# Prospectus/ Curriculum:

**Name of the course: Diploma in Medical Radiotherapy Technology (DMRT):**

***The DMRT course is affiliated from Aryabhatta Knowledge University (AKU), Patna and approved from "Atomic Energy Regulatory Board (AERB), Govt. Of India, Anushati Nagar, Mumbai"***

Duration of the course: 2 years + 3 months (Three months) compulsory post examination training.

**Objective of the course:**

At the end of the course the candidates should be:

1. Able to execute all routine radio therapeutic procedures as per prescription and direction of Radiation Oncologist.
2. Able to operate and maintain Radiotherapy equipments used in treatment of cancer patient, Radiotherapy planning & Procedures under the guidance of Medical Physicist.
3. Able to provide adequate knowledge about the safe handling of medical radiation sources, keeping in mind the radiation protection of staff, patients and public.

**Medium of Instruction**: English.

**Rules governing the course:**

1. The following are the minimum qualification to entry in the said course:
   a. That he/she has passed the Higher Secondary (10+2) or equivalent examination recognized by any Indian University or a duly constituted Board with pass marks in Physics, Chemistry, Biology/Mathematics.
   b. That he/she has attained the age of 17 years as on -(current year) & maximum age limit is 30 years.
   c. That he/she has to furnish at the time of submission of application form, a certificate of Physical fitness from a registered medical practitioner and two references from persons other than relatives testifying to satisfactory general character.

**Procedure for submission of application:**

1. Eligible candidate are to submit the application form for admission in DMRT Course, annexed to this Prospectus, duly filled-in neatly and correctly and countersigned by any Gazetted Officer affixing his Seal there on by ----------(before submission date)
2. The filled-in application for admission to DMRT course attached with the prospectus is to be sent to the "Director, Mahavir Cancer Sansthan, Phulwarishrif, Patna-801505,Bihar, by registered post/ Courier superscripting the envelope with the words, " Application for the Admission in DMRT course" so as to reach him on or before the last date----------.
3. Attested copies of Marks Sheet for H.S./10+2 OR equivalent exam. Admit Card for proof of Age, SC/ST/PH certificate should be submitted along with filled in application form.
4. Application form received after the last date will not be accepted irrespective of the date of dispatch.
5. Incomplete application will be treated as cancelled.

**Mode of Selection:**

1. Mode of selection by a selection committee will be marks obtained in 10+2 or equivalent and the performance in the interview (50% + 50%).
2. The Merit list of candidates will be displayed on ---------- at the notice board, Director's office, Mahavier Cancer Sansthan, Phulwarisharif, Patna-801505.
3. After selection or publication of Merit List or during admission if it is found on scrutiny that an applicant has furnished wrong information in the Application Form, his/her application for admission will be summarily rejected even though his/her name appears in the Merit List and also a seat allotted in the respective course.
4. Counselling for admission in respect of successful candidates from the Merit List in order to Merit at a fixed venue, date and time will be notified by the Director, Mahavir Cancer Sansthan, Phulwarisharif, Patna during publication of Merit List.
5. A Candidate allotted a seat on a particular counselling date will have to deposit Rs. 70,000/- (Seventy thousand only) at the time of admission – by Demand Draft drawn in favour of "The Director, Mahavir Cancer Sansthan" payable at Patna, failing which his/her seat will be cancelled.
6. No separate intimation will be sent to any candidate by the Mahavir Cancer Sansthan, Phulwarisharif, Patna, for admission in the course.
7. In the matter of admission of a candidate to this course, the decision of the Director, Mahavir Cancer Sansthan, Phulwarisharif, Patna shall be final and binding

**Fees payable by the students**

1. The selected candidate is to pay the total Course fee of Rs 70,000(fifty thousand) only for two years, which may be paid in two equal instalments.
2. The above course fee does not include students Registration fees and examination fee for university (Aryabhatta Knowledge University) & caution money (Refundable) of Rs 5,000/- (five thousand) only.
3. The candidates will have to bear the entire expenses for undergoing the courses and the MCS will not award any stipend for this purpose.

