



BACHELOR OF PARA MEDICAL TECHNOLOGY (BPMT)

Course Name :- Radiotherapy

Learning Objectives

By the end of the course, the student should be able to understand:

1. Human anatomy.
2. Human physiology.
3. Radiobiology in relation with radiotherapy.
4. Radiation physics.
5. Basics of computer related with radiotherapy machines.
6. Basic concept of radiotherapy.
7. Teletherapy and brachytherapy .
8. Technique of radiotherapy treatment.
9. Measurement of doses and dosimetry
10. Different cancer in human body.
11. Concurrent chemotherapy.
12. Radiation hazards and protection.
13. Recent advances in radiotherapy.
14. Communication skill with patient.
15. Medico legal aspect of radio therapy.
16. Radiotherapy reaction and management during radiotherapy treatment.



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1st Year: Assessment System & Syllabus

Sr. No	Paper	Subject	Subject Code	Theory			Practical			Total Marks
				IA	Final	Total	IA	Final	Total	
1	Paper – I	Basic Sciences		30	60	90	30	80	110	200
2	Paper – II	Radiation Physics, Radiation hazards and Protection		30	60	90	30	80	110	200
3	Paper - III	General care and Instruments		30	60	90	30	80	110	200

Paper I

Subject: Basic Sciences

Sr. No	Topic	Theory Hours
1.	Basic knowledge of English and Computers	1
2.	Introduction to Anatomy	1
3.	Introduction to body parts and systems	1
4.	Bones of upper limb (Only nomenclature and major parts)	3
5.	Bones of lower limb (Only nomenclature and major parts)	3
6.	Bones of pelvis (Only nomenclature and major parts)	3
7.	Bones of skull (Only nomenclature and major parts)	3
8.	Bones of vertebral column (Only nomenclature and major parts)	3
9.	Bones of thorax (Only nomenclature and major parts)	2
10.	Dental Anatomy	1
11.	Joints and classification (Only nomenclature)	3
12.	Anatomy & Functions and lymphatic drainage of respiratory System (Only Organ nomenclature and brief functions)	2
13.	Anatomy & Functions of cardiovascular system (Only Organ nomenclature, important arteries and veins and their branches / tributaries)	2
14.	Anatomy & Functions and lymphatic drainage of Abdominal Organs , GI system (Only nomenclature and brief functions)	2
15.	Anatomy & Functions and lymphatic drainage of Pelvic Organs (Only nomenclature and brief functions)	2
16.	Anatomy & Functions of Nervous System (Only nomenclature and brief functions)	2
17.	Anatomy & Functions of Endocrine glands (only nomenclature, site and brief functions)	2
18.	Important Surface Landmarks – Upper Limb	2
19.	Important Surface Landmarks – Lower Limb	2
20.	Important Surface Landmarks – Head and Neck	2
21.	Important Surface Landmarks – Thorax and abdomen	2
22.	Important Surface Landmarks – Joints	2
23.	Important Surface Landmarks – Vertebral column	2
24.	Meanings of axial, coronal, sagittal and oblique planes	1
25.	Introduction of neoplasia	2
26.	Common cancers	2

Practical (Paper I)

Sr. No.	Topic	Theory hours
1.	Identification visceral organ specimens	3
2.	Identification and function of human bones	3
3.	Project work with charts and models of organ system	3
4.	Demonstration of surface marking of important anatomical landmarks	2
5.	BP Recording, TPR charting	2

