بسم الله الرحمن الرحيم

CURRICULUM / STATUTES/ REGULATIONS

FOR 2 YEARS DIPLOMA PROGRAMME IN

Faisalabad Medical University

Faisalabad

Contents

Section A

VISION STATEMENT:

Faisalabad Medical University has been established since 05-05-2017 for purpose of imparting better medical education and encouraging and arranging extensive research and publication in the field of medical science. The vision of university is:

"Striving to achieve national and international stature in undergraduate and postgraduate medical education with strong emphasis on professionalism, leadership, community health services, research and bioethics"

MISSION STATEMENT

The mission of the University is:

"Educate Healthcare professionals to prevent, diagnose and treat human illnesses to practice evidence-based medicine with focus on lifelong healthcare in order to meet the challenges of community needs and competitive medical profession at the same time"

Nomenclature

Diploma in Medical Radiology Therapeutics

Course Title:

DMRT

Training Centers

Department of Radiotherapy Affiliated with Faisalabad Medical University, Faisalabad.

Duration of Course

The duration of course shall be 2 years with structured training in recognized department as per university rules and curriculum

Course structure:

The course is structured in two parts:

Part I: The candidate shall undertake the training in the basic sciences as per curriculum. 75% content will be uniform for all the specialties, approved by the Dean basic sciences and academic council, while 25% will be subject specific, provided and approved by the relevant department and academic council. At the end of 6-month, Part I Examination will be held by the examination department of Faisalabad medical University as per the table of specification in the basic medical Sciences subjects with same percentage of content from uniform and subject specific content as indicated above i.e. 75% and 25% respectively. All the candidates will attend classes in basic science departments as per the time table for 5 days(mon-fri) and on Saturday they will attend the class in their respective specialty as per the time table provided by the university during first 6 months.

Part II: The candidate shall undertake training in the specialized department as per the curriculum. At the end of 2 years, Part II Examination will be held by the examination department of Faisalabad medical University as per the table of specification in the subject concerned.

Section B:

Admission and Eligibility Criteria:

Applications for admission to DIPLOMA will be invited through advertisement in print and electronic media and according to guidelines and rules approved by the Faisalabad Medical University

Candidates shall have MBBS or equivalent classification, valid PMDC registration, one year House job (Three year house job in relevant specialty will be preferred), secured pass percentage in entry test conducted by The Faisalabad medical university, qualify the interview successfully

Required Documents:

1. Completed application Form
2. Copy of MBBS degree with mark sheets of Professional Examinations and certificate of number of attempts in Professional Examination
3. Copy of PMDC Registration certificate.
4. Certificate of completion of required experience.
5. Reference letters from two consultants, with whom the applicant has worked
6. Three latest passport size photographs

Accreditation Related Issues Of The Institution

A. Faculty

Properly qualified teaching staff in accordance with the requirements of Pakistan Medical and Dental Council (PMDC).

B. Adequate resources

The university will provide adequate resources Including class-rooms (with audiovisual aids), demonstration rooms, computer lab, clinical pathology lab, theaters, instruments and other equipment etc. for proper Training of the residents as per their course outcomes and objectives.

C. Library

Departmental library should have latest editions of recommended books, reference books and latest journals (National and International).

Section C:

AIMS AND OBJECTIVES OF THE COURSE

AIM

The aim of two years Diploma programme in(Name of department) is to equip medical graduates with relevant professional Knowledge, skill and ethical values to enable them to apply their acquired expertise at health care institutions.

LEARNING OBJECTIVES:

To train the students in learning cancer epidemiology, etiology, screening, prevention, diagnosis and treatment with Radiation therapy, Chemotherapy, Immunotherapy, Target therapy, Cancer Research, Behaviour and management of toxicity.

GENERAL OBJECTIVES

To Train the students as good human being with good ethics, good doctor, good radiation Oncologist to serve the humanity specially cancer patients in a well-mannered way.

SPECIFIC LEARNING OUTCOMES

Trained Oncologist / Radiotherapy Consultant to examine and treat the cancer patients in skill full way in good manners.

Content list:

Part I:

A : Basic science:

Anatomy:

Gross Anatomy .of Head & Neck

- SCALP & FACE
- BONY ORBIT
- MANDIBLE & CERVICAL VERTEBRA
- TEMPORAL FOSSA, INFRA TEMPORAL FOSSA & MANDIBLE
- EYE BALL & EXTRAOCCULAR MUSCLE
- FASCIA & TRIANGLES OF NECK
- TONGUE, ORAL CAVITY & SALIVARY GLAND
- LARYNX & THYROID GLAND
- PHARYNX
- EAR

- NOSE & PARANASAL AIR SINUSES
- VESSELS OF HEAD & NECK
- LYMPHATIC DRAINAGE OF HEAD & NECK
- RADIO GRAPHY OF HEAD & NECK
- Cranial Cavity