**Mode of Fees payable by the students of all the institution:**

The above charges are payable in the following manner:

1. Either 100% or 50% i.e. Rs 35000/- (Rupees thirty five thousand) at the time of admission.
2. Rest 50% i.e. Rs 35000/- at the beginning of second year at the MCS office. The Second year students will also be allowed to start classes only on production of original Money Receipt for payment of 2nd year course fees issued by the MCS office and without production of such a receipt no student will be allowed to continue studies in the 2nd year classes.

**Eligibility for appearing in the examination:**

A candidate has to secure at least 80% attendance (separately in theoretical and Practical) for appearing at the examination. No relaxation, whatsoever, will be permissible to this rule under any ground including indisposition etc.

**Cancellation of admission**

The Director, MCS shall have the right of cancellation of admission and/or studentship of any student during the session if he/she is found guilty of any of the following charges:

1. Suppression of information
2. Supply of false information
3. General misconduct unbecoming of a student
4. Adoption of unfair means at the examination and
5. General indiscipline.

**Syllabus and Scheme of Study:**

The theory portion will be covered through class room training as per routine and for practical parts of Radiotherapy and Radio diagnosis; the trainee will be posted to the department of Radiotherapy and Radio diagnosis. Internal assessment will be conducted at the end of each posting; there marks will be included in the final assessment of the candidate and on the basis of internal assessment, the approval will be given to the candidate to appear in the theory and practical examination. During the course the trainees will be permitted to avail holidays as per the hospital rule. Only medical leave is allowed for DMRT trainees.

- ✓ ***DMRT***

**Syllabus of the course & Structure of the course:**

| Year | Paper | Marks | | |
|---|---|---|---|---|
| | | Class Test/ Sessional | Semester Exam. | Total |
| 1st. | 1. **Paper I – Elementary Mathematics & Physics** | 20 | 80 | 100 |
| | 2. **Paper II-Radiotherapy Physics-part-1** | 20 | 80 | 100 |
| | 3. **Paper II-Anatomy, Physiology,** | 20 | 80 | 100 |
| | 4. **Paper IV- Pathology & Patient care** | 20 | 80 | 100 |
| | 5. **Paper –V-Practical part-1** | | | 50 |
| 2nd. | 1. **Paper VI- Radiotherapy Physics- part-2** | 20 | 80 | 100 |
| | 2. **Paper VII- Radiobiology** | 20 | 80 | 100 |
| | 3. **Paper-VIII –Radiological Safety in Radiotherapy** | 20 | 80 | 100 |
| | 4. **Paper IX- Radio therapeutic Practices & Principle of Treatment** | 20 | 80 | 100 |
| | 5. **Paper -X-Practical part-2** | | | 50 |
| | 6. **Viva** | | | 100 |
| | | Total= 1000 | | |

****Pass marks will be 50% of aggregate and minimum 50% in each paper**

**Paper-I (Elementary Mathematics & Physics)**

**Chapter-1: Elementary Mathematics**

1. Calculation of percentage, Profit & Loss, Simple interest, compound interest, time & work ,Ratio & proportion, Surds, Indices, Logarithm, Inverse Square Law,
2. Geometry of triangles, Similar triangles, Properties of Triangles
3. Trigonometry: Height & Distance
4. Graphical Representation of Exponential and Inverse exponential functions, Linear and semi-log graphs. **(total-16 classes)**

**Chapter-2: Basic Physics, Electrostatics, Magnetism & Current Electricity**

1. Units & Dimension, Newton's Laws of Motion, Velocity & Speed, Force, Momentum etc.
2. Coulomb's Law, Electric field & potential, Capacitance, Ohm's Law, Heating effect of current, Biot-Severt Law, Definition of Tesla and Gauss, Magnetic field due to circular coil. Elementary Principles of-Magnetization of Materials by electric current, Electromagnets. Lorentz force. Magnetic flux. Electromagnetic induction, mutual and self inductance. Transformer, Eddy current. Alternating Current, RMS and Average Current. Variation of Voltage and current in AC circuit consisting only Resistor, Only Induction and Only Capacitor. Power factor of the AC circuit.
3. Instruments: Electrometer, Galvanometer, Ammeter, & Voltmeter **(20 Classes)**

