ಮಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

MANGALORE UNIVERSITY

(Accredited by NAAC with 'A' Grade)

ಕ್ರಮಾಂಕ/No. MU/ACC/CR46/2015-16/A2

ಕುಲಸಚಿವರ ಕಚೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ – 574 199
ಕರ್ನಾಟಕ, ಇಂಡಿಯ
Office of the Registrar
Mangalagangothri - 574 199
Karnataka, India

ದಿನಾಂಕ/Date : 20/10/2018

NOTIFICATION

Sub: Regulation and Syllabus governing two years Diploma in Radiotherapy Technology programme.

Ref: 1) Approval of the Academic Council meeting held on 3-2-2017 for the Agenda No. 3:16 (2016-17).
2) Government letter No: ED 14 UDS 2016, dated 20-9-2018.

** ** ** **

The Regulation governing two years Diploma in Radiotherapy Technology programme is assented by the Chancellor on 3-9-2018 as communicated in Government letter cited to reference (2) and the Syllabus thereon is approved by the Academic Council meeting held on 3-2-2017. Hence, the Regulation and Syllabus are hereby notified for implementation with effect from the academic year 2019-20.

REGISTRAR

To:

1) The Head, Centre for Application of Radioisotopes Radiation Technology [CARRT], Mangalore University.
2) The Registrar [Evaluation], Mangalore University.
3) Prof. H. M. Somashekarappa, Chairperson, Ad-hoc BOS in Radiotherapy Technology, Mangalore University.
4) The Asst. Registrar [ACC], Mangalore University.
5) The Superintendent [ACC], O/o. the Registrar, Mangalore University.
6) A4/A6/A7 Caseworkers (ACC), O/o. the Registrar, Mangalore University.
7) Guard file.

MANGALORE UNIVERSITY

REGULATIONS GOVERNING TWO YEARS DIPLOMA IN RADIOTHERAPY TECHNOLOGY.

(Framed under Section 44 (1)(c) of the KSU Act 2000)

Preamble:

In recent decades, radiation therapy has come to play an increasingly vital role in the treatment of cancer patients. High quality patient care in radiation therapy depends upon the teamwork consisting trained and qualified team members. The radiation oncologist or the radiation therapist, the engineers, the medical physicist specializing in radiation therapy, the ***radiation technologists***, the dosimetrist and the nurse are all important members of the team. Radiation Technologist plays very vital and important role in this team work in terms of ensuring the expert service in radiotherapy equipment operation and also in its proper maintenance. They will be assisting the Medical Physicists in achieving accurate and optimum doses to be delivered to patients.

There are tremendous increases in the technological advancement of the radiation therapy equipments. The technological advancements ranging from: superficial & deep x-ray, tale-cesium, tele-cobalt, low energy linear accelerators, multi leaf collimators, high energy linear accelerators, Intensity Modulated Radiation Therapy (IMRT) and Image Guided Radiation Therapy (IGRT). These advances, IGRT, IMRT and SRT, have revolutionized the treatment outcome of the cancer since these treatments precisely target the cancer cells and associated clinical target volume. These treatment modalities are delivered with stringent quality assurance procedures of the treatment machine and patient. Radiotherapy technologists play vital role in handling, operating and maintenance of these high quality sophisticated equipment and related responsibilities.

Over the years, the numbers of radiation oncology centers and hospitals have increased many folds. There is an acute shortage of trained and qualified

Radiation Technologists to assist the Oncologists and Medical Physicists in the country. Therefore, there is a great deal of demand Radiotherapy Technology professionals in the country. Hence, starting this two years Diploma in Radiotherapy Technology course will fulfill the national requirement of trained manpower in this highly specialised area and also good job opportunities for the students completing this course.

1. **Title and commencement**:
   i. These regulations shall be called the Regulations governing two years ***Diploma in Radiotherapy Technology***.
   ii. These regulations shall come into force from the date of assent of the Chancellor.

