <p>□ <i>General Osteology:</i> General morphology of bones; structural classification of bones; identification and naming of individual bones of the skeleton; development and growth of skeletal tissue and bones.</p> <p><i>General Arthrology:</i> Structural and functional classification of joints; general morphology of a synovial joint and associated structures; movements made available by synovial joints</p> <p><i>Detailed Osteology and Arthrology:</i> Naming and identification of osteological features of individual human bones; naming, identification and application of classifications to the major joints of the human body; examples of variability in the human skeleton.</p>
UNIT 2	<p><i>Cardiovascular System:</i> Macroscopic features, function and location of the adult and foetal heart and the location of major arteries and veins; microscopic features of blood vessels including arteries, veins and capillaries; morphological features of the cellular components of blood.</p> <p>□ <i>Lymphatic System:</i> Macroscopic features, major function and location of the lymphatic vascular structures, lymph nodes, tonsils and other mucosa-associated lymphatic tissue, spleen and thymus; microscopic anatomy of lymph nodes.</p> <p>□ <i>Nervous System:</i> Macroscopic features and major functions of the brain and spinal cord; morphological features and major functions of the contents of the peripheral nervous system and autonomic nervous system.</p> <p>□ <i>Respiratory System:</i> Macroscopic features and major functions of the nasal cavity, paranasal sinuses, pharynx, larynx, trachea, bronchi, lungs and thoracic wall including the thoracoabdominal diaphragm; general microscopic anatomy of the epithelium of the respiratory tract and the lungs.</p> <p>□ <i>Digestive System:</i> Macroscopic features and major functions of the mouth, salivary glands, pharynx, oesophagus, stomach, small and large intestines, liver, pancreas, biliary system and peritoneal cavity; general microscopic anatomy of the oesophagus, stomach, small intestine, pancreas and liver.</p>
UNIT 3	<p>□ <i>Urinary System:</i> Macroscopic features, major functions and location of the</p>

	<p>kidneys, ureters, urinary bladder and the urethra; microscopic anatomy of the kidney.</p> <ul style="list-style-type: none"> □ <i>Endocrine System</i>: Macroscopic features, location and basic function of the hypothysis cerebri, thyroid gland, parathyroid glands, suprarenal glands, pineal gland and organs with a minor endocrine function; microscopic anatomy of the hypothysis cerebri, thyroid gland and suprarenal glands. □ <i>Male Reproductive System</i>: Macroscopic features, major functions and location of the scrotum, testes, epididymis, ductus deferens, inguinal canal, seminal vesicles, prostate gland, bulbourethral gland and penis; microscopic anatomy of the testis. □ <i>Female Reproductive System</i>: Macroscopic features, major functions and location of the ovaries, uterine tubes, uterus, vagina and external genitalia; microscopic anatomy of the ovary. □ <i>Special Senses</i>: Macroscopic features and major functions of the contents of the orbital cavity, the eyeball, lacrimal apparatus, and external, middle and internal ear; microscopic anatomy of the photosensitive retina.
UNIT 4	<ul style="list-style-type: none"> □ Upper Limb: relevant osteology; detailed plain radiographic anatomy of skeletally mature and immature individuals; regional and surface anatomy of the shoulder, axilla, and upper limb with an emphasis on blood and lymphatic vessels; MRI and axial sectional anatomy of the glen humeral joint. □ Lower Limb: relevant osteology; detailed plain radiographic anatomy of skeletally mature and immature individuals; regional and surface anatomy of the hip, thigh, crus and pes, with an emphasis on blood and lymphatic vessels; MRI of the knee joints; angiography of the lower limb. □ Head and Neck: relevant osteology of the skull and cervical vertebrae; surface anatomy, lymphatics, major blood vessels and nerves of the head and neck; regional anatomy of the brain and its meninges; axial, coronal and sagittal sectional anatomy of the head and axial sectional anatomy of the neck; plain radiographic anatomy, computerised tomography, MRI and angiography of the head and neck.
UNIT 5	<p><i>Introductory Pathology</i>: Cellular adaptation and cell death; inflammation and repair; infection; circulatory disorders; immune defense; genetics of disease; neoplasia. Cell injury and adaptation: Atrophy, hypertrophy, metaplasia, hyperplasia, classification of tumors, premalignant lesion , Types of inflammation & system manifestations of inflammation Disorders of vascular flow & shock (Brief Introduction): Oedema, hyperemia or congestion, thrombosis, embolism, Infarction shock, Ischemia, Over hydration, Dehydration , The Response to infection: Categories of infectious agents, host barriers to infection, how disease is caused, inflammatory response to infectious agents Haematopoetic and Lymphoid System: Haemorrhage, various type of Anaemia, leucopenia, leucocytosis, bleeding disorders coagulation mechanism</p>