Gross Ana.of Abdomen & Pelvis

- ANTERIOR ABDOMINAL WALL
- ANTERIOR ABDOMINAL WALL & RECTUS SHEATH
- INGUINAL CANAL & HERNIA,SCROTUM & EXTERNAL GENITALIA
- PERITONEUM
- STOMACH & SMALL INTESTINE
- LIVER,PANCREAS,SPLEEN & EXTRAHEPATIC BILLIARY APPARATUS
- BLLOD SUPPLY & NERVE SUPPLY OF ABDOMEN
- LARGE INTESTINE + APPENDIX
- POSTERIOR ABDOMINAL WALL
- BONY PELVIS + JOINTS OF PELVIS
- FEMALE REPRODUCTIVE SYSTEM
- ANAL REGION
- NERVES & VESSELS OF PELVIS
- RADIO GRAPHS OF ABDOMEN & PELVIS

Neuroanatomy

- DURAL VENOUS SINUSES &MENINGIES
- BRAINSTEM 1
- BRAINSTEM 2
- BRAINSTEM 3
- ANS
- CEREBRUM 1
- CEREBRUM 2
- DIENCEPHALON 1
- DIENCEPHALON 2
- VENTRICULAR SYSTEM
- CRANIAL 1
- CRANIAL 2

GROSS ANATOMY OF SPINAL CORD

General & Special Embryology

General & Special Histology

Physiology:

CLINICAL DIPLOMA COURSE OF PHYSIOLOGY

Conceptual and considered approach to

1. Cell physiology
2. Basic and Clinical Neurophysiology

3. Blood physiology
4. Heart and overview of Circulation
5. Renal Physiology
6. Advance Endocrinology
7. Respiratory Physiology
8. Molecular and physiological aspects of Nerve and Muscle

CELL PHYSIOLOGY

1. Functions of cells, cell membranes and its organelles
2. Homeostasis
3. Necrosis
4. Apoptosis

BASIC AND CLINICAL NEUROPHYSIOLOGY

1. Nerve physiology
2. Action potential in nerve fiber, mechanism of generation action potential in a nerve fiber
3. Parts of central, peripheral nervous system and their physiology
4. Autonomic nervous system
5. Special sense vision (eye)

6. Pathophysiology of the diseases involved

BLOOD PHYSIOLOGY

1. Components of blood, functions of blood plasma and plasma proteins
2. Blood grouping and principles of transfusion
3. The body defense systems (lmmunology)
4. Disorders of the blood

HEART AND OVERVIEW OF CIRCULATION

1. The basic structure and function of heart, ECG recording and interpretation
2. Conductive pathway of heart
3. Physiological principles to manage a person in shock due to various reasons
4. Disorders of the CVS

RENAL PHYSIOLOGY

1. Basic structure and function of the kidney
2. Glomerular filtration, tubular function and urine formation.
3. Role pf kidney in acid base, Na,K,Ca blance
4. Endocrine and regulatory functions of the kidney

ADVANCE ENDOCRINOLOGY

1. Endocrine glands, classification their functions
2. Feedback control mechanisms
3. Disorders of endocrine glands

Biochemistry

.1. Buffers

- Ionization of water
- Henderson – Hasselbach equation
- Body buffers and regulation of Acid base balance human body
- Acids produced in the body, mechanisms of regulation of pH, role of lungs and kidney in buffering mechanism
- Disorders of acid base metabolism

2. Enzymes:

- Classification/nomenclature, Properties of enzymes and catalysts, regulation of enzyme activity
- Functions of enzymes and catalysts,
- Therapeutic use and application of enzymes in clinical diagnosis

- Enzyme kinetics, Factors affecting enzyme activity (Michaelis – Menten and Lineweaver Burk equations)

- Classification of enzyme inhibitors and their biochemical importance

3. Carbohydrates:

- Definition, biochemical function and classification of carbohydrates, Structure and functions of monosaccharides and their derivatives

- Disaccharides, Oligosaccharides, Polysaccharides and their Biochemical importance.