2. **Eligibility for admission**:
   Candidates who have passed the two years **Pre-University examination in science with Physics, Chemistry, Mathematics and Biology (PCMB) subjects** conducted by the Pre University Education Board in the State of Karnataka or any other examination considered as equivalent thereto with 45% aggregate marks in PCMB (40% for SC/ST) shall be eligible.

3. **Duration of the programme**:
   The duration of the programme shall extend over a period of **two academic years –** Non-semester with annual examination.

4. **Medium of instruction**:
   The medium of instruction and examination shall be in **English**.

5. **Hours of instruction per week**:
   There shall be **90** hours of instructions per week. These hours may be distributed for lectures, practical, tutorials and seminars.

6. **Attendance**:
   Each paper (theory/practical) shall be treated as an independent unit for the purpose of attendance. A student shall attend a minimum of 75% of

the total instruction hours in a paper (theory/practical) including tutorials and seminars. There shall be no provision for condonation of shortage of attendance and a student who fails to secure 75% attendance shall be required to repeat that year.

7. **Maximum period for completion of the programme**:
   The candidate shall complete the programme within four years from the date of admission to the programme.

8. **Subjects of study**:
   Principles of Radiation Physics, Radiation Units and Measurements, Imaging in Oncology, Basic Radiotherapy Techniques, Introduction to Anatomy, Introduction to Physiology, Pathology, Radiation Instrumentation, Advanced Radiation Physics and Radiation Therapy Techniques, Brachy therapy, Radiation Protection, Radiation Biology, Introduction to Clinical Oncology etc. and any other subjects introduced from time to time as and when revision of syllabus taking place.

9. **Scheme of examination and instruction**:
   There shall be examinations at the end of each academic year ordinarily during April/May. The scheme of examination and instructions are as below:

Academic Year	**Subjects**	**Hrs per paper /week**	**Duration of Exam (hrs)**	**Marks**			
				I.A.	**Exam**	**Total**	
1st Year	4Theory	4 X 3	4 X 3	4 X 20	4 X 80	4 X 100	400
	2 Practical	2 X 4	2 X 4	2 X 20	2 X 80	2 X 100	200
Total for first year							**600**
2nd Year	4Theory	4 X 3	4 X 3	4 X 20	4 X 80	4 X 100	400
	1 Practical	1 X 4	1 X 4	1 X 20	1 X 80	1 X 100	100
	1 Project	1 X 4		1 X 20	1 X 80	1 X 100	100
Total for second year							**600**
Grand Total (for two years)							**1200**

10.**Internal assessment**:

10.1 Marks for internal assessment shall be awarded on the basis of tests, assignments etc. as determined by the Board of Studies from time to time. The internal assessment marks shall be notified on the department/college notice board for information of the students and it shall be communicated to the Registrar (Evaluation) 10 days before the commencement of the University examinations and the Registrar (Evaluation) shall have access to the records of such internal assessment evaluations.

10.2 Internal assessment marks shall be shown separately in the marks card. A candidate who has rejected the result or who, having failed, takes the examination again or who has appeared for improvement shall retain the internal assessment marks already obtained.

11. **Registering for the examinations**:

A candidate shall register for all the papers in the subject when he/she appears for the examination for the first time.

12. **Valuation of answer scripts**:

Each theory paper/practical shall be evaluated by eligible examiners. Each practical examination shall be conducted and evaluated by one internal and one external examiner or two external examiners if there are no internal examiners but not by two internal examiners.

13.**Minimum for a pass**:

13.1 No candidate shall be declared to have passed in the examination unless he/she obtains not less than 40% marks in the University Examination in each unit such as theory papers/practical and 40% marks in theory/practical and internal assessment marks put together.

13.2 There shall be no minimum in respect of internal assessment.

13.3 A Candidate who fails in any of the theory paper/practical shall reappear in that theory paper/practical and pass the examination subsequently.

14. **Classification of successful candidates**:

14.1 The results of successful candidates at the end shall be classified on the basis of aggregate marks obtained.

14.2 The candidates who pass the examinations in the first attempt are eligible for ranks provided they secure 60% and above marks.