MICROBIOLOGY

UNIT 1	<p>Morphology: Classification of microorganisms, size, shape and structure of bacteria. Use of Microscope in the study of bacteria.</p> <p>Growth and nutrition: Nutrition, growth and multiplications of bacteria, use of culture media in diagnostic bacteriology.</p> <p>Sterilization and Disinfection: Principles and use of equipments of sterilization namely Hot Air oven, Autoclave and serum inspissator. Pasteurization, Anti septic and disinfectants.</p> <p>Antimicrobial sensitivity test</p>
UNIT 2	<p>Immunology : Immunity Vaccines, Types of Vaccine and immunization schedule Principles and interpretation of commonly done serological tests namely Widal, VDRL, ASLO, CRP, RF & ELISA. Rapid tests for HIV and HbsAg(Technical details to be avoided)</p> <p>Systematic Bacteriology : Morphology, cultivation, diseases caused ,laboratory diagnosis including specimen collection of the following bacteria(the classification, antigenic structure and pathogenicity are not to be taught) Staphylococci, Streptococci, Pneumococci, Gonococci, Meningococci, Cldiphtheriae, Mycobacteria, Clostridia, Bacillus, Shigella, Salmonella, Esch coli, Klebsiella, Proteus,vibrio cholerae, Pseudomonas & Spirochetes</p> <p>Parasitological : Morphology, life cycle, laboratory diagnosis of following parasites E. histolytic, Plasmodium, Tape worms, Intestinal nematodes</p>
UNIT 3	<p>Mycology: Morphology, diseases caused and lab diagnosis of following fungi. Candida, Cryptococcus, Dermatophytes, opportunistic fungi.</p> <p>Virology : General properties of viruses, diseases caused, lab diagnosis and prevention of Following viruses, Herpes, Hepatitis, HIV, Rabies and Poliomyelitis.</p> <p>Hospital infection Causative agents, transmission methods, investigation, prevention and control Hospital infection. Principles and practice Biomedical waste management</p>

BIOCHEMISTRY

UNIT 1	<p>CARBOHYDRATES: Chemistry, Definition, classification with examples, functions. Digestion and Absorption, glycogenesis, glycolysis, TCA cycle. Hormonal regulation of blood glucose, diabetes mellitus, glycosuria, changes in Carbohydrate, protein & lipid metabolism.</p> <p>PROTEINS: Definition, Importance, Functional, Classification Digestion & Absorption, decarboxylation, deamination, transamination, transmethylation, Urea cycle, clinical significance of serum urea, function of glycine, Phenylalanine, tryptophan, methionine tyrosine.</p> <p>ENZYMES: Definition, Modern Classification, Factors affecting enzymes Action, diagnostic & therapeutics uses & enzymes, iso-Enzymes, competitive & Non competitive inhibition.</p>
---------------	---

UNIT 2	<p>VITAMINS: Definition, Classification, Fat & water soluble vitamins, functions, Deficiency manifestations sources & RDA</p> <p>MINERALS: Ca, P, Fe, I, Zinc, Selenium, Fluorine, Magnesium, Function sources, Deficiency manifestations</p> <p>HORMONES: Definition with mechanism of action, classification</p> <p>NUTRITION: Composition of food, balanced diet, kwashiorkor, marasmus, nitrogen balance, major dietary constituent & they importance</p>
UNIT 3	<p>Clinical Biochemistry: Liver function test, Renal function test, Lipid profile in serum</p> <p>LIPID: Definition, classification with examples, biomedical importance, Phospholipid & lipoproteins functions. Digestion & absorption of lipid B – oxidation of fatty acid with energetic, Ketone bodies and their & metaboism, cholesterol, importance of cholesterol, obesity.</p> <p>Muscle Contraction: Mechanism & Biochemical, events</p> <p>Connective Tissue- Biochemistry of connective tissue-collagen-Glyco-protein-proteoglycans</p> <p>NUCLEIC ACID: Function of DNA, RNA, genetic code specialized products of amino acids phenyalminetryosine trptophan, glycine, methionine. Transmionation, deamination and urea cycle (protein)</p> <p>Clinical Significance of some importance biochemical constituents in serum in various diseases.</p>

PHYSIOLOGY

UNIT 1	<ol style="list-style-type: none"> 1. General Physiology Structure of cell membrane. Transport across cell membrane and Homeostasis (only short notes) 2. Blood: Rh- A B O system & mismatch-transfusion WBC plasma protein Eryt hrocytes. Haemoglobin. Normal values of Blood (composition & function) 3. Nerve Neuron AHC <ol style="list-style-type: none"> i) Structure, classification & Properties; ii) R.M.P. iii) action potential; iv) Propagation of nerve impulse; v) degeneration & regeneration vi) Reaction of degeneration (retrograde) 4. Muscle <ol style="list-style-type: none"> i) Structure- properties-classification-excitation/contraction coupling ii) Motor unit- E.M.G.- factors affecting muscle transmission iii) Neuro-muscular transmission
UNIT 2	C.N.S. & P.N.S.

