

BHARATHIAR UNIVERSITY : COIMBATORE – 641 046



M.Phil. / Ph.D. Medical Physics

(Full-Time / Part-Time)

PART - I : SYLLABUS

(effective from 2010-11 and onwards)

PAPER I – Research Methodology and Bio Statistics

PAPER II – Radiotherapy Equipments

PAPER III - 1. Advanced Clinical Radiation Therapy Physics

Paper-I : Research Methodology and Bio Statistics

RESEARCH METHODOLOGY

Literature survey, Identification of research problem, mode of attack, role of guide and preparation of research paper and thesis. 4

Mathematical methods in physical research - Numerical integration, Newton's and Lagrange's method of interpolation, Least squares method of curve fitting (straight line and parabola). 4

BIO STATISTICS

Introduction: - Application and uses of Bio statistics as a Science; as figures; Scope, Common statistical terms; Notations. 3

Sources and Presentation of Data: - Qualitative (Discrete), Quantitative (continuous) data; Methods of presentation, Tabulation; Frequency distribution drawings, Quantitative data; Qualitative data. 4

Measures of Location – Averages and Percentiles: - Measures of central tendency – averages, mean, median, mode; Measures of location-percentiles. Graphic method; Arithmetical method; Application and uses of percentiles. 4

Variability and its measures :- Types; Biological; Real; Experimental; Measures of Variability; Range; Semi interquartile range (Q); Mean deviation; Standard deviation; Coefficient of variation. 4

Normal Distribution and Normal Curve: - Demonstration of a Normal distribution; Normal Curve; Standard normal deviate (Z). 3

Sampling: - Representative sample; Precision (sample size); Sample bias; Sampling techniques; Simple random sampling and systematic sampling. 3

Probability; - Addition law of probabilities; Multiplication law; Binomial probability distribution, probability chance from the shape of normal distribution or normal curve. 4

Sampling variability and significance :- Sampling distribution ; Significance; Estimation of population parameter; Testing statistical hypothesis; type I and type II errors; Tests of significance; Z test; One tailed and two tailed tests. 4

Significance of Difference in Means: - standard error of mean; Application and uses; Standard error of difference between two means of large samples; small samples; t-test; 4

The Chi Square test as a test of goodness of fit. Correlation and Regression: - correlation coefficient 4

Total : 45 Periods

REFERENCES

- 1) The Physics of Radiology, H.E.Johns and J.R.Cunningham.
- 2) The Physics of Radiation Therapy, FaizM.Khan.
- 3) Fundamental Physics of Radiology, W.J.Meredith and J.B. Massey.
- 4) Principles of Radiological Physics, Donald T.Graham.
- 5) Radiation Therapy Physics, William R.Hendee, Geoffrey S.Ibbott.
- 6) Principles of Radiological Physics, Robin J Wilks.
- 7) Selected topics in Physics of Radiotherapy and Imaging, U.Madhwanath, K.S.Parthasarathy and T.V. Venkateshwaran.
- 8) Walter & Miller's Text book of Radiotherapy, C.K.Bomford, I.H.Kunkler, B.W.Hancock.
- 9) Progress in Medical Radiation Physics, C.Orton.
- 10) Physics of Linear accelerator, Karzmark.
- 11) Introductory methods of Numerical Analysis, S.S.Shastry.
- 12) Methods in Bio Statistics for Medical Students and Research workers, Dr.B.K.Mahajan (Jaypee Brothers publication).

Paper-II : Radiotherapy Equipments

AIM:

It is designed to familiarize the students with various radiation therapy equipments.

OBJECTIVE:

To understand the physical design, maintenance and quality assurance of tele cobalt, Linear accelerators and other radiation therapy equipments

1. TELEGAMMA MACHINES

9

Co-60 and Cs-137 as teletherapy sources - source containers - international source capsule - effect of penumbra- Types of collimators - beam directing devices - Different Source Shutter Systems-Quality Assurance of telegamma units.

2. LINEAR ACCELERATORS

9

Components of modern linear accelerator-Standing and travelling wave guides, Magnetrons and Klystrons.Bending Magnet, Target, Flattening filter, Collimators. Need for high quality portal imaging - Fluoroscopic, diode, crystal, Ionization chamber detectors and film detectors, amorphous silicon - Diagnostic imaging on a linear accelerator - portal dose images, Portal Dosimetry. TelecobaltVsLinacs.