Percentage of marks for declaring class:

First Class with Distinction	70% and above
First Class	60% and above but less than 70%
Second Class	50% and above but less than 60%
Pass Class	40% and above but less than 50%

15 **Rejection of results**:

15.1 A candidate may be permitted to reject the result of the whole examination. Rejection of result paper-wise/subject-wise shall not be permitted. A candidate who has rejected the result shall appear for the immediately following regular examination.

15.2 The rejection shall be exercised only once and the rejection once exercised shall not be revoked.

15.3 Application for rejection along with the payment of the prescribed fee shall be submitted to the Registrar (Evaluation) through the College of study together with the original statement of marks within 30 days from the date of publication of the result.

15.4 A candidate who has rejected the result is eligible for only class and not for ranking.

(Assented by the Chancellor on 03.09.2018 as communicated in Government letter No.ED 14 UDS 2016 dated 20.09.2018)

Sd/-
REGISTRAR.

Mangalore University

Syllabus for the Newly Proposed Two Years Diploma Course in Radiation Therapy Technology (DRTT)

Proposed by
Mangalore Institute of Oncology (MIO)
Mangalore

2016

Mangalore University

Syllabus for the Newly Proposed Two Years Diploma Course in Radiation Therapy Technology (DRTT)

DRTT - First Year

Sl. No.	Subject Name	No. of Hours
1.	Radiation Physics	90
2.	Human Anatomy, Physiology and Pathology	90
3.	Diagnostic Radiology Applied to Radiotherapy	90
4.	Basic Radiotherapy Techniques	90
5.	Practicals -I	180
6.	Practicals-II	180
	Total No. of Hours	720 Hours

DRTT - Second Year

Sl. No.	Subject Name	No. of Theory Hours
1.	Physics of Radiation Oncology & Instrumentation	90
2.	Radiotherapy Techniques	90
3.	Radiation Hazard Evaluation & Control	90
4.	Radiobiology and Clinical Oncology	90
5.	Practical	180
6.	Project	180
	Total No. of Hours	720 Hours

Detailed Syllabus – First Year

1. **Radiation Physics: (90 Hours)**

Unit 1: General Physics - Introduction - Measurements & Units- force, work and energy, temperature and heat - its SI units -Atomic structure- structure of atoms - Nucleus, atomic number, mass number, electron orbit and energy levels - isotopes - isobars - ionization and excitation.-Electromagnetic radiation - electromagnetic waves- quantum theory of radiation and visible light.

Unit 2: Radioactivity - discovery of radioactivity - types of radiation emitted - transformation process - branching - radioactive decay - artificial or induced radioactivity- Natural radioactivity - Half life - unit of activity - specific activity - gamma ray sources for medical uses. Nuclear fission and fusion.

Unit 3: interaction of radiation with matter: Attenuation of electromagnetic radiation with matter - photoelectric, Compton effect - pair production - transmission of homogeneous beam through a medium - filtration - transmission of beam through body tissues.

Unit 4: Radiation units - Roentgen - Exposure - Radiation intensity -flux and fluence- limitation of roentgen - kerma, absorbed dose - radiation dose equivalent - radiation weighting factor - old and SI units and their relations ship - Radiation detection and measurements and its equipments.

Books:

1. Physics for Radiographer by George A Hay and Donald Hughes – B Williams & Wilkins.
2. Physics of radiation therapy by F M Khan

2. Human Anatomy, Physiology and Pathology (90 Hours)

Unit 1: Definition of various terms used in anatomy-Structure and function of cell-Elementary tissues of the body- structure and function of skeleton-composition of blood and its functions- lymphatic system - structure and function of heart .

Unit 2: Structure and function of respiratory system and urinary system - parts of nervous system - sensory organ - digestive system and their functions - Endocrine glands and hormones - reproductive organs and their functions.

Unit 3: Physiology of reproductive system and breast - Structure and function of liver physiology of digestive system and absorption - Endocrine gland and hormones, location of the glands their hormones and functions of pituitary, thyroid gland and pancreas.