	<ul style="list-style-type: none"> i) Receptor physiology-classification & properties-; ii) Synapse-structure, properties, & transmission; iii) Reflexes-classification & properties; iv) Sensory & Motor Tracts-effect of transaction (complete & incomplete) at various levels v) Physiology of Touch, Pain, Temperature & Proprioception; vi) Physiology of Muscle Tone (muscle spindle); Stretch vii) Vestibular Appralus mainly ottolyth organ Anatomy viii) Function of Basal Ganglia, Thalamus, Hypo-Thalamus, Pre- frontal lobe, P.A.S., ix) Sensory / motor cortex; x) Limbic system; xi) Learning, memory & condition reflex, xii) Physiology of Voluntary movement
UNIT 3	<p>Excretory system</p> <ul style="list-style-type: none"> i) Kidneys- (short note)- structure & function; ii) urine formation; iii) Micturition- neural control – neurogenic bladder <p>Temperature Regulation</p> <ul style="list-style-type: none"> i) circulation of the skin- body fluid- electrolyte balance <p>Endocrine</p> <ul style="list-style-type: none"> i) secretion- regulation & function of Pituitary-thyroid-adrenal-parathyroidpancreas <p>Reproductive system</p> <ul style="list-style-type: none"> i) Functions of Estrogen, Progesterone & Testosterone ii) Puberty & Menopause <p>Special senses</p> <ul style="list-style-type: none"> i) Eye-Errors of refraction-accommodation-reflexes-dark & light adaptation photosensitivity Ear, Skin
	<p>Respiratory system</p> <ul style="list-style-type: none"> i) Introduction, general organization; ii) Mechanics of respiration; iii) Pulmonary Volumes & capacities; iv) Anatomical & Physiological Dead space-ventilation/perfusion ratio, alveolar ventilation v) Transport of respiratory gases vi) Nervous & Chemical control of respiration vii) Pulmonary function tests-Direct & indirect method of measurement; viii) Physiological changes with altitude & acclimatization

	<p>Cardio-Vascular</p> <ul style="list-style-type: none"> i) structure & properties of cardiac muscle; ii) Cardiac cycle; iii) Heart rate regulation-factors affecting; iv) Blood pressure- definition-regulation-factors affecting; v) cardiac output-regulation & function affecting; vi) Peripheral resistance, venous return vii) Regional circulation-coronary-muscular, cerebral viii) Normal ECG.
	<p>Exercise physiology</p> <ul style="list-style-type: none"> i) Effects of acute & chronic exercises; ii) oxygen / CO₂ transport-O₂ debt iii) effects of exercise on muscle strength, power, endurance, B.M.R., R.Q.-hormonal & metabolic effects-respiratory & cardiac conditioning iv) AGING v) Training-fatigue- & recovery; vi) Fitness-related to age, gender, & body type <p>A.N.S.</p> <p>Sympathetic / parasympathetic system-adrenal medulla-functions-Neuro Transmitters-role in the function of pelvic floor-(micturation, defecation labour)</p>

PATIENT CARE IN PROFESSIONAL PRACTICE

<p>UNIT 1</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Principles of Patient Care. <input type="checkbox"/> Professional roles, ethics and legal implications of practice. <input type="checkbox"/> Basic health care needs of individuals seeking medical imaging and radiographic therapeutic health services. <input type="checkbox"/> Developing effective care strategies for populations including individuals with special needs. <input type="checkbox"/> Emergency responses in the health care environment. <input type="checkbox"/> Infection control and precautions.
<p>UNIT 2</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Introduction to manual handling. <input type="checkbox"/> Better patient-professional communication; maximizing patient satisfaction and compliance. <input type="checkbox"/> Communication skills; non-verbal communication and verbal communication;

	<p>developing better listening skills.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Developmental and psycho-emotional issues for health care; special needs clients. <input type="checkbox"/> Time and stress management. <input type="checkbox"/> Organisational dynamics and health care teams. <input type="checkbox"/> Maximizing outcomes in health care by treating the whole person.
UNIT 3	<ul style="list-style-type: none"> <input type="checkbox"/> Problem solving and decision making skills; <p>Attitudes and values.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Communicating in difficult situations; <p>Assertion and non-defensive communication.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Conflict resolution skills. <input type="checkbox"/> Emergency responses in the health care environment. <input type="checkbox"/> Introduction to manual handling.