Paper - II

Radiation Physics, Radiation hazards and Protection

Sr. No	Topic	Theory
1.	Units and measurement used in radiotherapy	2
2.	Electric current, AC and DC, its characters	1
3.	Effects of electric current, Electrolysis	1
4.	Magnetism: Fundamental Principles and Terminology	1
5.	Magnetic induction, flux and demagnetization	1
6.	Electromagnetic induction, Faradays laws	1
7.	Mutual and self induction	1
8.	Transformer : Step up and step down .	1
9.	Rectification : Type of rectification .	1
10.	Atom, structure, atomic no, mass no, Isotopes, ionisation	1
11.	Electromagnetic Spectrum	1
12.	Interaction of Energy and Matter at the atomic level like comption effect ,pair production	1
13.	Radioactivity: Laws, Terminology, Half Life	1
14.	Principles of X Ray Production	1
15.	X-Ray machine components and circuit diagram	1
16.	Power supply to X-Ray machine , main fuse box , constructions .	1
17.	Auto transformer : construction , principles and connections .	1
18.	High-tension transformer : Construction , Principles and connections .	1
19.	Timer : Construction , type and their proper use	1
20.	Filament Control , location , purpose and function	1
21.	Filament heating transformer and functions	1
22.	Line voltage compensator	1
23.	Rectification : Self and half wave rectification.	1
24.	X Ray Generators: Power Supply	1
25.	Construction of an X-Ray tube , Rotating anode X-Ray tube	1
26.	Production of X-Ray . Effects of KVP & MA	1
27.	Tube ratings .	1
28.	Properties of X rays	1
29.	Atomic & Nuclear structure. General Introduction to the properties of radiation and matter.	1
30.	General properties & production of radioactive materials. Radioactive Decay,.	1
31.	Half life, mean life. Transient & Secular equilibrium. Isotopes used in	1
32.	Properties of gamma rays	1
33.	Properties of beta rays	1
34.	Properties of alpha rays	1
35.	Introduction to radiation oncology	1
36.	Properties of various rays	1
37.	Production of various rays	1
38.	Effects of exposure to radiation	1

39.	Protective devices	1
40.	Concept of ALARA	1
41.	Measurement of radiation	1
42.	Gray, Sievert etc units	1
43.	Absorbed dose	1
44.	Kerma	1
45.	Linear energy transfer, RBE, 4 R's of Radio Biology	1
46.	Dose equivalents (BED, EQD2 calculations)	1
47.	Effective dose	1
48.	Dose conversions	1
49.	Health effects of ionizing radiations	1
50.	Deterministic effects, stochastic effects	1
51.	Recommended effective dose limits	1
52.	Concepts and measurements of attenuation	1
53.	Introduction to protective devices	1
54.	Demonstration of various protective devices	1
55.	Role of Imaging in oncology (X rays, fluoroscopy, CT, MRI, PET etc)	2

Practical (Paper II)

Sr. No.	Topic	Theory Hours
1.	Identification of instruments used in radio therapy	2
2.	Identification and uses of dosimetry instruments (survey meter, gamma zone monitors, well type chambers)	2
3.	Radiation protection devices.	2
4.	Output measurement and dose calculation of different radiation sources.	2
5.	Uses of marker and localization x rays.	1
6.	Practical demonstration of x ray production tube.	1
7.	Interpretation of various isodose charts, use of wedges and different shielding blocks.	3

Paper III General care and Instruments

Sr. NO	Topic	Theory Hours
1	General principals in patient care	2
2	Communicating with patient and relatives	2
3	Positioning in radiotherapy	3
4	Introduction to various planes, angles used in radiotherapy	2
5	Patient positioning in common cancers	2
6	Principals of patient positions during radiotherapy	1
7	Legal aspects in radiotherapy	2
8	<u>Brief knowledge</u> about Design of a radiotherapy department	1
9	Introduction to various instruments / equipments used in radiotherapy	2
10	Introduction to linear accelerator, cyclotron etc	1
11	Demonstration of instruments / equipments	2
12	General precautions in handling of the instruments / equipments in radiotherapy department	3

PRACTICAL (Paper III)

Sr. No.	Topic	Theory Hours
1.	Identification and uses of instruments used in brachytherapy.	3
2.	Identification and uses of instruments used in teletherapy	3
3.	Demonstrate the various positions used in Radiotherapy planning for different malignancies	4
4.	Identification and uses of various immobilization devices.	1

Lecture notes / Modules must be given to the students for all topics by the teaching department



BACHELOR OF PARA MEDICAL TECHNOLOGY (BPMT)

Course Name :- Radiotherapy

2nd Year: Assessment System & Syllabus

Sr. No	Paper	Subject	Subject Code	Theory			Practical			Total Marks
				IA	Final	Total	IA	Final	Total	
1	Paper – I	Radiation Physics		30	60	90	30	80	110	200
2	Paper – II	Clinical Radiation Oncology		30	60	90	30	80	110	200
3	Paper - III	Radiation Hazards and safety		30	60	90	30	80	110	200

Paper I

Radiation Physics

Sr. No	Topic	Theory Hours
1.	Teletherapy Units & Accessories : Superficial & deep X-ray machines. Different types of Tele isotope units. Beam directing devices (e.g. isocenter, pin & Arc, Back pointers etc).	2
2.	Beam modifying devices (e.g. wedge filters, penumbra trimers, Breast cones compensators etc) & their practical applications. Immobilising devices.	2
3.	Interaction of X-Rays with matter : Photoelectric, Compton effects & pair production Processes & their clinical importance. Attenuation & absorption coefficients, exponential	2
4.	Law, half value layer & simple calculations.	1
5.	Principles of Radiation Detection & Dosimetry: Basic principles of radiation detection,	1
6.	Ionization chambers and G M Counters, photographic film dosimetry, the thermoluminescence Dosimetry, semiconductor detectors, clinical dosimeter.	3
7.	Principles of Radiotherapy for Dosimetry: Basic concept % depth doses. Tissue air ratio (TAR),	1
8.	Peak scatter factor (PSF/BSF) & tissue maximum ratios and their use in treatment	1
9.	Time calculation, calibration of tele therapy equipment & isodose curves.	2
10.	Concept of Electron beam therapy	1
11.	Treatment planning concepts	1
12.	Radio isotopes clinically used in Radiation therapy	2
13.	Historical development of Radio Therapy machines	1

PRACTICAL (Paper I)

Sr. No	Topic	Theory Hours
1.	Identification and uses of beam modifying devices	2
2.	Radiation protection survey in and around the Radio Therapy premises.	2
3.	Measurement and calculation of depth dose.	2
4.	Uses of simulator for treatment verification.	3
5.	Treatment planning system.	3

Paper II

Clinical Radiation Oncology

Sr. No.	Topic	Theory Hours
1.	What is Oncology? General introduction to Radiotherapy	1
2.	Biological effects of radiation therapy.	1
3.	General aspects of Radiotherapy.	1
4.	Human body with typical medical descriptive terminology Discussion.	1
5.	Major organs of human body with major functions & general physiology.	1
6.	Osteology, growing bones & bone marrow.	1
7.	General pathology of tumors, staging & confirmation of diagnosis Discussion.	1
8.	Lymphatic system.	2
9.	Effects of radiation on normal tissue.	1
10.	Radiation Modifiers.	1
11.	Radiotherapy treatment planning general introduction, Ext RT, Brachytherapy Discussion.	2
12.	Surface anatomy- head&neck.	1
13.	Radiological anatomy -- head&neck.	1
14.	Care of patients-before, during & after radiation therapy.	1
15.	Oropharynx cancers.	1
16.	Hypo pharynx, Nasopharynx.	1
17.	Tumors of larynx & paranasal sinuses.	1
18.	Irradiation side effects – early & late complications.	1
19.	Central nervous system.	1
20.	Eye tumours & spinal cord tumours.	2
21.	Basic knowledge of chemotherapy used concurrently with radiation.	1
22.	Basic knowledge of Palliative Radio Therapy fractionation	1
23.	Role of radio therapy in oncologic emergency (Spinal cord compression,bleeding etc)	1

Practicals (Paper II)

Sr. No.	Topic	Theory hours
1.	HDR Brachytherapy Units.	3
2.	Theratron 780 E Unit , Linear accelerator (Teletherapy Unit)	3
3.	Simulator (Simulix HP 1200)	2
4.	Preparation of POP Moulds.	2
5.	Preparation of Acrylic Moulds.	2
6.	Preparation of Mantle Blocks.	2
7.	Patient set up in brachytherapy.	4
8.	Patient set up in teletherapy.	4
9.	Demonstrate various simulation techniques. (localization x rays, barium swallows etc)	4