3.RADIOTHERAPY SIMULATORS

9

Conventional simulators - CT simulators - cone beam CT simulators (CBCT) - comparison and quality assurance of simulators - different simulation techniques - Orthogonal, Semi-orthogonal, Isocentric, Variable angle and Stereo-Shift.

4. BRACHYTHERAPY

9

Introduction - Manual pre loading systems- manual after loading systems - remote after loading systems -source trains(fixed and programmable) - stepping source - different types of applicators(gynecological ,esophageal, nasopharyngeal, bronchial) and templates Introduction to computerized brachytherapy planning.

5.ADVANCED RADIOTHERAPY EQUIPMENTS

9

Superficial X-ray therapy units - Gamma knife - cyber knife - Intra operative radiation therapy units- Tomotherapy -Neutron therapy - boron neutron capture therapy (BNCT)-particle accelerators - proton therapy - carbon ion therapy.

Total : 45 Periods

REFERENCE:

1. Radiation oncology physics : A Handbook for teachers and students. IAEA publications 2005.
2. F.M.Khan,The Physics of Radiation Therapy,ThirdEdition,Lippincott Williams and Wilkins, U.S.A.,2003
3. Photodynamic therapy, By Thierry Patrice Published by Royal Society of Chemistry, 2004
4. Medical Applications of Lasers By D. R. Vij, K. Mahesh Published by Springer, 2002
5. Watmough and Ross, Hyperthermia, Blackie 1986

Paper-III : Advanced Clinical Radiation Therapy Physics

AIM:

To make the student update the recent development in clinical radiation therapy physics.

OBJECTIVE:

In the last two decades there was a significant growth in radiation therapy and complex treatment procedures, in order to make the student to get required information about the special techniques in clinical radiation therapy.

- 1. CONFORMAL RADIOTHERAPY WITH MULTI LEAF COLLIMATOR 9**
Introduction to CRT with MLC-Modern developments in MLC – Different categories of MLC – Leaf position detection – commercially available MLC systems – Universal wedge – Enhanced Dynamic wedge for Linac – Wedges with MLC on Linac – MLC acceptance testing, commissioning and safety assessment – clinical application – Quality assurance.
- 2. INTENSITY MODULATION RADIATION THERAPY 9**
Introduction to IMRT – physical optimization – Biological models for evaluation and optimization of IMRT – Image registration and fusion in IMRT planning – Target and critical structure definitions for IMRT – Static MLC IMRT, Dynamic MLC IMRT, compensator based IMRT – comparison of IMRT delivery systems – Radiation shielding for IMRT – potential problems with IMRT – Commissioning and QA for IMRT treatment planning – clinical implementation of IMRT – patient specific quality assurance in IMRT – IMRT delivery system quality assurance – Modulated electron therapy – Introduction to serial Tomotherapy and Helical Tomotherapy.
- 3. STEREOTACTIC RADIO SURGERY AND RADIOTHERAPY 9**
Introduction to SRS and SRT – SRS with Co-60 sources; the gamma knife – stereo tactic multiple –arc radiotherapy with a Linac – Dynamic SRS – Dynamic collimation for SRS with multiple arc.
- 4. IMAGE GUIDED RADIATION THERAPY 9**
Mechanics of breathing – Methods to manage respiratory motion in radiation treatment – x-ray imaging techniques for guidance in the Radiation therapy setting – clinical procedures in employing x-ray imaging technologies. – Effect of motion on the total dose distribution – 4D computed tomography imaging and treatment planning.
- 5. MEGA VOLTAGE PORTAL IMAGING 9**
Need for high quality portal imaging – Fluoroscopic, diode, crystal, Ionization chamber detectors and film detectors, Amorphous silicon – Diagnostic imaging on a linear accelerator – portal dose images, transit Dosimetry.

Total : 45 Periods.

REFERENCES:

1. Steve Webb, The Physics of Three-Dimensional Radiotherapy, Institute of Physics Publishing, Bristol and Philadelphia, 2002.
2. Faiz M Khan and Roger A Potish, Treatment Planning in Radiation Oncology, Williams and Wilkins, USA, 2003.
3. Faiz M Khan , The Physics of Radiation Therapy, 3rd edition, Lippincott Williams&Wilkins, USA, 2003.
4. Jatinder R Palta and T. Rockwell Mackie, Intensity Modulation Radiation Therapy, Medical Physics publishing, Madison , Wisconsin, 2003.
5. AAPM Report No.72 , Basic Applications of Multileaf collimators, AAPM, USA, 2001.