PRINCIPLES OF MEDICAL RADIATIONS

UNIT 1	<ul style="list-style-type: none"> <input type="checkbox"/> Fundamentals of Radiography. <input type="checkbox"/> Preliminary Aspects of Diagnostic Radiography. <input type="checkbox"/> Dark Room Procedures. <input type="checkbox"/> Terminology and Basic Positioning Principles. <input type="checkbox"/> Image Intensified Fluoroscopy. <input type="checkbox"/> Fundamentals of Radiation Therapy.
UNIT 2	<ul style="list-style-type: none"> <input type="checkbox"/> Computed Radiography. <input type="checkbox"/> Computed Tomography. <input type="checkbox"/> Nuclear Medicine.

	<ul style="list-style-type: none"><input type="checkbox"/> Diagnostic Ultrasound Imaging.<input type="checkbox"/> Magnetic Resonance Imaging.<input type="checkbox"/> The Cancer Cell.
UNIT 3	<ul style="list-style-type: none"><input type="checkbox"/> Tumour Diagnosis.<input type="checkbox"/> Tumour Classification.<input type="checkbox"/> Cancer Treatment: A Multidisciplinary Approach.<input type="checkbox"/> Surgery, Radiotherapy, Chemotherapy.<input type="checkbox"/> Other Therapies.<input type="checkbox"/> Role of Research in Cancer.<input type="checkbox"/> Basic information literacy skills

SECOND YEAR**RADIATION PHYSICS**

UNIT 1	<p>Electromagnetic Radiation, Atomic Structure and Radioactivity:</p> <ul style="list-style-type: none"> • Electromagnetic waves and their properties, Inverse square law • The quantum theory of Radiation (Planck's concept of quanta, Photon and its characteristic properties), • The electromagnetic spectrum, Fluorescence and Phosphorescence, Photoelectric Emission, Photocell, Intensity and quality of electromagnetic radiation. • The structure of the Atom: Nucleus, Atomic number (Z), Mass number (A), Ionization & Excitation, Isotopes, And the Periodic Table. • Radioactivity, Properties of alpha, beta, gamma radiation, Radioactive transformation process (Radioactive displacement law), Radioactive decay (Radioactive disintegration law), decay constant, half-life, Units of Radioactivity • Radioactive nuclides in medicine • Radioactive disintegration process and radiation emission and daughter products. • Properties of radium and its daughter elements. • Radioactive equilibrium. • Production of artificial radioactive isotopes. • The principles of the nuclear reactor. • The curie and specific gamma ray emission.
UNIT 2	<p>Principles of Radiation detection and measurement: Gas-filled detectors (ion chambers, proportional counters and Geiger Muller counters) scintillation detectors, thermo-luminescent dosimeters (TLD). Reasons for choice of airionization. Roentgen and Rad. Simple principles of dosimeters. Thimble chamber – electronic equilibrium and dose buildup. Secondary Dosimeter. Elementary principles of Scintillation detectors, Thermoluminescence dosimeters, Semi conductor devices.</p> <p>Biological Effects of Radiation: Chemical effects of Radiation, radiolysis of water, production of free radicals, radical's reactions, G-value. Effects - Stochastic and non-stochastic effects, chromosome aberrations and mutations. Radiation effects on whole body (early effects and late effects). Concept of doubling dose.</p> <p>Radiation Protection: Philosophy of radiation protection – historical development, Maximum permissible exposure concept; Annual dose equivalent limits (ADEL) ALARA concept; international recommendations and current code of practice. Annual dose limits for public & Radiation workers. Protection of Public and Radiation workers Protective materials: Concrete, lead, lead – impregnated substances, building materials, concept of barriers, lead equivalents and variations with quality. Teletherapy Bunker (Room) Design (Telecobalt, Linear Accelerator). Radiation protection features taking into account the work load, use factor, occupancy factor. Wall features with respect to primary beam and secondary radiation. Ceiling thickness depending on occupancy on the floor above Teletherapy room. Positioning of Air conditioning outlets. Design of Brachytherapy room: difference between public area and restricted areas. Radioactive source movement, control and maintenance of records. Protection instruments and personnel and area monitoring. (Survey meters, area monitors, pocket dosimeters and contamination monitors).</p>