4. Proteins:

- Definitions, biochemical importance and classification of proteins based on physiochemical properties, Structure of proteins and their significance in pH maintenance

- Amino acids and their structure, properties, functions, Classification and nutritional significance of amino acids,

- Immunoglobulins and their biomedical significance

- Plasma proteins and their clinical significance

5. porphyrins and Hemoglobin:

- Chemistry and biosynthesis of porphyrins and related disorders

- Structures, functions and types of hemoglobin, Oxygen binding capacity of hemoglobin, factors affecting and regulating the oxygen binding capacity

- of hemoglobin, Haemoglobinopathies (Sickle cell disease, Thalassemia etc.) and their biochemical causes

- Degradation of haem, formation of bile pigments, its types, transport and excretion

- Hyperbilirubinemias, biochemical causes and differentiation

6. Lipids and Fatty Acids:

- Classification of lipids and their biochemical functions, Structure and biochemical function of neutral lipids phospholipids, glycolipids and sphingolipids

- Classification of fatty acids and their biochemical functions,

- Eicosanoids and their function in health and disease

- Steroids and their biochemical role, Cholesterol, its structure, chemistry and functions

- Bile acids and bile salts

- Lipid peroxidation and its clinical significance

7. Vitamins and minerals:

- Vitamins and their different types, Classification of vitamins, their chemical structure and biochemical function, Absorption of vitamins and minerals

- Daily requirements, sources of water- and fat-soluble vitamins

- Clinical effects of vitamin deficiency, Role of vitamins as co-enzymes, Hypo- and hyper-vitaminosis

- Minerals in human nutrition, sources, biochemical actions and recommended daily allowance (RDA), Sodium, potassium, chloride, calcium, phosphorus, magnesium, sulfur, iodine, fluoride, Trace elements: Iron, Zinc, Selenium, Iodine, Copper, Chromium, Cadmium, Manganese (Fe, Zn, Se, I, Cu, Cr, Cd and Mn)

8.Endocrinology:

- Introduction of hormones, mechanism of hormone action, classification of hormones

- Endocrine hormones of human body (Synthesis, Secretion, Mechanism of Action, effects on target tissues, regulation, related disorders)

a. Anterior Pituitary Hormones

b. Posterior Pituitary Hormones

c. Hormones of Adrenal Cortex, Adrenal Medulla

d. Sex Hormones of male & female reproductive system

e. Hormones of thyroid gland

f. Parathyroid Hormone

g. Endocrine portion of Pancreas

9.Nucleotides and Nucleic acids:

- Chemistry of purines and pyrimidines, their derivatives, structure and function, Derivatives of purines and pyrimidines, their role in health and disease

- Chemistry and structure of nucleoside and nucleotide and their biochemical role, Nucleic acids (DNA & RNA) their types, structure and functions

10. Bioenergetics and Biological oxidation:

- Endergonic and exergonic reactions, coupling through ATP
- Oxidation and reduction, methods of electron transfer, redox potential, enzymes and coenzymes of biologic oxidation and reduction
- Respiratory chain and oxidative phosphorylation, components of respiratory chain, electron carriers
- ATP synthesis coupled with electron flow
- ADP coupled to electron transfer
- Uncouplers and inhibitors of oxidative Phosphorylation

11.Metabolism of carbohydrates:

- Glycolysis, Phases and reactions of glycolysis
- Energetics of aerobic and anaerobic glycolysis and their importance, Regulation of glycolysis
- Cori's cycle, The fate of pyruvate
- Citric Acid Cycle, Reactions, energetics and regulation and importance of citric acid cycle

- Amphibolic nature of citric acid cycle (tricarboxylic acid cycle –TCA or the Krebs's cycle)
- Anpoleratic reactions and regulations of TCA cycle
- Gluconeogenesis
- Important three by-pass reactions of gluconeogenesis
- Entrance of amino acids and intermediates of TCA cycle and other nutrients as gluconeogenic substrates
- Significance of gluconeogenesis
- Glycogen metabolism
- Reactions of glycogenesis and glycogenolysis
- Importance of UDP-Glucose
- Regulation of glycogen synthase and glycogen phosphorylase
- Glycogen phosphorylase A and the blood glucose sensor
- Disorders of glycogen metabolism (glycogen storage diseases)
- Secondary pathways of carbohydrate metabolism
- Hexose Mono Phosphate (HMP) shunt, its reactions and importance
- Glucuronic acid pathway, its reactions and importance

- Metabolism of fructose, galactose and lactose
- Regulation of Blood Glucose level
- Hyperglycemia, hypoglycemia and their regulating factors
- Biochemistry of Diabetes Mellitus, its laboratory findings and diagnosis

12. Metabolism of Lipids:

- Mobilization and transport of fatty acids, triacylglycerol and sterols
- Oxidation of fatty acids
- Activation and transport of fatty acid in the mitochondria
- β-oxidation, fate of acetyl CoA, regulation of β-oxidation
- Other types of oxidations, i.e., αoxidation, ω-oxidation, peroxisome oxidation, oxidation of odd number carbon-containing fatty acids and unsaturated fatty acids etc.
- Ketogenesis
- Mechanism and utilization of ketone bodies and significance
- Ketosis and its mechanism
- Biosynthesis of fatty acids
- Eicosanoids, synthesis from arachidonic acid, their mechanism and biochemical functions
- Triacylglycerol synthesis and regulation