**Paper- II (Radiotherapy Physics-part-1)**

**Chapter-1: Physics of Radiation**

1. Definition of Radiation and is types. Electromagnetic Radiation, Radiation as a wave motion. Wave length, Frequency, Amplitude, Velocity and their Relations. Concept of Quanta, Energy of Radiation, Electromagnetic spectrum, Common Properties of Radiation. **(05 Classes)**
2. Radioactivity: Atomic and Nuclear structures, Rutherford and Bohr Atomic modal of Hydrogen Atom. Atomic Number, Mass Number, Atomic mass, Binding energy, energy level, Nuclear Binding energy, NP ratio, definition of Radioactivity , Natural Radioactivity, Artificial Radioactivity, radioactive decay, half life, decay constant, mean line and their relation, specific activity, Radiation from Radioactive elements, alpha and beta particle, Gamma radiation and their properties. Radioactive series. Properties of Radium and its daughter products. Radioactive equilibrium. Units of activity. The curie and Becquerel, Specific Gamma Ray Constant. Fission & Fusion. **(10 classes)**
3. X-ray- Conduction of electricity though gases, effect of Varying pressure, cathode rays, X-rays. Principles of production of X-rays, Intensity, continuous and characteristic spectrum. Basic circuit of X-ray tube. Construction of Modern X-ray tubes, Filament, Anode, Cathode,

Methods of Cooling Anode, Inherent Filtration, added filtration and their effect on Quality of Spectrum, Rectification. Basic principle of CT and MRI. **(10 classes)**

**4. Chapter II: Interaction of Radiation with Matter.**

1. Attenuation of Radiation of E.M. Radiation. Attenuation and Absorption coefficients, Linear Attenuation Coefficient, Mass Electronic and Atomic Absorption Coefficients. Energy Transfer and Absorption coefficients. Modes of interaction, coherent Scattering, Photoelectric effect, Compton Effect, pair production, photo disintegration. Energy Absorption in Biological material, the effect of bone on depth dose curves, energy absorption in cavities within bone.
2. Basic principles of interaction of Charged particle with matter and Bragg peak. **(15 classes)**

**5. Chapter III: Radiation Units and Measurements**

1. Radiation quantities: Exposure, KERMA, Absorbed Dose and units.
2. The Ionizing Process: Ionization of air as a basis for a practical System of Dosimetry. Photon and energy flux density and fluence. Principle of measurement-Ionization, different regions of operation of gas filled detectors. Ionization and Scintillation detectors. Photographic, Calorimetric, Thermo luminescence Dosimetry Principles. Measuring instruments, Dosimeters. Quality of Radiation. HVL and its measurements. **(20 classes)**

**Paper III (Anatomy, & Physiology,)**

Introduction: The standard aimed is that a more extensive and detailed knowledge is required of surface and regional anatomy, since during the treatment knowledge of the size and position of organs is of paramount importance. Emphasis should be made in the appropriate context of topographical relation of the organs of the body.

**Chapter-1 Anatomy & Physiology**

1. Structure and function of cell; cell division; tissue: definition and classification (Gross outline)
2. General Anatomical terms and topography of the body-planes regions, positions, movements.
3. Skeleton & joints- Long bones, vertebrae, pelvic and shoulder girdles, hands and feet, skull , face and teeth; parts of classical long bone; outline of different joints and type of movements.
4. Muscles; Classification, structure and function (Gross outline)
5. Brain & spinal cord with its coverings and cavities including cerebrospinal fluids and pituitary gland (Macroscopic anatomy and surface anatomy only)
6. Head & Neck; Oral cavity & lips, Pharynx, Larynx, Nasal Cavity and Para Nasal sinuses, Salivary Glands, Ear; Orbit & its content; Thyroid Glad and Nodal Areas (Macroscopic Anatomy only)
7. Thorax: Structure of Thoracic cage, Oesophagus, Trachea, Lungs & Pleura, The Mediastinum including Thymus, Heart and Great Vessels and Diaphragm (Macroscopic and Surface Anatomy)
8. Abdomen: Structure of Abdomen & Peritoneum, Retro Peritoneal structures (including Kidney), Stomach, Small Intestine, Colon, Liver, Pancreas, Spleen (Macroscopic and Surface Anatomy)
9. Pelvic and Perineum: Structure of Pelvis, Rectum & Anus, Bladder, Prostate, Female Genital Tract, Male Genital Tract and Inguinal Femoral Region (Macroscopic and surface Anatomy)
10. Lymphatic system and Reticulo-endothelial system (Gross outline only)- Position and function of Lymph Nodal regions ( Including Neck, Axilla, Mediastinum, paraaortic, Inguinal) Extranodal Lymphatic Tissues(Waldeyer's Ring, Spleen and Liver, Malt, Bone Marrow, Thymus) and Re System; Lymphatic Drainage. (total-50 classes)

**Paper IV (Pathology & Patient care)**

**Chapter -I**

Introduction: Teaching of Pathology and the clinical aspect of disease should be at the elementary level with the intention of providing a background to the students understanding of the work being carried out in the department.