UNIT 3	<p>Production of X- and Gamma Ray Beams for Therapeutic purposes: Tubes and high-tension circuits for the production of X-ray from 5 to 500 curie Kv. Insulation and cooling problems in Radiotherapy tubes. Mains voltage compensation. Control of tube voltage. The control panel and control. The filament circuit. Timers safety devices and interlocks, Basic principles of mega voltage X-ray Machines. Distribution of Radiation around the target. Gamma ray beam unit.</p> <p>Interaction of X and Gamma Rays with Matter: Photoelectric absorption; Compton scattering; pair production. Dependence on the nature and atomic number of the absorber and on the radiation energy. Range of secondary electron and its practical importance. Principles of filtration, protection and beam definition. Filters, beam – flattening devices, diaphragms and applicators.</p> <p>Measurement of X and Gamma Rays: The roentgen and the rad, Quality. Half value thickness and its measurement, Methods of measurement; ionization; photographic; scintillation; calorimetric; thermo Luminescent, their relative advantages. Ionization dosimeters; dose – rate, integrating and capacitor types. The Geiger – Muller counter. Scintillation counters and dosimeters.</p> <p>Technical aspects of X and Gamma Ray Therapy: Tumour location and verification, principles of simulators, Field combinations and treatment planning, Beam direction devices, Compensating filters (for example wedges) Physical principles of moving field and grid therapy, Special aspects of Radiotherapy using mega voltage radiations, including electron beam therapy.</p>
UNIT 4	<p>Clinical Dosimetry for Photon and Electron Beams Dose distribution along beam axis , Dose distribution off axis , Variation of dose rate with distance and collimator settings , Manual calculation of treatment times , Beam modifiers (bolus, wedge, compensators) Computer dose calculations , Definition of volumes and their significance , Single, parallel and multi-field technique , Effect of change of energy, beam direction, beam collimation, irradiation Geometry , Calculated and applied doses and beams against professional knowledge</p> <p>EXTERNAL BEAM THERAPY</p> <p>Radiation equipment Principles and functioning of low energy x-rays , Principles and functioning of Tele-cobalt machines Principles and functioning of linear accelerators</p> <p>Dose delivery to the patient Immobilisation of patient , Interpretation of the treatment prescription and plan , Setting up of the prescribed beam parameters and check against reference marks , Preparation, fixation and care of in vivo dosimeters (if available) , Registration of the delivered beam parameters on a daily basis , Documentation of portal verification and results of in vivo dosimetry , Surveying the patient during the treatment procedure</p> <p>Special techniques Total body irradiation , Hemi-body irradiation , Conformal Beam Radiation Therapy , Intensity Modulated Radiation Therapy , Stereo tactic radiotherapy , Intra-operative radiotherapy , Image guided radiotherapy Tom therapy</p> <p>Technical Aspects of the use of Radioactive Sources in the Body: Construction, measurement, testing and properties of small sealed radioactive sources, Dose calculations involving the inverse square law, Physical principles of moulds and implants, Superficial beta ray therapy. Measurement beta ray dose. Clinical beta-ray appliances. Physical principles of the clinical use of unsealed radioactive sources.</p>
UNIT 5	<p>Construction of Cobalt –60 Teletherapy Units: Types of source drawers (cylindrical/ Rotating Drum) , Isocentric Setup and design of the Unit Collimation: Primary, secondary & tertiary , Laser beam, Beam direction devices,</p>

	<p>back pointer, pin & arc principles. Beam modifying devices: Wedge Filters, Tissue compensators. Blocks, Breast cone. Radiation safety aspect , Understanding why strength of Teletherapy source at a given distance, definition of RHM / RMM Construction of Linear Accelerator Isocentric Setup and design of the Unit , Collimation: Primary, secondary & tertiary Symmetric/Asymmetric. RF production, Accelerator Tube, Bending Magnets , Targets of X-ray and Electron beam production , Radiation safety aspect: Ionization chamber, quality assurance checks. Definition of TMR, TPR with respect to high energy x-ray beams , Concept of monitoring units instead of timer as in Telecobalt , Measurement of out put factor and it calibration Multileaf collimator: 3D conformal / Sterotactic Radiation therapy & Surgery/IMRT. Portal imaging/IGRT.</p>
--	--