Unit 4: Growth of the cell- reproduction of cell, cell cycle - tumors - benign and malignant - cause of cancer, spread of cancer in the body - lymphatic's - metastasis, biopsy - purpose and method, degeneration and process of cell death, repair of wound, inflammation, infection and immunity.

Books:

1. Ross & Wilson, Anatomy and Physiology in health and illness - Anne Waush & Alisonn Grant, Elsevier Health

2. Essentials of medical Physiology - K. Sembulingam, Jaypee Brothers.

3. Introduction to clinical pathology - Harsh Mohan.

3. Diagnostic Radiology Applied to Radiotherapy: (90 Hours)

Unit 1: X-rays - properties and production of x rays - Bremsstrahlung and characteristic X-rays spectra of x-rays - quality and intensity of x-rays - factors influencing quality and quantity of x-rays - - self rectifying circuits - half wave rectifier - full wave rectifier- constant potential circuits - measurements of high voltage - X-rays circuits - Mains voltage circuits - X-ray tube voltage (kV) - Exposure control - X-ray tube current (mA) -control of kV circuits and mA circuits.

Unit 2: Radiographic Image: Primary radiological image formation - use of contrast media , density - contrast - brightness - exposure of x-rays - developers - effect of temperature - optical density measurement - Fog and noise- Intensifying screen - Fluorescence - constituents of intensifying screens - type of screens - intensification factors - speed of screen -screen unsharpness. Cassette - construction and use of cassettes - effect of screen in reduction of patient dose.

Unit 3: Scattered Radiation and Fluoroscopy: Significance of scatter - Beam limiting devices - Grid principle and structure - Types of Grids - Stationary grid, parallel grid, focused grid - crossed grid, moving grid - potter bucky diaphragm.

Unit 4: CT, Ultrasound and MRI: Theory of tomography - multi section radiography - tomographic equipment - CT- scanning principle - reconstruction of image- viewing and evaluation of the image- image quality - Physical aspects of ultrasound - different ultrasound scans - Doppler effect - MRI principle - imaging methods - slice section - image contrast - factors affecting image quality.

Books:

1. Physics for Radiographer by George A Hay and Donald Hughes – B Williams & Wilkins.

2. Ball and Mores, Essentials physics for radiographer, IV edition, Blackwell publishing, UK

4. Basic Radiotherapy Techniques (90 Hours)

Unit 1: Methods of treatment of malignant disease- chemotherapy , hormone therapy, Radiotherapy and surgery in management of disease, relative value of each method for individual tumors or tumor sites -importance of correct dosage, Blood supply, time factor, fractionation, quality - Radical and palliative treatment. Principle affecting the treatment of malignant disease, emergency radiotherapy, terminal care.

Unit 2: Choice of treatment and radiotherapy -Anatomical site, relation to other tissue, general condition of the patient to include inherent diseases, extent of tumor and histopathology, place of previous treatment, place of radical and palliative therapy. Tumors sensitivity, anatomical site, relation to other structure availability of equipments.

Unit 3: Single and multiple field techniques for all treatment sites (from Head to Feet) with appropriate immobilizing device(s).- Fix, Rotation, Arc and Skip therapy procedures. Use of Rubber traction, POP, Orfit, Body Frame in treatment technique, Evaluation of patient setup for simple techniques.

Unit 4: Use of Beam Modifying devices, such as wedges, Tissue compensators, Mid Line Block (MLB) in the treatment of respective sites. Customized shielding blocks and its properties.

Asymmetric jaws, Motorized wedges.

Books:

1. Carlton Richard R. Delmar's Principles of radiographic positioning & procedures pocket guide 1999 Delmar Pub, Albany Comuelle, Andrea Gauthier Radiographic anatomy and positioning: An integrated approach – 1998 Appleton & Stamfort, Lange.