1. Elementary Pathology- Degeneration and process of cell death, Repair or wounds, inflammation, infection, immunity (Brief outline only)
2. Tumours- Definitions, causes, different classifications, spread, General effects**.(10 classes)**

**Chapter II Patient care**

1. Hospital procedure: Hospital staffing and organization; records relating to patients and departmental statistics, professional attitude of the technologist to patients and other members to the staff; medico-legal aspects accidents in the departments appointments organization; minimizing waiting time, out –patient and follow-up clinics; stock-taking and stock keeping.
2. Care of the patient: First contact with patients in the department, management of chair and stretcher patients and aids for this , management of the unconscious patient, elementary hygiene, personal cleanliness, hygiene in relation to patients (for example clean linen and receptacles, nursing care, temperature pulse and respiration, essential care of the patient who has a tracheotomy, essential care of the patients who has a colostomy, bedpans and urinals, simple application of a sterile dressing. First aid, Infection (Bacteria, spread of infections, auto-infection etc).
3. Drugs in the department: Storage: Classification; labelling and checking, regulations regarding dangerous and other drugs, unit of measurement, special drugs, anti-depressive, anti-hypertensive etc.**(total-15 classes)**

# 2nd Year

## Paper VI (Radiobiology)

### Chapter I Effect of Radiation on the Body

1. Physical, chemical and biological effect of radiation (Including radiation induced cell death), Principles of Radiotherapy (Differential effects on tumours and tissues) Therapeutic gain; Four R's of Radiobiology and fractionation; Acute and late effects of different organs of the body including skin and mucous membrane; Effects of whole body acute and chronic radiation exposure; acute Radiation syndrome; Lethal dose.
2. Factors Modifying Radiation Effect: Patient Related – Age, State of Health, tumour type, site, blood supply, oxygenation, organ at risk, previous treatment, treatment related- Type of Radiation, Dose, Volume, Total time and Fractionation of Treatment LET, RBE, and OAR; Response to Radiation; Radio-sensitivity, and Radio-curability. (total-15 classes)

## Paper VII (Radiological Safety in Radiotherapy)

1. **Basic Radiation Therapy Physics**: Historical developments in Radiotherapy, Physicals components of Tele-cobalt Unit/Linear Accelerator Unit/Remote After Loading Brachytherapy Unit/ Gamma Knife Unit/ Simulator and their descriptions. Various types of sources used in Radiotherapy and their properties, Physics of Photons, electrons, protons and neutrons in radiotherapy, Physical parameters of dosimetry such as Percentage Depth Dose, Tissue-Air Ratio, Tissue Maximum Ratio, Physics of Bolus and Phantom materials, Compensators, Wedges, Shielding Blocks, Patient immobilization devices, Port film, Processing and development, special techniques in Radiotherapy such as SRS, SRT, IMRT, IGRT, and Tomotherapy. (10 classes)
2. **QA in Radiotherapy:** Accessories and tools used for QA tests in Radiotherapy such as Front pointer, Back pointer, Laser Alignments etc. Optical Radiation field congruence, Bam shaping blocks, Beam shaping jaws, Delineator/Diaphragm movements , Isocentre, alignment, Patient support system, Beam on and off mechanisms, Technician's role in QA tests on tele-cobalt/Linear Accelerator/Brachythearapy/Gamma-knife/Simulator/CT Simulator machines.(10classes)
3. **Radiation Emergency Preparedness:** Safety and security of radiation sources, case histories of emergency situations and preparedness, equipments and tools including role of Gamma Zone Monitor, Regulatory requirement and prevention of emergency, Preventive maintenance and Safety Culture, Role of Technicians in handling radiation emergencies.(3 classes)
4. **Radiation Protection:** Definition of parameters and their units used in Radiation. Personnel Monitoring- Film badge & TLD badges. Protection level instruments.(3 classes)
5. **Regulatory Requirements:** National Regulatory Body, Responsibilities, organization, Safety Standards, Codes and Guides, Responsibilities of licensees, registrants and employers and Enforcement of Regulatory requirements.(3 classes)

**Paper-VIII- (Radiotherapy Physics - part-2 & Radiography)**

Introduction: Emphasis should be place on the principles of the subject. The treatment should be comprehensive but excessive detail should be avoided.