- Synthesis and degradation of phospholipids and their metabolic

disorders

- Cholesterol synthesis, regulation, functions, fate of intermediates of
- Cholesterol synthesis, hypercholesterolemia, atherosclerosis
- Plasma lipoproteins, VLDL, LDL, HDL, and chylomicrons, their transport, functions and importance in health and disease
- Glycolipid metabolism and abnormalities

13. Metabolism of proteins:

- Amino acid oxidation, metabolic fates of amino acid, transamination, deamination decarboxylation, deamidation and transamination
- Transport of amino group, role of pyridoxal phosphate, glutamate, glutamine, alanine
- Ammonia intoxication, nitrogen excretion and urea formation,
- Urea cycle and its regulation, genetic defects of urea cycle
- Functions, pathways of amino acid degradation and genetic disorders of individual amino acids

14. Metabolism of Nucleotides:

- De novo purine synthesis
- Synthesis of pyrimidine

- Recycling of purine and pyrimidine bases (Salvage pathway)
- Degradation of purine, formation of uric acid
- Disorders of purine nucleotide metabolism

15. Bio signaling:

- G-Protein Coupled Receptor
- Second Messengers
- Tyrosine Kinase Receptor
- Role of cGMP
- Multivalent Adaptor Proteins and Membrane Rafts
- Gated Ion Channels
- Bidirectional Cell-Adhesion Receptors
- Regulation of Transcription by Nuclear Hormone Receptor
- Regulation of Cell Cycle by Protein Kinases
- Oncogenes, Tumor Suppressor Genes, Programmed Cell Death

16. Genes and Chromosomes:

- Chromosomal elements
- DNA supercoiling

- Structure of chromosomes
- Genetic Mutations

17. DNA Metabolism:

- DNA structure
- DNA replication
- DNA damage and repair mechanism
- DNA Recombination

18. RNA Metabolism:

- DNA dependent synthesis of RNA
- RNA processing
- RNA dependent synthesis of RNA & DNA
- HIV Reverse Transcriptase
- Methods for generating RNA polymers

19. Regulation and gene expression:

- Principles of gene regulation
- Process of Transcription, Post-Transcriptional Modification

- Regulation of gene expression in bacteria/eukaryotes
- Genetic code
- Process of Translation, Post-Translational Modification

Metabolic disorders and their Clinical importance

1. Metabolic disorders related to Carbohydrate Metabolism

- Diabetes Mellitus& its complications
- All types of Glycosuria
- Classical Galactossemia
- Hereditary fructose intolerance
- Essential Fructosuria
- Essential Pentosuria
- G-6 PD deficiency
- Hyperosmolar Nonketotic Diabetic Coma
- Glycogen Storage Diseases
- Hypoglycemia
- Lactose intolerance

2. Metabolic disorders related to Lipid Metabolism

- Lipid Storage Diseases
- Ketosis and Ketonuria including Diabetic Ketoacidosis
- Respiratory Distress Syndrome
- Hypercholesterolemia
- All types of Hyperlipidemias including hyperlipoproteinemia
- Hypo lipoproteinemia
- Atherosclerosis, CVA, CHD
- Steatorrhea
- Chyluria
- Cholelithiasis/Obstructive Jaundice
- Congenital Adrenal Hyperplasia
- Carnitine Deficiency
- Fatty liver
- Obesity/Metabolic Syndrome
- Disorders related to oxidation of Fatty Acids (Refsum's Disease, Zellweger syndrome, Methyl Malonic Acidemia, SIDS)

3. Metabolic disorders related to Protein Metabolism

- All types of Uremia
- Hepatic Encephalopathy
- Hyperammonemia
- Arginine-succinic aciduria
- Citrullinemia
- Isovaleric academia
- Glycinuria /Hyperoxaluria
- Cystinuria / Cystinosis
- Phenylketonuria/Albinism
- Tyrosinemia
- Alkaptonuria
- Homocystinuria
- Hartnups disease
- Maple Syrup Urine Disease
- Histidinemia
- Creatinuria
- Carcinoid syndrome

4. Metabolic disorders related to Nucleotides and Nucleic Acids Metabolism

- Hyperuricemia &Hypouricemia
- Gout
- Lesch-Nyhan Syndrome
- Severe Combined Immunodeficiency Disease (SCID)
- Oroticaciduria
- Purine Nucleoside Phosphorylase Deficiency

5. Metabolic disorders related to heme metabolism

- Porphyria's
- Hyperbilirubinemia
- Jaundice

6. Disorders related to Vitamins and Minerals

- Vitamin DeficiencyDiseases
- Minerals & Trace elements Deficiency Diseases

7. Clinical Enzymology

- Principles of Diagnostic Enzymology
- Isoenzymes and their role in clinical diagnosis

- Types of various enzymes in human body
- Functional & Non-Functional Enzymes
- Enzymes used as reagents and drugs