Paper III

Radiation Hazards and safety

Sr. No	Topic	Theory Hours
1	Effect of radiation on human tissue	2
2	Different types of radiation hazards	1
3	Protective devices	1
4	Legal aspects in radiotherapy	2
5	Legal aspects in designing of the radiotherapy department	2
6	Technical aspects in design of radiotherapy department	1

7	Sources of radioactive material	2
8	General precautions in handling of radioactive material	1
9	Disposal of radioactive material	1
10	Protective devices	1
11	Physics related to radiation protection	1
12	Dosimetry in radiology	1
13	Instruments used in radiation dosimetry, their handling, use and care	2
14	Radiation Protection : Maximum permissible levels external internal ICRP recommendations – shielding calculations – time, distance, shielding principles – materials and properties. Personnel Monitoring.	3
15	Radiation syndromes	1
16	Emergencies in radiotherapy	1
17	AERB safety codes used in Radio therapy	1
18	Knowledge about different ICRUs used in different radio therapy techniques	1
19	Quality assurance in Radio therapy	1

Practical (Paper III)

Sr. No	Topic	Theory Hours
1.	Radiological protection survey of radio therapy equipments	4
2.	Calibration procedure for measuring and monitoring instruments.	4
3.	Quality assurance on radio therapy equipments.	3
4.	Basic knowledge about different AERB safety codes.	2
5.	Shielding devices	2
6.	Demonstration of procedure to be followed in source stuck situations.	2

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Course Name :- Radiotherapy

3rd Year: Assessment System & Syllabus

Sr. No	Paper	Subject	Subject Code	Theory			Practical			Total Marks
				IA	Final	Total	IA	Final	Total	
1	Paper – I	Advanced radiation physics		30	60	90	30	80	110	200
2	Paper – II	Advanced Clinical Radiation Oncology		30	60	90	30	80	110	200
3	Paper - III	Recent Advances in radiotherapy		30	60	90	30	80	110	200

Paper I

Advanced radiation physics

Sr. No	Topic	Theory Hours
1.	Simulator : simulator including technology, machine parameters, mechanism, image receptor, lasers.	2
2.	Different Types of Treatment Techniques : Treatment Techniques for different types of cancers by single, two fields and multiple field techniques (e.g. ca breast, urinary bladder, cervix, esophagus, vocalcord, Maxillary Antrum, Lung, Parotid, Retinoblastoma, Prostate, Whole body Irradiation, Rotation therapy etc., including special accessories with MLB, wedge filter, shielding blocks etc.	3
3.	Brachytherapy : Different types of Brachytherapy treatments, mould intracavitary and interstitial applications, manual after loading system, remote after loading system.	2
4.	Treatment Planning System : Hardware - computer principles, algorithms – input data- peripherals – digitizer – printer – plotter – CT based – PC based system – Beam planning – Brachytherapy planning.	3
5.	Radiation Protection : Maximum permissible levels external internal ICRP recommendations – shielding calculations – time, distance, shielding principles – materials and properties. Personnel Monitoring, Planning of Radiotherapy department.	2
6.	Biological Effects of Radiation : Somatic – general effects, effects on cellular levels, effects on organs, Genetic effects.	1
7.	Time Dose Fractionation : NSD, TDF, CRE.	2
8.	Quality Assurance in Radiation Therapy Units : Equipment mechanical & radiological aspects of quality assurance. Treatment quality assurance aspects – Dosimetry and other aspects.	2
9.	Record Keeping : Treatment chart – notes – computerization.	1
10.	Modern Radiotherapy Techniques: 3 DCRT, IMRT, IGRT, SRT, SRS.	3
11.	Electron Beam therapy	1
12.	Heavy ion therapy & Particle therapy	1

Paper II

Advanced clinical radiation oncology

(Please note that it is limited only to the **Role of radiotherapy technician**)