RADIATION BIOLOGY

UNIT 1	<p>The Physics and Chemistry of Radiation Absorption</p> <ul style="list-style-type: none"> • DNA strand breaks and chromosomal aberrations • Cell Survival curves • Dose response relationship for normal tissues • Oxygen Effect and reoxygenation • Linear Energy transfer and Relative Biologic Effectiveness • Time, Dose and Fractionation in Radiotherapy • New Radiation Modalities • Acute Effects of Total Body Irradiation • Radiation Carcinogenesis, Hereditary Effects, • Effects on Embryo and Foetus, Cataractogenesis • Radiation Protection • The Cell cycle, effects of radiation on the normal cell and abnormal cell. • Radio sensitivity of normal and tumours cells,
UNIT 2	<p>APPLIED ANATOMY & PATHOLOGY</p> <ul style="list-style-type: none"> • Tumours, Definition, formation of tumours, characteristics of benign and malignant tumours, spread of tumours. Types of benign tumours, Types of malignant tumours • Epidemiology • Aetiology • Carcinogenesis • Characteristic of neoplasia (Natural History) • Histological classification of neoplasia • Spread of neoplasia • Staging and grading systems
UNIT 3	<p>PATHOLOGY OF COMMON MALIGNANT DISEASE OF INDIVIDUAL SITES</p> <ul style="list-style-type: none"> • Skin cancer • Head and neck tumours • Brain tumours • GI tract tumors (oesophagus, rectum, and anus) • Lung cancer • Lymphomas • Breast cancer • Gynecological cancers • Prostate cancer • Bladder cancer

	<ul style="list-style-type: none"> • Seminoma • Pediatric Tumours and others
--	--

TREATMENT PLANNING

UNIT 1	<ul style="list-style-type: none"> ▪ Radiotherapy Terminology. ▪ Patient positioning. ▪ Radiographic technique for palliative treatment of the spine, limbs, skull, chest and pelvis. ▪ Single plane contouring technique and data translation. ▪ Interpretation of the radiotherapy prescription: ICRU Report 50 dose specification.
UNIT 2	<ul style="list-style-type: none"> ▪ Use of Percentage Depth Dose (%DD). ▪ Use of Tissue Air Ratio (TAR), Tissue Phantom Ratio (TPR), Tissue Maximum Ratio (TMR) in isocentric treatments. ▪ Production of the absorbed dose distribution including: Representation of absorbed dose; Calculation of absorbed dose at any point; Dose normalisation; Characteristics of isodose curves and charts; Scatter and variations in dose due to depth, beam size and shape, SSD and attenuators. ▪ The Monitor Unit (MU). ▪ Preparation and presentation requirements for the isodose plan and treatment sheet.
UNIT 3	<ul style="list-style-type: none"> ▪ Surface Obliquity correction: tissue attenuation, inverse square law and shift method. ▪ Isodose curve correction: blocking and prefabricated wedges. ▪ Single field techniques.

	<ul style="list-style-type: none"> ▪ Two field techniques: Beam addition, wedging, weighting, blocking; Breast tangent pair, Spinal Cord shielded lung cancer treatment; whole skull. ▪ Introduction to multifield techniques; Four field prostate plan. ▪ Introduction to and interpretation of the planning CT scan.
--	---

MEGAVOLTAGE THERAPY

UNIT 1	<ul style="list-style-type: none"> <input type="checkbox"/> Introduction to radiation treatment environment. <input type="checkbox"/> Megavoltage therapy equipment: general principles, quality assurance. <input type="checkbox"/> Treatment techniques for SSD and isometric single fields, opposed pairs and the 4-field pelvis and breast tangents techniques. <input type="checkbox"/> Basic patient positioning: leveling devices, measurements, landmarks and reproducibility. <input type="checkbox"/> Stabilization devices: head rest and foams, mouthpieces, shells and masks, construction and use.
UNIT 2	<ul style="list-style-type: none"> <input type="checkbox"/> Patient transportation in the treatment room. <input type="checkbox"/> Department design and radiation safety. <input type="checkbox"/> Professional practice. <input type="checkbox"/> Medical legal and ethical issues. <input type="checkbox"/> Tolerance to ionizing radiation exposure of normal and tumor tissues. <input type="checkbox"/> Fractionation and its biological basis.
UNIT 3	<ul style="list-style-type: none"> <input type="checkbox"/> The limitations and advantages of cancer treatment modalities, considering the use of combined modality therapy and associated techniques; chemotherapy, analgesia and hormones. The cancer in specific sites will include a brief description of pathology, symptoms, complications and natural history of the disease. <input type="checkbox"/> Principles of radiotherapy treatment technique and procedures, incorporating;

	<p>a revision of anatomy, treatment field limits, patient positioning, outlines and associated measurements, treatment delivery, portal film use and interpretation as well as patient care.</p> <p>□ The specific sites detailed in this unit are as follows:</p> <p>Semester 1: Brain, pituitary, metastatic bone, primary bone and sarcoma, salivary gland tumours including parotid, the oral cavity including; tonsil, tongue, the mandible, antrum, nasopharynx, spine and CSF and skin including electron techniques;</p> <p>Semester 2: Oesophagus, Lung, Abdomen, Rectum, anus, prostate, breast, hemopoietic and lymphatic systems, cervix, thyroid, thymus endocrine and benign disease</p>
--	--

RADIATION SAFETY AND BIOLOGY

<p>UNIT 1</p>	<ul style="list-style-type: none"> ▪ Cellular Effects of Radiation. ▪ Determinants of Biological Effects. ▪ Whole Body Radiation Syndrome. ▪ Long Term Effects - Somatic and Genetic. ▪ Mechanisms for Modifying Dose Effects.
<p>UNIT 2</p>	<ul style="list-style-type: none"> ▪ Work of International Commission on Radiological Protection (ICRP). ▪ Codes of Practice and of Local Legislation. ▪ Internal Sources of Radiation. ▪ Protective Materials. ▪ X-ray Department Design - Diagnostic and Therapeutic.

UNIT 3	<ul style="list-style-type: none"> ▪ Special Considerations for Pregnant Patients. ▪ Survey of Departments. ▪ Personnel Monitoring. ▪ Contamination Monitoring. ▪ Radioisotope Laboratories (Unsealed Sources).

PRINCIPLES OF RADIOTHERAPY

UNIT 1	<p>Basics of Oncology : Multidisciplinary approach to the management of the Cancer Patient: - Radiation Therapy, Surgery and Chemotherapy.</p> <p>Development of neoplasia within the patient</p> <p>Clinical signs and symptoms of neoplasia,</p> <p>Physical effects of neoplasia on the body</p>
UNIT 2	<p>Staging of Cancer (TNM classification).</p> <p>External Beam Therapy & Brachytherapy: Rationale, Preparation of Patient, Techniques,</p> <p>Dose, Volume, Time, Fractionation, Simulation, Reduplication of Treatment, Results, Survival.</p> <p>Altered Fractionation Schedules</p> <p>Acute and Late Effects of Radiation Therapy</p>
UNIT 3	<p>Care & assistance during Sedation / Anesthesia</p> <p>Physical effects of radiotherapy, chemotherapy, surgery and other Treatments, in combination and alone on the body.</p> <p>Prevention and treatment of the acute side effects of radiotherapy and associated treatments</p> <p>Complications associated with cancer and its treatment, Causes of death</p>

THIRD YEAR
CLINICAL RADIOTHERAPY

UNIT 1	Simulation of routine procedures. Dosimeter for basic techniques. Treatment of routine procedures.
UNIT 2	CT simulation - simulation of routine procedures. 3D computer dosimeter for routine techniques. Treatment of routine procedures and some basic junction techniques.
UNIT 3	Students will be provided with a detailed guide of the expectations of total hours, number of cases and assessment criteria. Students will be required to maintain a clinical record of the procedures encountered at any level. Students will be required to maintain a clinical diary of their reactions, expectations and encounters. The clinical centre will provide experienced personnel to supervise the students. The clinical supervisor will provide an assessment of the student's practical ability at the end of the session. Students will be visited by a QUT staff member or nominee at least once during the clinical session.
UNIT 4	Radiotherapy treatment using a linear accelerator and low voltage radiotherapy

	equipment Simulation Dosimeter Brach therapy
--	---

RADIOTHERAPY PLANNING & PHYSICS

UNIT 1	<p>Dosimeter principles: Dose calculations of photon and electron beam.</p> <p>Multiple Plane data acquisition and contouring techniques.</p> <p>Multiple field techniques using prescribed protocols, including two, three and four fields, and tangential beams.</p> <p>Plan optimization and dosimetry strategies including wedging and weighting variations.</p>
UNIT 2	<p>Normal tissue tolerances and complications.</p> <p>Inhomogeneity corrections for photon beams Introduction to the physics of in homogeneity correction.</p> <p>Electron beam characteristics.</p>
UNIT 3	<p>Specific sites to include lung, larynx, breast, parotid, esophagus, prostate, bladder, rectum, cervix, uterus, pituitary.</p> <p>X-ray image production; factors affecting the quality of radiographic images.</p> <p>CT: Fundamentals of CT image viewing.</p>

COMPUTER ASSISTED TREATMENT PLANNING

UNIT 1	<ul style="list-style-type: none"> • Advanced x-ray simulation techniques. • Data acquisition and translation principles for 3D planning. • Introducing the student to a 3D radiotherapy computer planning system. • Plan optimisation and dosimetry strategies including compensation for contour and dose variations. • Electrons and wax compensation techniques. • Multiple phase planning. • Multiple field 3D planning strategies from a PTV. • 3D plan evaluation using DVH?s and ROI dose statistics. • Specific sites to include: pelvis, abdomen, lung, breast, brain and head and neck.
UNIT 2	<p><i>Data Acquisition and 3D Planning Techniques</i></p> <ul style="list-style-type: none"> • Conventional simulation, 3D CT data acquisition, CT data translation and virtual simulation. • 3D planning techniques including: Compensators, Irregular beams, elongated fields, electrons, junction techniques, arc techniques, and non-coplanar fields. • Specific sites to include: Face, Pelvis, Hemi-body irradiation, Full CNS, Breast and Head and Neck.
UNIT 3	<p><i>Principles of Computed Tomography</i> Obtaining x-ray profiles, collimation and detection systems, reconstruction algorithms, CT numbers, image display, performance evaluation, and artefacts.</p> <p><i>3D Computer Planning Physics</i> 3D computer planning algorithms and dose calculations (photons and electrons). Potential errors in 3D dose calculations/quality assurance. Special considerations: Irregular and elongated fields, Off-axis ratios and patient data influences on dose calculations.</p>

RADIOTHERAPY EQUIPMENT

UNIT 1	<ul style="list-style-type: none">• The production and acceleration of electron beams.• The principles of operation of the magnetron and klystron.• Acceleration of electrons in the waveguide of a linear accelerator toward the target.• Control of beam energy and direction in a linac.
UNIT 2	<ul style="list-style-type: none">• The linac head - target and bending magnets.• Interaction of radiation with tissue.• Dosimetry - e.g. ion chambers, TLDs, diodes.• Multi-leaf collimators.
UNIT 3	<ul style="list-style-type: none">• Electronic Portal Imaging systems.• Cyclotrons and Proton therapy.• Quality assurance in radiotherapy.• Radiation protection in a RT department

SPECIALIZED RADIOTHERAPY TECHNIQUE

UNIT 1	<p>Basic principles of brachytherapy: types of treatments including surface, interstitial and intracavity; comparison to external beam therapy; historical perspective; future perspective.</p> <p>Characteristics of brachytherapy sources: types; methods of use; comparative advantages; dose calculations in air and tissue.</p> <p>Systems of dose calculation with multi-sources: Manchester and Paris systems; surface applications; interstitial and volume implants; manual and remote loading systems; beta-ray; strontium-90 plates; dosimetry and application of specific techniques; safety procedures.</p> <p>Radionuclide therapy: principles; selection of isotopes; treatment applications.</p> <p>Low voltage therapy: principles; equipment; room design and safety; single fields Each technique to include: anatomy; patient positioning; contours; isodosing and calculation; mould preparation treatment sheet preparation; treatment delivery and patient care.</p>
UNIT 2	<p><i>Radiotherapy Equipment and clinical techniques for:</i> Image guided radiotherapy techniques, PACS, radiosurgery, stereotactic frames and new stabilisation devices, 4D treatment techniques, paediatric radiotherapy techniques, specialised electron therapy techniques and whole body treatments.</p> <p><i>Associated Treatment Techniques:</i> Oncology nursing practices including infection control, skin care and interdisciplinary health care management, chemotherapy, cryotherapy, hyperbaric oxygen therapy, neutron and proton therapy, hyperthermia, social and welfare issues, dietetics.</p>

DIGITAL IMAGE PROCESSING & ADVANCED TREATMENT PLANNING

UNIT 1	<ul style="list-style-type: none"> ▪ Applications of image processing in diagnostic and therapeutic medicine. ▪ Fourier Transform (FT) theory. Fast FT. Discrete FT. ▪ Applied FT theory. Convolution theory. 2-D FT. Image sampling. ▪ Image enhancement techniques. Histogram modification, LUT, scaling, subtraction. ▪ Image restoration and deconvolution. ▪ Uniformity correction and linearity correction. ▪ Image reconstruction techniques. ▪ PACS.
UNIT 2	<ul style="list-style-type: none"> • <i>Principles of MRI:</i> <p>Basic principles.</p>

	<p>Spatial localisation techniques.</p> <p>Relaxation times.</p> <p>Imaging methods.</p> <p>Reconstruction techniques.</p> <p>Technical parameters and considerations.</p> <p>Hazards.</p> <p>Quality assurance.</p>
UNIT 3	<ul style="list-style-type: none"> • <i>Principles of PET:</i> <p>The physics of PET.</p> <p>Principles of image formation.</p> <p>Radiotracer production and mechanism of uptake.</p> <p>Radiation doses.</p> • <i>Oncological clinical application of MRI and PET:</i> <p>Specific clinical application.</p> <p>Image fusion and overlay.</p> • <i>Advanced treatment planning techniques.</i>

PROJECT:

1. **Research Guidelines.**
2. **Ethical Considerations.**
3. **Information Retrieval Skills.**
4. **Experimental Design.**
5. **Survey Methodology.**
6. **Statistics.**
7. **Research Proposal.**
8. **Report Writing.**
9. **Poster Presentation.**