2. F.M. Khan, Physics of Radiation Therapy - 1994 Williams & Wilkins Levitt S. H.

3. Technological basis of radiation therapy – 1999 Lippincott Williams & Wilkins, Philadelphia 14.

5. Practical - I (180 Hours)

1. Study of Human skeleton
2. Study with help of charts and models of the following systems and organs- 1.Digestive system, 2.Respirative system, 3.Nervous system, 4.cardiovascular system and urinary system.
3. Determination of clotting time blood, erythrocyte sedimentation rate and hemoglobin value.
4. Examination of blood films for TLC, DLC and malarial parasite.
5. Recording of body temperature, pulse, heart rate, blood pressure and ECG
6. Determination of focal spot size of diagnostic x-ray tube.
7. Consistency of Radiation output.
8. Periodic response assessment of patient
9. Determination of wedge factor of a teletherapy unit.
10. Study of cell cycle with charts

6. Practical - II (180 Hours)

1. Determination of HVT and Linear attenuation coefficient
2. X-ray simulator - Patient setup and X-ray exposure
3. Assessment of reaction during radiotherapy.
4. Linearity testing of the X-rays unit Timer
5. Evaluation of total filtration of the tube.
6. Consisting of mA loading
7. Table top exposure rate measurement in fluoroscopy
8. Mold room practices - Thermoplast mold making for different sites of cancer patients.
9. CT simulator QA
10. X-rays Dark room techniques.

Detailed Syllabus – Second Year

1. Physics of Radiation Oncology and Instrumentation (90 Hours)

Unit 1: Teletherapy Machines - Historical development - kilo voltage - grenz ray therapy - contact therapy - superficial therapy - deep therapy megavoltage therapy - Radio isotopes units - physical components of cobalt 60 telecobalt units - source housing beam collimation and penumbra - Different type of shutter mechanism in telecobalt units - Caesium 137 units - Advantages and disadvantages - Gamma knife units - simulators and its description.

Unit 2: Principle and production of high energy X- rays in Linear accelerators - physical components of linear accelerators - Different beam bending magnets systems - Microwave generators - Accelerator wave guides - Collimators - primary and secondary collimators - Target and beam flattening system- electron beam and electron scattering foil and applicators - Cyclotron.

Unit 3: Beam therapy data- various sources used in radiotherapy and their properties - physics of photons, electrons, protons and neutrons in radiotherapy. Physical parameters of dosimetry - phantoms - PDD, TAR, BSF, TMR, TPR - SSD technique and SAD technique Treatment time dose calculation basics.

Unit 4: Treatment planning concepts and Beam directing devices and special techniques: Physics of Bolus & Phantom material - isodose curves - measurements of isodose curves - wedge filters - application of wedge filters in radiotherapy and compensating filters - shielding blocks, patient immobilization devices , port film, processing and development . Dose calculations with isodose curves and wedge fields. SRS, SRT, IMRT, IGRT and Tomotherapy- Brachytherapy - ICR , LDR, MDR and HDR - interstitial implants.

Books:

1. New Technologies for Radiation oncology by L.W. Brdy.

2. Physics of Radiation therapy, Faiz M. Khan, 4th edition, Lippicott, Williams and wilkins, USA.

2. Radiotherapy Techniques: (90 Hours)

Unit 1: Technique of fixed beam treatment - single direct filed, parallel fields, multiple fields, regional fields. The use of wedge filters, compensators and shaping blocks, diaphragms and applicators, positioning of the patient, principles of rotation and arc therapy - beta ray and electron beam therapy, 3DCRT, IMRT, IGRT, cyber knife, gamma knife, concept of simulation and virtual simulation.

Unit 2: Methods of use to include after loading techniques and remote control system - advantages and disadvantages of various radionuclides used, dosage fractionation and overall treatment time - cleaning, sterilization and care of small sealed radioactive sources - beta ray application, interstitial implants, ICR, ILRT and mold therapy.

Unit 3: Planning procedures and immobilization devices- contour, isodose plans, tissue inhomogeneity, large field matching, immobilization devices, mould room procedure. General problems - iodine and thyroid gland - phosphorous - tracer and therapy techniques - precautions in use and hazards involved - emergency procedures.