8. Clinical Nutrition

- Factors altering nutrition requirements in different conditions
- Nutritional assessment and support in health & convalescence
- Diseases that produce nutrition problems
- Protein Energy Malnutrition (PEM)

9. Single-Gene Disorders:

Major Modes of Inheritance (Autosomal Dominant, Autosomal Recessive, X-Linked Recessive)

10. Cytogenetics:

- Numerical chromosome abnormalities:
- Euploidy, Aneuploidy
- Structural chromosome abnormalities:
- Translocations, deletions
- Other chromosomal abnormalities:
- Inversions, Ring Chromosome, Isochromosome, Uniparental Disomy

- Advances in molecular cytogenetics:
- Fluorescence in situ hybridization (FISH), Spectral Karyotyping

11. Genetics of Common Diseases

Multifactorial inheritance

12. Gene Mapping

Different types of DNA Polymorphism

- Restriction Fragment Length Polymorphisms (RFLPs)
- Variable Number of Tandem Repeats (VNTRs)
- Short Tandem Repeat Polymorphisms (STRPs)
- Single Nucleotide Polymorphisms (SNPs)

13. Gene Mapping: Linkage Analysis

4. Genetic Diagnosis Recombinant DNA Technology

- Isolation of DNA from Blood
- Isolation of DNA from tissues
- RNA isolation from blood and tissues
- Restriction enzymes

Practical work:

(A) Basic biochemical practical

1. pH metery

- Principle of pH metery
- Components and working of pH meter
- Applications of pH metery in Biochemistry laboratory

2. Centrifugation

- Principle of Centrifugation
- Types of centrifuge machines
- Ultracentrifugation
- Uses in Biochemistry lab

3. Spectrophotometer and Photometry

- Spectrophotometry
- LFT’s
- RFT’s
- Lipid Profile
- Sugar
- Uric Acid

- Serum Bilirubin Direct / Indirect
- Serum Albumin A/G ratio

4. Elisa Based Test

- Principal of Elisa
- Thyroid Profile
- Hepatitis B & C (ICT & Elisa based)
- Cortisol
- HIV (ICT & Elisa based)

5. Urine Complete Examination

- pH, Specific gravity
- Albumin, Sugar, proteins
- Microscopy
- UPT

6. Specimen Collection & Processing; Sources of Biological variation:

- Sources & composition of blood specimen
- Types of blood specimen & equipment

- Venipuncture, skin puncture, arterial puncture, anticoagulants & preservatives of blood, hemolyzed sample
- Preanalytical considerations
- Capillary specimen collection
- Specimen handling & processing for testing
- Collection of urine, faces, spinal fluid, other fluids for analysis

7. Establishment and use of reference values

- Introduction to statistical terms & techniques
- Use of reference values

8. Quality assurance

Elements of quality assurance

Pharmacology:

1. **Cardiovascular system**
    a. Antihypertensive drugs
    b. Drugs for heart failure
    c. Antianginal drugs

d. Anticoagulants

2. Respiratory system

a. Anti-asthmatic drugs

b. Antihistamines

3. Central nervous system

a. General anesthetics

b. Local anesthetics

c. Antipsychotics

d. Antidepressants

4. Drugs acting on uterus

a. Tocolytic drugs

b. Drugs for labor and delivery

5. Endocrinology

a. Antidiabetic drugs

b. Estrogens and androgens

6. Chemotherapeutic drugs

a. Antibiotics of general use

GENERAL PATHOLOGY:

Cell as a unit of Disease

- The genome.
- Cellular metabolism & cellular activation.
- Signal transduction pathways, growth factors and receptors.
- Cell cycle and stem cell.

Cell injury and adaptation

- Reversible and Irreversible Injury
- Fatty change, Pigmentation, Pathological classification
- Necrosis and Gangrene

Cellular adaptation

- Atrophy, Hypertrophy,
- Hyperplasia, Metaplasia, Aplasia

Inflammation

- Acute inflammation, Vascular changes, Chemotaxis, Opsonization and Phagocytosis
- Enlist the cellular components and chemical mediators of acute inflammation
- Differentiate between exudates and transudate

- Chronic inflammation
- Etiological factors, Granuloma

Cell repair and wound healing

- Regeneration and Repair
- Healing---steps of wound healing by first and second intention
- Factors affecting healing
- Complications of wound healing

Hemodynamic disorders

- Define and classify the terms Edema, Hemorrhage, Thrombosis, Embolism, Infarction & Hyperemia
- Define and classify Shock with causes of each.
- Describe the compensatory mechanisms involved in shock
- Describe the pathogenesis and possible consequences of thrombosis
- Describe the difference between arterial and venous emboli

Neoplasia

- Dysplasia and Neoplasia
- Differences between benign and malignant neoplasm

- Enlist the common etiological factors of Neoplasia
- Define and discuss the different modes of metastasis
- TNM staging system and tumor grade

Immunity and Hypersensitivity

- Humoral and cell mediated immunity and types of Hypersensitivity with examples.

General Microbiology

- General Microbiology
- Introduction to microbiology
- Role of microbes in various human diseases
- Sources of infection
- Classification of microorganisms.
- Morphology and identification of bacteria.
- Bacterial metabolism and growth.
- Sterilization and disinfection, definition, use of physical and chemical disinfectants and their practicalutility in clinical practice.
- Infection and immunity pathogenicity, pathology of infection, Resistance and natural immunity, antigens and antibodies.

B: Medical Physics:

1. Basic Physics relevant to Radiotherapy

- Atomic structure, atomic and mass numbers
- Electron shells and energy levels
- Nuclear forces and nuclear energy levels
- Particle radiation
- Electromagnetic radiation, wave and quantum model
- Electromagnetic spectrum
- Energy quantitization
- Relationship between wavelength, frequency and energy
- Description of an x- or gamma-ray beam (quality, energy, intensity, size)
- Basics of production of gamma-rays
- Nuclear Reactions and Nuclear Reactors
- Basics of production of x-rays, including the X-ray tube and the basic X-ray circuit
- Continuous and discrete spectra
- Attenuation, absorption, scattering of x-rays
- Attenuation coefficient, Energy Transfer and Energy Absorption coefficients, half value layer

2. **Electromagnetic Radiation and its interaction with Matter, Relative importance of various types of interactions**
    - Ionization
    - Coherent scattering
    - Photoelectric effect
    - Compton effect
    - Pair production
    - Photonuclear interactions
    - Auger effect
    - Scattered radiation
    - Secondary electrons
    - Range versus energy
    - Linear energy transfer
3. **Interaction of sub atomic particles with matter**
    - Ionization and excitation due to charged particles
    - Electrons
        - collision loss
        - radiative loss
        - stopping power due to each and total stopping power
        - particle range
        - Bragg peak
    - Bremsstrahlung
    - Neutrons: elastic and inelastic collisions
    - Protons, ionization profile
    - Elementary knowledge of pions and heavy ions
4. **Radiation Dosimetry**
    - Concept of absorbed dose
    - Definitions and units
    - Variation of absorbed dose in different tissues and materials
    - Concept of exposure and KERMA
    - Simple introduction to the relationship between exposure, KERMA and absorbed dose
    - Ionization in gases
    - The physical principles underlying radiation dose measurement
    - Concepts and practice of dose measurement
    - Relationship between measurement of ionization and derived measurement of dose
    - Measurement of exposure
    - Free air ionization chamber
    - Methods of measurement
    - Elemental knowledge of the construction, advantages and disadvantages of the following:

    - ionization methods (ionization chamber, Geiger counter, diodes)
    - chemical methods, primarily films
    - thermo luminescence (TLD)
    - scintillation counters
    - calorimetry
  - Calibration methods
    - intercomparisons
    - standards (local and national)
    - corrections (température, pressure, beam direction etc)
    - constancy checks
  - Practical dose measurements
    - introduction to the derivation of isodose curves
    - central axis depth dose profiles

5. **Teletherapy beams physics (x-rays)**
   - X-rays beams used in clinical practice
   - Energy ranges
   - Build up and skin sparing for x-rays
   - Isodose curves for x-rays
   - Fixed FSD and isocentric approaches
   - Principles of wedges
   - Wedge angle
   - Trays
   - Output factors
   - Beam geometry
     - Magnification, field size definition and penumbra
6. **Electron Beam Physics**
   - Electron beams used in clinical practice
   - Energy ranges , energy specification and measurement
   - Electron dosimetry
   - Percentage depth dose
   - Factors affecting depth dose
   - Build up and skin sparing for electrons
   - Isodose curves for electrons
   - Effects of surface obliquity and in homogeneities on dose distributions
   - Field shaping ,External shielding ,Internal shielding
   - Principals of Electron Arc Therapy and Total Skin Irradiation.
7. **Radiotherapy treatment planning**
   - Data required for treatment planning
   - Immobilization (techniques and accuracy)
   - Effects and minimization of patient and organ movement
   - Tumour localization: direct visual, simulator, CT, MRI,

ultrasound
- Separation and contour information (uniplanar, multiplanar)
- Transposition of patient data: magnification, target volumes, sensitive structures, dose modifying structures
- Structure and use of a simulator
- Use of a CT scanner in radiotherapy planning
- CT simulator
- Fixed FSD v isocentric planning
- Coplanar planning in a uniform medium
- Isodose distributions in each of the following situations, their uses and critical assessment:
    - Single field
    - isodose summation
    - multifield planning
    - weighting
- Principles of conformal therapy
- Principles of arc and rotational therapy
- Principles of non-coplanar planning
- Principles of stereo tactic localization
- Tissue compensators
- Surface obliquity
- Inhomogeneous media
- Volume definition (various methods including ICRU 50, 62)
- Dose prescription (various methods including ICRU 50, 62)
- Basics of dose calculations in the presence of extensive shielding (eg sector or Clarkson integration)
- Field matching
- TBI (Total Body Irradiation)
- Principles of CT treatment planning
    - acquisition of data and data transfer
    - image manipulation and image fusion
    - defining the volume, growing tools
    - beam placement using beam's eye view
    - plan verification and evaluation using isodose display, dose volume histograms (DVH cumulative and frequency) and digitally reconstructed radiographs (DRR)
    - elements of inverse planning
    - elements of intensity modulated radiotherapy

8. **Beam Therapy Equipment**
    - Principles of superficial and orthovoltage x-ray production
    - Principles of the linear accelerator
    - Basics of the following:
        - microwave production
        - wave guide construction
        - electron beam production
        - x-ray production, beam control and stability
    - Basics of the linear accelerator head construction
    - Betatron
    - Microtron
    - Cyclotron
    - Basic construction of a cobalt machine
    - Output
    - Concept and definition of the isocentre
        - source size
        - defining the beam geometry: collimators, applicators, multileaf collimators, cast blocks, penumbra, factors influencing penumbra
        - defining the beam quality
        - wedges and applicators: types, construction, action, use and effect on depth dose
        - shielding: techniques, materials, transmission, scatter, doses under shields
    - Irradiating the target
        - the treatment couch
        - positioning the patient
        - lasers
        - pointers
        - light fields
        - monitoring radiation output
        - control of the accelerator
    - Multileaf collimators: edge definition, leaf leakage, influence of leaf size
    - Stereo tactic equipment
9. **Quality Assurance in Radiotherapy**
    - Definition of quality assurance and quality control
    - Writing and implementing the radiotherapy prescription
    - The role of computer verification
    - Manual checking
    - Monitoring accuracy of treated volume: verification films and mega-voltage imaging
    - Monitoring accuracy of positioning (laser, light-fields, mechanical pointers, tolerances)

- Monitoring accuracy of radiation output: symmetry and field flatness (tolerances)
- Legal requirements

10. **Radioactive sources**
    - Basics of radioactivity, including
        - types of radiation and radioactive decay
        - isotopes
        - definitions and units of activity and half-life.
        - characteristics of radiation
        - parent and daughter decay series
        - radioactive equilibrium
        - sealed and unsealed sources
    - Types of sources and their construction (wires, hairpins, seeds, tubes, needles, ovoids, etc)
    - Requirement for clinical sealed sources
    - Specific forms of sources (^{198}Au, ^{192}Ir, ^{137}Cs, ^{125}I, ^{90}Sr)
    - Inverse square law
    - Specifications of source strength, air KERMA rate
    - Calculation of absorbed dose from a source
    - Dose distributions around standard sources
    - Hazards with sealed sources
    - Control and testing of sealed sources
    - Measurement of activity
    - Storage and movement control
    - Source handling, issue
    - Leak testing, inspection
    - Safety devices

11. **Brachytherapy**
    - Principles of clinical use
    - Distribution rules and dose calculation basis for Paris system
    - Gynaecological intracavitary brachytherapy systems, source and dose distributions
    - Dose specification
    - Principles of after loading
    - Types of after loading (manual, remote, low, intermediate and high dose rate)

12. **Unsealed sources**
    - Isotopes
    - Stability, shelf life
    - Physical vs. biological half life
    - Radio pharmaceuticals
    - Use in imaging and therapy
    - Clinical applications and dose calculations

13. **Radiation Protection**

- Radiation risks
- Stochastic and non-stochastic processes
- Quality factors and dose equivalent
- Statutory framework
- Background radiation
- Low level exposure effects
- Radiation limits
- Classification of staff, designated areas
- IRR 1999
- Guidance Notes
- IR(ME)R 2000
- Local Rules
- Dose limits
- Controlled areas and screening
- Protection mechanisms: time, distance, shielding
- Design of treatment rooms
- Primary/secondary barriers
- Transmission through barriers, elementary calculations
- Mazes, doors and interlocks
- Leakage and scattered radiation
- Design of sealed sources
- Monitoring of personnel: construction and operating of film badge, TLD badge, direct reading dosimeter
- Dose reporting mechanisms and dose levels

Part II:

- Clinical oncology, Radiotherapy, Diagnosis, Staging, Planning, Radiation Delivery, in the management of toxicity..

Instructional Strategies:

As a policy, active participation of students at all levels will be encouraged.

Following teaching modalities will be employed:

1. Lectures

2. Seminar Presentation and Journal Club Presentations
3. Group Discussions
4. Grand Rounds
5. Conferences and seminars
6. Assignments
7. Self-study, and use of internet

Section D:

Assessment Plan:

Program duration	Course contents	Assessment method
At the end of 6 months of program	Basic medical sciences: • Anatomy including histology • Physiology • Biochemistry • Pathology • Pharmacology • Medical Physics =25% } 75%	**Part I** to be taken by university. It will include: Written (MCQ)=100(1 each) **Total Marks =100**
At the end of 2nd year	Specialized training in the relevant Department	**Part II Examination** to be conducted by university. It will include:

		A) Paper A MCQ=50(1 each)=50 SEQ=10 (5 each)=50 **Total Marks=100** **Paper B** MCQ=50(1 each)=50 SEQ=10 (5 each)=50 **Total Marks=100** **C) Log Book=20 Marks** **D) Clinical Paper=180** OSCE/OSPE =90 marks Clinical=90 marks (long case= 30 marks Short cases=4 caring 15 marks each total 90) **Total Marks=400**

Part I Examinations:

Part I would be conducted for the candidate at the end of 6 months of the program.

Components of Part I Examination

MCQ =100 (each 1 mark)

Total = 100

Eligibility Criteria:

To appear in the Part II Examination the candidate shall be required: .

1. At least 75% Attendance in all the basic medical sciences subjects as per the curriculum provided.
2. Evidence of payment of examination fee as prescribed by the university from time to time.
3. The examination fee once deposited cannot be refunded / carried over to the next examination under any circumstances.
4. Candidate remained on institution roll during the period required for appearing in examination.

Declaration of Results

- The candidates scoring 60% marks in the written examination will be considered pass and will then be eligible to appear in the Part II examination.
- A maximum of total SIX (6) consecutive attempts, availed or un availed, will be allowed in Diploma Part I examination. If the candidate fails to pass this examination within the

above mentioned limit of SIX (6) attempts, he/she shall be removed from the program and the seat will fall vacant.

Part II Examination

(at the end of 2nd Calendar year of the program)

Components of Part II Examination

A) Paper A

MCQ=50(1 each)=50

SEQ=10 (5 each)=50

Total Marks=100

Paper B

MCQ=50(1 each)=50

SEQ=10 (5 each)=50

Total Marks=100

C) Log Book=20 Marks

D) Clinical Paper=180

OSCE/OSPE =90 marks

Clinical=90 marks

(long case= 30 marks

Short cases=4 caring 15 marks each total 90)

Total Marks=400

Eligibility Criteria:

To appear in the Part II Examination the candidate shall be required:

1. Result card showing that the candidate has passed Part I Examination.
2. Certificate of completion of 2 Years training as per the curriculum approved by the university.
3. Evidence of payment of examination fee as prescribed by the university from time to time.
4. The examination fee once deposited cannot be refunded / carried over to the next examination under any circumstances.

Declaration of Results

a. The candidates scoring 60% marks in aggregate of Paper A and Paper B of the written examination will be declared pass and will become eligible to appear in the Clinical Examination.

Clinical, TOACS/OSCE:

a) The Clinical Examination will consist of 04 short cases, 01 long case and TOACs/OSCE with 01 station for a pair of Internal and External Examiner.

b) The Total Marks of Clinical and TOACs/OSCE & Oral will be 180 and to be divided as follows:

- 4 Short Cases (15 each) Total Marks = 60
- 1 Long Case Total Marks = 30
- TOACS/OSCE & ORAL Total Marks = 90

Total= 180

Log Book=20 marks

Declaration of Results

- A student scoring 60% in long case, 60% in short cases ad 60% in TOACS/OSCE will be considered pass in the examination.

Section E

Award of Diploma In

A candidate having declared successful in all the components of examination i.e. ***Theory and Clinical*** shall be declared pass and shall be conferred Diploma in Diploma in Medical Radiology Therapeutics.

Section F:

Log Book

As per format approved by the university

Section G

Paper Scheme

Part I

written

- General Pathology (8 MCQs)
- General anatomy & Histology (20 MCQs)
- Basic Biochemistry (20 MCQs)
- General pharmacology (7 MCQs)
- General physiology (20 MCQs)
- Medical Physics (25 MCQs)

MCQ Paper 100OneBestType

Total Marks **100Marks**

Part II Examination

written

Sr No.	Paper	Number Of MCQ	Number Of SEQ	Total Marks
1	Paper A	50 MCQ (1 each)	10 (5 each)	100
2	Paper II	50 SEQ (1 each)	10 (5 each)	100

TOACS Station distribution:

Section H

Resources and references (books and other resource material)

Section I

List of authors and contributors

Signed by head of Department