Sr. No	Topic	Theory Hours
1.	Radiotherapy in the treatment of cancers of respiratory tract	2
2.	Radiotherapy in the treatment of cancers of alimentary tract	2
3.	Radiotherapy in the treatment of cancers of CNS	2
4.	Radiotherapy in the treatment of cancers of male genital organs	2
5.	Radiotherapy in the treatment of cancers of female genital organs	2
6.	Radiotherapy in the treatment of cancers of urinary tract	1
7.	Radiotherapy in the treatment of cancers of skeletal system	2
8.	Radiotherapy in the treatment of cancers of other organs	2
9.	Radiotherapy in the treatment Lymphomas & Leukemia's.	1
10.	Radiotherapy in the treatment Pediatric tumours	2
11.	Irradiation side effects – early & late complication.	1
12.	Metastatic Lesions –Lung, Brain, Bone, Liver etc.	1
13.	Importance of beam directed X-ray therapy	1
14.	Information technology, Networking in Radiotherapy.	1
15.	Immunotherapy.	1
16.	basic knowledge about Gene therapy.	1
17.	Hyperthermia.	1

Paper III

Recent Advances in Radiotherapy

Sr. No.	Topic	Theory Hours
1.	Helical Tomotherapy.	2
2.	SRS (Stereotactic radio surgery),SRT, SBRT (stereo tactic body radio therapy)	3
3.	Cyber knife, Gamma Knife, X knife	3
4.	Particle beam therapy.	2
5.	Radio immunotherapy.	1
6.	SPECT	1
7.	SMART Radio Therapy.	2

3rd Year PRACTICAL

Sr. No	Topic	Theory hours
1.	Preparation of POP Moulds.	2
2.	Preparation of Acrylic Moulds.	2
3.	Preparation of Mantle Blocks.	2
4.	Patient set up in different Radio therapy techniques.	3
5.	Radiological Protection survey.	2
6.	Treatment Planning Computer.	2
7.	Calibration of Tele cobalt Unit.	2
8.	Quality Assurance of Teletherapy Unit.	2
9.	HDR Brachytherapy Unit – Programming & Source Loading / Unloading.	2
10.	Care of applicators used in brachytherapy.	1
11.	Source stuck emergency in cobalt source & brachytherapy	1
12.	CT simulation planning	2

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BACHELOR OF PARA MEDICAL TECHNOLOGY (BPMT)

Course Name :- Radiotherapy

List of Reference Book

1st Year Reference Books

Paper 1

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|--|--------------------|
| 1. Text Book Of Human Anatomy | B.D.Chaurasia |
| 2. An Atlas Of Normal Radiographic Anatomy | Richard And Albien |
| 3. Essentials Of Human Anatomy | Russel |
| 4. Text Book Of Physiology | Guyton |

Paper 2

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|-------------------------------------|-------------|
| 1. The Physics Of Radiation Therapy | Faiz M Khan |
| 2. Basic Medical Radiation Physics | Stenton |
| 3. Radiobiology For The Radiologist | Eric Hall |

Paper 3

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| 1.Principles And Practice Of Radiaiton Oncology | Perez And Brady |
| 2.Radiation Oncology Rational Techniques And Results | Moos |

2nd Year Reference Books

Paper 1

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| 1. Radiaiton Protection And Dosimetry | Michael Stabin |
| 2. Quality And Safety In Radio Therapy | Todd Pawlicki Et Al |
| 3. Physics Of Radiation Therapy | Faiz M Khan |

Paper 2

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| 1. Text Book Of Radiation Oncology Principles And Practice | G.K.Rath,B.K Mohanti |
| 2. Principles And Practice Of Radiation Oncology | Perez And Brady |
| 3. Text Book Of Radiotherapy | Walter And Miller |
| 4. Technical Basis Of Radiation Therapy | S.H.Levitt And J.A.Purdy |

Paper 3

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|---------------------------------------|---------------------|
| 1.Radiaiton Protection And Dosimetry | Michael Stabin |
| 2.Quality And Safety In Radio Therapy | Todd Pawlicki Et Al |
| 3.Physics Of Radiation Therapy | Faiz M Khan |
| 4.Aerb Safety Codes. | |

3rd Year Reference Books

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| 1. Physics Of Radiation Therapy | ----- Faiz M Khan |
| 2. Principles And Practice Of Radiaiton Oncology | ---- Perez And Brady |