Unit 4: Patient care and use of equipments and responsibilities : General welfare of patient during treatment, including care of patient in case of any inherent disease (ex. diabetes, TB, Arthritis)- Observation and reporting of any change in the signs and symptoms of patients receiving radiation treatment -observation of instruments and reporting of faults - care and use of accessory equipment - beam directing devices - lead rubber aprons - management of radiotherapy equipments - records supervision of patients work - administration - some legal points.

Book:

1. Perez & Brady, Principles and practice of Radiation Oncology.

2. New Technologies in Radiation oncology by L.W. Brady.

3. Radiation Hazard Evaluation, control and Safety (90 Hours)

Unit 1: Background radiation levels – philosophy behind radiation protection and Basic concepts of radiation protection standards- ICRP and its recommendations – the system of radiological protection – Justification of practices, Optimization of protection and individual dose limits – Radiation and tissue weighting factors, equivalent dose, effective doe, committed equivalent dose, committed effective dose – concepts of collective dose – potential exposures, dose categories of exposures – occupational, public and medical exposures internal exposure.

Unit 2: Effects of time, distance, shielding - shielding materials- shielding calculations- different barrier thickness calculations - General considerations and evaluation of work load -personnel and area monitoring rules and instruments – Brachytherapy facilities – telegamma and accelerator installations,- protective equipment - Radiation safety during source transfer operations Special safety features in accelerators, reactors–.

Unit 3: Radioactive wastes – Classification of waste – Disposal of radioactive wastes -Transportation of radioactive substances- Regulations applicable for different modes of transport- Special requirements for transport of large radioactive sources and fissile materials - Exemptions from regulations – Shipment approval

Unit 4: Radiation accidents and emergencies -Typical accident cases. Regulatory framework – Atomic Energy (Radiation Protection) Rules – Applicable Safety Codes, Standards, Guides and Manuals – Regulatory Control – Licensing, Inspection and Enforcement – Responsibilities of Employers, Licensees, Radiological Safety Officers and Radiation Workers.

Books:

1. R. F. Mold, Radiation Protection in Hospitals, Adam Hilger Ltd., Bristol, 1985.

2. A. Martin and S. A. Harbisor, An introduction to Radiation Protection, John Wiley & Sons Inc., New York, 1981.

3. ICRP Publications, 1990.

4. K. N. Govindarajan, Advanced Medical Radiation dosimetry, Prentice-Hall of India Pvt. Ltd, 2004.

4. Clinical Oncology and Radiobiology (90 hrs)

Unit 1: Symptoms at presentation, Diagnosis, Staging and Treatment for most common cancers in India specifically of Head and Neck, esophageal, gastric, brain, lung, breast, cervical, colon, rectum, pancreatic, ovary, endometrial, leukemia and lymphomas.

Unit 2: Care of Patient – Before, during and after radiotherapy, Concepts in cancer treatment (single modalities, combination, especially chemoirradiation, adjuvant, neo-adjuvant, palliative treatment). Pharmacology of important cancer drugs used in chemoirradiation. Principles and procedures in basic life saving skills during radiotherapy (cardiopulmonary resuscitation (CPR) methods, controlling bleeding). Symptoms at presentation, Diagnosis, Staging, Radiation treatment schedules. Important scientific terminologies and their meanings (mucositis, dermatitis, anemia, febrile neutropenia, Leukocytosis etc) and grading of important radiation side effects using the international scales (RTOG/WHO/ CTCAE).

Unit 3: Basics of Radiobiology - Biological basis of radiation-induced cell kill (direct and indirect), hydrolysis of water, cell damage, DNA damage, Somatic effects, Genetic effects, Stochastic and non-stochastic effects, Effects on organs,

Rs in radiation, Hypoxia and treatment, free radicals, oxygen effect and free radical scavengers, LET and RBE theory. Differences in cell kill mechanism by conventional radiotherapy and SRT. Radiation sensitizers, protectors and biologicals (growth factors) used in radiotherapy, Dose modifying factors.

Unit 4: Medical Ethics - History of Medical ethics (Nuremberg code, Helsinki declaration, Belmont report, ICMR guidelines), patient's rights, confidentiality, Beneficence and Non-Maleficance, autonomy, empathy and informed consent. Ethics in data collection, documentation and storage. Research ethics, Code of ethics for technologists during interacting with health care professionals, patients and their caregivers.

Books:

1. Choa K. S., Clifford Radiation oncology – management decisions – 1998. Lippincott – Raven Pub., Philadelfia Perez et.al. Principles of radiation oncology 4th -Lippincott – Raven Pub., Philadelphia.
2. Arnold Rath GK et.al. Text book of radiation oncology, 1st 2000 B.I Churchill Livingstone Journals International Journal of Radiation Oncol Biology Physics - Journals Radiotherapy Oncology.
3. Hall Eric J. Radiobiology for the radiologist – 1994 Lippincott Williams & Wikins, Philadelphia.
4. Bushong, Stewart C. Radiological Science for technologists – physics, biology and protection-- 1997 Mosby, St. Louis.
5. BIOETHICS core curriculum, UNESCO Publications, Design & Production, UNESCO, Geneva 2008

5. Practical Second year (180 Hours)

1. Patient setup and Treatment Delivery - Single direct technique
2. Patient setup and Treatment Delivery - AP/PA parallel opposing filed technique.
3. Patient setup and Treatment Delivery - Three field technique for Ca. Oesophagus.
4. Patient setup and Treatment Delivery - Wedge field technique of Head and neck case.
5. Patient setup and Treatment planning - Ca bladder
6. Patient setup and Treatment planning - Ca Cervix ICR
7. Radiation Protection survey of Radiation installation (linear accelerator)
8. Radiation Protection survey of Brach therapy installation.
9. Microselectron HDR treatment delivery
10. Teletherapy units dosmetric QA

6. Project (180 Hours)

A mini project on patients coming to Cancer Hospital, undergoing investigation, simulator, treatment planning and radiation treatment for not less than 20 number must be carried out and must submit a report at the end of the year before examination for evaluation and viva voce examination.

Elective papers

1. Nuclear Medicine Physics (90 Hours)

Unit 1: Radio isotopes in medical diagnosis in vitro and in vivo procedures - scintillation counters - specific activity - effective half-life - Radio isotope generators - quality control of radio pharmaceuticals.

Unit 2: Scanners - cameras - Auger camera: Design criteria, resolution, sensitivity measurements, ch

Unit 3: Bone scanning - Principal agents for bone scanning, 99m Tc, indications for bone scanning,

Unit 4: Criteria for evaluation of radioisotope imaging systems in terms of concentration ratios - rad activation analysis - Models of body compartments - SPECT, PET, Nuclear cardiology - Monoclonal studies and RIA.

Books:

1. W. H. Blahd, Nuclear Medicine, McGraw Hill Co., New Delhi, 2002.

2. S. Webb, The Physics of Medical Imaging Medical Science Series Adam Hilger Publications, Bristol, 1990.

3. Medical Ethics (90 Hours)

Unit 1: Historical perspectives of medical ethics (Nuremberg code, code of medical ethics, Declaration of Helsinki, Medical Council of India Code of Ethics (2002), Human dignity and human rights, right to health Topics

Unit 2: Autonomy and responsibility, freedom and personal responsibility, patients' bill of rights, respect of the individual and dignity, truth and confidentiality, autonomy of decision, privacy, informed consent and assent, ethics of human life, equality and Justice, immortality, vulnerability

Unit 3: Benefit and harm (Principles of beneficence, non maleficience), research ethics, Animal and experimental research/humanness, human experimentation, human volunteer research-Informed Consent, Drug trials, ethics of caring

Unit 4: Ethics in genetic counseling end of life issues, active, passive, advance directives, life support systems, death awareness, prolongation of life, ART guidelines, onco-fertility.

Books:

1. BIOETHICS core curriculum, UNESCO Publications, Design & Production, UNESCO, Geneva 2008