Chapter-1 Radiotherapy Treatment Machines

Telecobalt unit, Medical Linear Accelerator, Gamma knife, Cyber knife, Tomotherapy-Clinical advantages, networking, R & V system, EPID, CBCT, Virtual simulation, Physical simulation. Brachytherapy (Pre, Manual and Remote after loader). (5 classes)

Chapter-II Treatment technique

Treatment techniques: Manual treatment using table and chart, Isocentric vs non isocentric . Arc/ volumetric, Skip therapy. (5 classes)

Chapter-III Planning Procedure

1. Planning procedure: Manual and CT simulation, Isodose line, Tumour localization, field selection, tissue inhomogeniety correction, single and multiple field technique. Large field and extended SSD technique. Field junctions and matching
2. Beam modifying devices and Mould room procedure: Wedge, Compensator, Bolus, Breast cone etc. Patient immobilization techniques, Mould room procedures, Preparation of Mould. (10 classes)

Chapter-IV Modern Techniques in Radiotherapy

3. Modern techniques: 3DCRT, Electron Beam Therapy, IMRT, IGRT, SRS,SRT and SBRT.(5 classes)

Radiography:

Radiographic Photography:

1. X-ray film materials: Structure of film emulsions-grain technology-Geliatin-Baseic film types-film formats and packing –Direct exposure dualities films- Single coated emulation- Films for specialized use-manufacturing process.
2. Intensifying screens and cassettes: Intensifying screen phosphor-construction-Intensifying factor-speed and detail cross over. Effect-resolution mottle-reciprocity- screen asymmetry-screen-film contact- Screen type and cleaning.
3. Photochemistry: film processing – latent image formation Mechanism-theory-Developer-nature of development-pH scale-constitution of developer- development time-facts in the use of developer. Fixer and washing. ( total 10 classes)

**Paper IX (Radio therapeutic Practices & Principle of Treatment)**

**Introduction:** The emphasis in this subject will be on Practical Instruction and Demonstration.

1. Method of Diagnosis (Elementary Principles)- Clinical Radiographic, Histological/Cytological and Biochemical Methods.
2. Staging of cancer and their clinical importance (Brief outline)
3. Treatment Modalities: General Principles of Medical, Surgical and Radio Therapeutic Methods.
4. Principles Underlying Choice of Treatment- Age and Performance, status of patient, CO morbid condition, type of neoplasm (Sensitivity to a particular treatment modality), stage off disease, accessibility, Nature of tumour bed (Relation to bone, Air to Organ at Risk), Radial and Palliative treatment.
5. Cancer in Special sites ( A Brief Description of Pathology, symptoms, signs, complications, natural history of Disease in each site and methods of treatment with particular reference to Radiotherapy techniques should be given)
    a. Head & Neck: Oral Cavity & Lips, Pharynx, Larynx, Nasal cavity and Para Nasal Sinuses, Salivary Glands, Ear.
    b. Thyroid Glands.
    c. Thorax: Esophagus, Lung, Mediastinum, (Including Thymus)
    d. Abdomen: Stomach, Small Intestine, Colon, Liver, Gall Bladder and Pancreas and Kidney.
    e. Pelvis: Testis, Prostate, Bladder and Penis, Uterine Cervix, Endometrium, Ovary, Vagina, Velva, Rectum, Anus.
    f. Breast
    g. Bone Tumours and soft tissue sarcoma.
    h. Brain, Spinal cord and Pituitary.
    i. Lymphoid and other Mematological Malignancies.
    j. Skin.
    k. Benign Diseases
6. Care of Patients undergoing Radiotherapy: Behaviours and physical and emotional support to the patients, identifying toxicities and other problems, routine check up and verifications, care of toxicities , when and how to communicate with Radiation Oncologist and Medical Physicists. (toal-30 classes)

**Paper V & X –Practical & Demonstration**

**Practical part-1:**

1. Preparation of Mould for head & neck case.
2. Preparation of Mould for Pelvis case.
3. Study of mould room equipment in Radiotherapy.
4. Preparation of customise shielding block for Cobalt unit.
5. Preparation of patient set-up in SAD technique.
6. Study of difference between SSD & SAD technique. (12 classes)

**Practical Part-2:**

1. Study of Record and Verify system in External Radiotherapy.
2. Study of operational safety mechanism of Medical Linear Accelerator.
3. Study to Radiological Safety mechanism of Cobalt Unit.
4. Online verification of patient set-up by EPID (Head & Neck).
5. Online verification of patient set-up by EPID (Pelvic).
6. Daily Quality Assurance in Cobalt unit.
7. Daily Quality Assurance in Remote Afterloader Brachytherapy Unit.( 14 classes)

**Demonstration:**

1. Time Distance and Shielding ,measurement of HVT & TVT
2. Familiarisation of Radiation survey meters and their function performance checks.
3. Radiation survey of Cobalt and Brachytherapy Units.
4. Time Distance and Shielding ,measurement of HVT & TVT
5. Familiarisation of Radiation survey meters and their function performance checks.
6. Radiation survey of Cobalt and Brachytherapy Units.
7. Daily Quality Assurance test for Tele cobalt and Brachytherapy unit. (14 classes)

**Books for study:**


- Anatomy and Physiology for Radiographers- C.A. Warrick
- Gray's anatomy Descriptive and applied- T.B. Johnstor
- An atlas of Normal Radiographic Anatomy- Richard & Alvin
- Essentials of Human Anatomy- Russell
- First year Physics for Radiographers- Hay & Hughes.
- Basic Radiological Physics- K. Thayalan, Jaypee publishers (p) Ltd, New Delhi (2001)
- Fundamental of X-ray and Radium Physics- Joseph Selman
- Basic Medical Radiation Physics- Stanton.
- Chrtistensen's Physics of Diagnostic Radiology- Christensen
- Radiographic Imagine-Chesney & Chesney, Blakwell Scientific publications, oxford (1981)
- Radiographic imaging- Derrick P. Roberts and Nigel
- A guide to Radiotherapy nursing (Livingstone)- Deeley
- Care of the cancer patient- Capra
- Radiation therapy in the management of cancers- Fletcher & Gilbert
- Care of patient in diagnostic Radiography- Chesney & Chesney.
- First Aid- Haugher & Gardner
- The Physics of Radiation Therapy- Faiz M Khan, Williams and Wilkins
- Physics of Radiology- Johns. Haronld and Conningham
- Text book of Physics applied to Radiotherapy and Radio diagnosis- Massey and Meredith.
- Short text book of Radiotherapy- Walter and Miller
- Radiation dosage the Manchester system- Meredith W J (et al)
- Radiation Oncology- Rationale technique results- Moss
- Radiation Protection in Hospitals- Richard F. Mould
- An introduction to Radiation Protection- Allen Martin & Samuel
- Radiation safety in Medical Practice- M.M. Rehani
- AERB Safety codes

# Admission form

## Diploma in Medical Radiotherapy Technologist (DMRT) Course (2011-13)

For official uses:

No allotted:

Payment detail:

Signature of dealing clerk:

Signature of course coordinator:

Approval of the Director:

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Self attested passport size photograph

Of the candidate

1. Name of the candidate:
2. Date of Birth:
3. Father's Name:
4. Mother's Name:
5. Permanent Address:

6. Address of communication:

7. Name of Local guardian:

8. Local address:

9. Phone number:

10. Mobile number of the candidate:

11. Educational Qualification:

| Degree/Diploma | Board/University | Subject | % of mark |
|---|---|---|---|
| 10th/Matriculation | | | |
| 10+2/Equivalent | | | |
| | | | |

12. Any criminal offence pending: Yes/ No.

13. Declaration:

    I hereby certify that the above information is correct and best of my knowledge.

    Signature of Guardian  Signature of the Candidate

    Date:

    Place: