सत्यमेव जयते

National Commission for Allied and Healthcare Professions

COMPETENCY BASED CURRICULUM

for

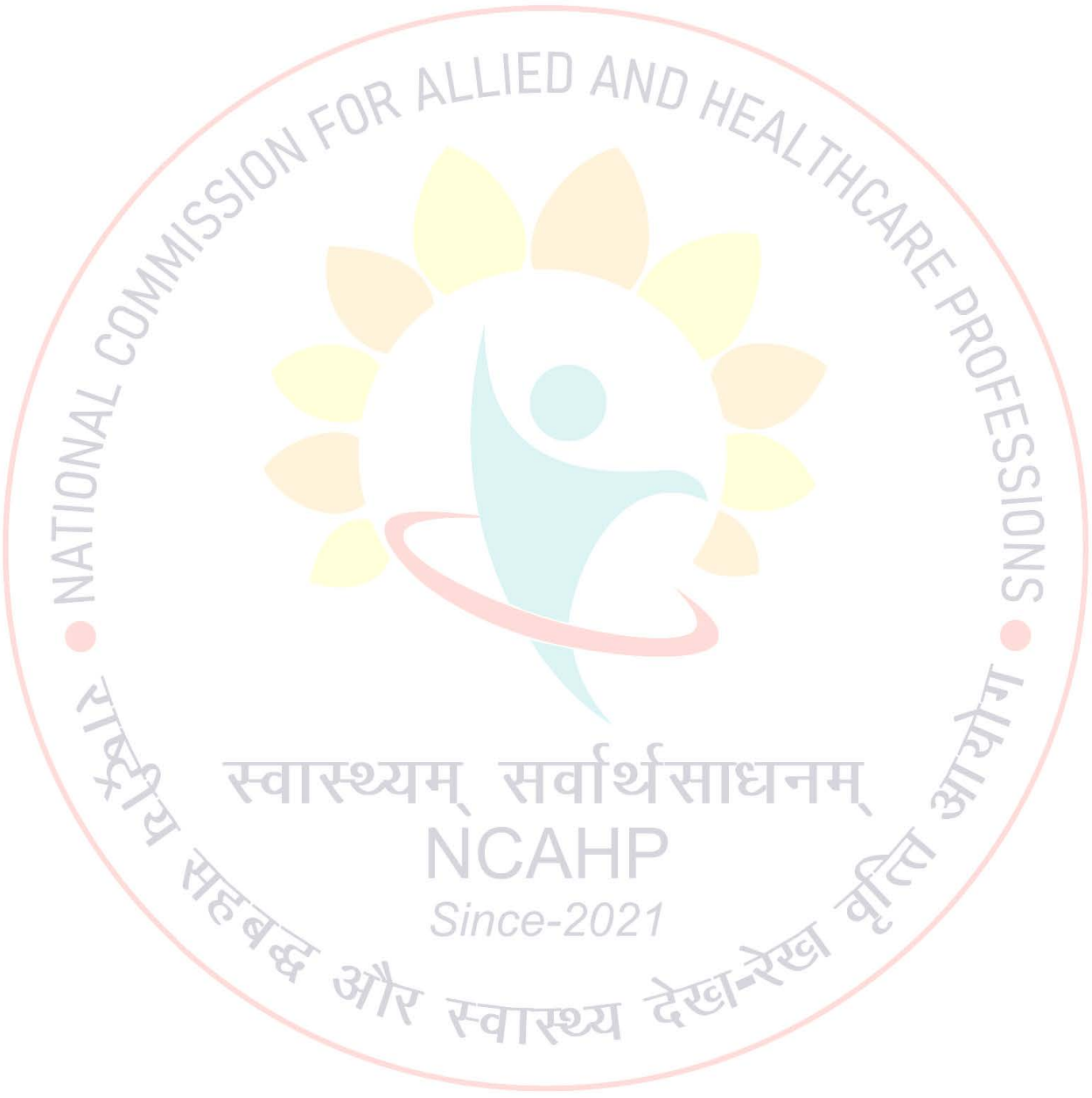
"RADIOTHERAPY TECHNOLOGY"

As per the NCAHP Act -2021

APPROVED SYLLABUS

2025

Ministry of Health & Family Welfare


NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
राष्ट्रीय संबद्ध और स्वास्थ्य देख-रेख पेशा आयोग
स्वास्थ्यम् सर्वार्थसाधनम्
NCAHP
Since-2021

Contents

CONTRIBUTORS TO DRAFTING AND REVIEW

1. Mr. Saji A V ,Senior Technical officer Department of Radiotherapy, AIIMS, Delhi

2. Mr. Prasath Bhaskaran, Chief Radiation Therapist
Amrita Institute of Medical Sciences , Kochi, Kerala.

3. Mr. Amit Gupta Deputy Chief Radiotherapy Technologist
Medanta The Medicity Global Health Limited, Gurgaon ,Haryana

3. Mr. George Biju Varghese, Technical Officer
Tata Memorial Hospital Homi Bhabha Block, Mumbai. Maharashtra.

4. Mr. Deepak Rahangdale Senior Radiotherapist
Balco Medical Centre (Unit of Vedanta medical research foundation), Chhattisgarh

5. Mr. Suryaprakash V Yadadu, Radiotherapy Technologist,
Jawaharlal Institute of Post Graduate Medical Education and Research (JIPMER), Puducherry

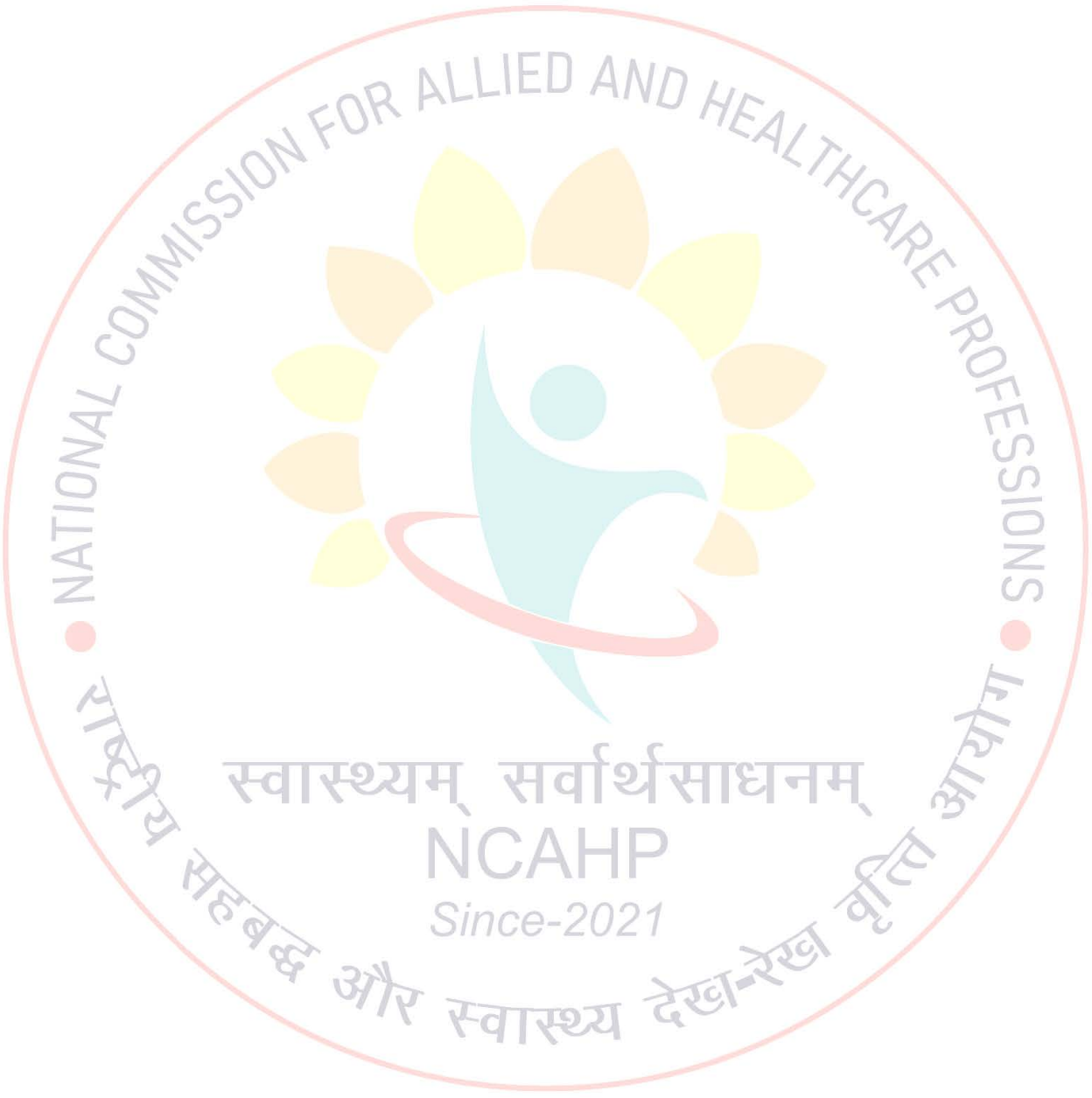
6. Mr.Gurvinder Singh Wadhawan Chief RTT cum Coordinator BSc RT
Department of Radiotherapy Rajiv Gandhi cancer Institute & Research Centre Delhi , AND
Lead Expert RTT curriculum Task force

List of Abbreviations

2D	Two Dimensional
3D	Three Dimensional
4D	Four Dimensional
AED	Automated External Defibrillator
AERB	Atomic Energy Regulatory Board
AHC	Anterior Horn Cell
AHP	Allied Health Professional
BARC	Bhabha Atomic Research Centre
BJR	British Journal of Radiology
BLS	Basic Life Support
BMW	Bio Medical Waste
BRW	Brown-Roberts-Wells
BSc	Bachelor of Science
BVM	Bag-Valve-Masks
CATS	Credit Accumulation and Transfer System
CBCS	Choice-Based Credit System
CbD	Case-based Discussion
CBSE	Central Board of Secondary Education
CEX	(Mini)Clinical Evaluation Exercise
CNS	Central Nervous System
CPR	Cardiopulmonary Resuscitation
CPU	Central Processing Unit
CRW	Cosman-Roberts-Wells
CT	Computed Tomography
CTV	Clinical Target Volume
DEXA	Dual-energy X-ray Absorptiometry
DNA	Deoxyribo Nucleic Acid
DOPs	Direct Observation of Procedures
DRR	Digitally Reconstructed Radiographs
DSA	Digital Subtraction Angiography
DVT	Deep Vein Thrombosis
EBRT	External Beam Radiotherapy
ECG	Electrocardiogram
ECTS	European Credit Transfer System
EEG	Electroencephalography
EMG	Electromyography
END	Electroneuro Diagnostic
EPID	Electronic Portal Imaging Device
ERCP	Endoscopic Retrograde Cholangiopancreatography
FDG	Fluorodeoxyglucose F- 18 Injection
FNAC	Fine-Needle Aspiration Cytology

GI	Gastro Intestinal
GTV	Gross Tumour Volume
HDR	High Dose-Rate
HSSC	Healthcare Sector Skill Council
HVT	Half Value Thickness
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
ICRU	International Commission on Radiation Units
ICT	Information & Communication Technology
IITV	Inverse Internal Target Volume
ILO	International Labour Organization
IMRT	Intensity-Modulated Radiation Therapy
ITV	Internal Target Volume
JCI	Joint Commission International
LAN	Local Area Network
LDR	Low Dose-Rate
LQ	Linear Quadratic
MAN	Metropolitan Area Network
MDCT	Multiple Detector Computed Tomography
MLB	Mid Line Block
MLC	Medico Legal Case
MLC	Multi Leaf Collimator
MMLC	Micro-Multi Leaf Collimator
MoHFW	Ministry of Health and Family Welfare
MOSFET	Metal–Oxide–Semiconductor Field-Effect Transistor
MRCP	Magnetic Resonance Cholangio Pancreatography
MRI	Magnetic Resonance Imaging
MS	Microsoft
MSc	Master of Science
NAAC	National Assessment and Accreditation Council
NABH	National Accreditation Board for Hospitals & Healthcare Providers
NAL	Non-Action Levels
NCRC	National Curricula Review Committee
NIAHS	National Initiative for Allied Health Sciences
NMI	Nuclear Medicine Imaging
NSDA	National Skills Development Agency
NSQF	National Skills Qualification Framework
NTCP	Normal Tissue Complications Probability
OAR	Organs at Risk
OSCE	Objective Structured Clinical Examination
OSLER	Objective Structured Long Examination Record
OSPE	Objective Structured Practical Examination

PACS	Picture Archival and Communication Systems
PCN	Percutaneous Nephrostomy
PDD	Percentage Depth Dose
PDR	Pulsed Dose-Rate
PET	Positron Emission Tomography
PhD	Doctor of Philosophy
PMS	Premenstrual Syndrome
PNS	Peripheral Nervous System
PPE	Personal Protective Equipment
PSF	Peak Scatter Factor
PTC	Percutaneous Transhepatic Cholangiography
PTV	Planning Target Volume
QA	Quality Assurance
QC	Quality Control
RAD	Radiation Dose
RECIST	Response Evaluation Criteria In Solid Tumors
RFA	Radiation Field Analyzer
RM	Risk Management
RMP	Resting Membrane Potential
RTT	Radiation Therapist
SAD	Source Axis Distance
SCA	Sudden Cardiac Arrest
SDL	Self -Directed Learning
SPECT	Single-Photon Emission Computed Tomography
SRS	Stereotactic Radio Surgery
SRT	Stereotactic Radiation Therapy
SSDL	Secondary Standard Dosimetry Laboratory
TAR	Tissue Air Ratio
TCP	Tumour Control Probability
TLD	Thermoluminescent Dosimeter
TMR	Tissue Maximum Ratio
TPR	Tissue Phantom Ratio
TPS	Treatment Planning System
TSU	Technical Support Unit
TVT	Tenth Value Thickness
UGC	University Grants Commission
UHC	Universal Health Coverage
WAN	Wide Area Network
WHO	World Health Organization
WWW	World Wide Web


NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
राष्ट्रीय संबद्ध और स्वास्थ्य देख-रेख पेशा आयोग
स्वास्थ्यम् सर्वार्थसाधनम्
NCAHP
Since-2021

Chapter 1

Introduction to the Handbook

Chapter 1: Introduction to the Handbook

Radiotherapy is a critical component of cancer treatment, utilizing precise radiation techniques to target and destroy cancerous cells while preserving healthy tissues. As advancements in medical technology continue to transform the field, the role of skilled radiotherapy professionals has become more essential than ever. The demand for highly trained specialists who can operate cutting-edge equipment, ensure patient safety, and collaborate within multidisciplinary oncology teams is steadily increasing.

This Curriculum Handbook for Radiotherapy Professions has been designed in accordance with the National Commission for Allied and Healthcare Professions (NCAHP) guidelines, ensuring standardization in education, training, and professional competencies across institutions. The handbook provides a structured framework for the academic and clinical training of radiotherapy professionals, equipping them with the necessary theoretical knowledge, technical skills, and ethical considerations required in modern oncology care.

Key features of this curriculum include:

A comprehensive competency-based structure covering fundamental principles of radiotherapy, radiation physics, treatment planning, and patient care.

A strong emphasis on practical skill development through hands-on clinical training, simulation-based learning, and exposure to emerging technologies such as intensity-modulated radiotherapy (IMRT), image-guided radiotherapy (IGRT), and proton therapy.

Integration of patient-centric approaches, ensuring that graduates are equipped to provide safe, compassionate, and effective care in diverse clinical settings.

By establishing a unified curriculum, this handbook aims to enhance the quality of radiotherapy education in India, reduce variations in training standards, and ultimately contribute to improved cancer care outcomes. It serves as a guiding document for universities, colleges, educators, healthcare institutions, and aspiring radiotherapy professionals—ensuring that they are aligned with national and global best practices in radiation therapy.

With a well-trained radiotherapy workforce, the healthcare system will be better positioned to meet the growing demand for cancer treatment services, making high-quality, technology-driven oncology care accessible to all. As a result, the National Commission for Allied and Healthcare Professions has introduced this handbook to provide structured educational frameworks and competency-based curricula for radiotherapy profession.

Definition of Allied and Healthcare Professionals

The National commission for allied and health care professions act defines the Allied & healthcare professionals as:

Allied and Healthcare Professional:

Allied and healthcare professionals (AHPs) perform any technical and practical task to support diagnosis and treatment of illness, disease, injury or impairment, and to support implementation of any healthcare treatment and referral plan recommended by a medical, nursing or any other healthcare professional, and who has obtained any qualification of diploma or degree under this Act, the duration of which shall not be less than two thousand hours spread over a period of two years to four years divided into specific semesters.

Healthcare Professionals:

Healthcare Professional includes a scientist, therapist or other professional who studies, advises, researches, supervises or provides preventive, curative, rehabilitative, therapeutic or promotional health services and who has obtained any qualification of degree under this Act, the duration of which shall not be less than three thousand six hundred hours spread over a period of three years to six years divided into specific semesters.

Scope and need for Radiotherapy Technologists in the Indian Healthcare System

Radiotherapy Technologists (RTTs) play a crucial role in cancer treatment by ensuring the accurate and safe delivery of radiation therapy. As cancer cases in India continue to rise, the demand for well-trained RTTs is increasing significantly. With advancements in radiation technology such as IMRT, IGRT, SRS, SBRT, and proton therapy, skilled professionals are essential to operate sophisticated equipment, plan treatments, and provide patient care.

The scope of radiotherapy technologists extends across government and private hospitals, cancer research centers, academic institutions, and specialized oncology clinics. They work closely with radiation oncologists and medical physicists to ensure precise radiation delivery while minimizing risks to healthy tissues.

Despite the growing need, India faces a shortage of trained RTTs, creating a gap in quality cancer care. Strengthening radiotherapy education, standardizing training, and integrating advanced technologies into the curriculum can enhance treatment outcomes, improve accessibility to radiation therapy, and support India's goal of Universal Health Coverage. Investing in skilled RTTs will not only bridge this gap but also elevate the country's oncology care standards to global levels.

Learning goals and objectives for allied and healthcare professionals

The handbook has been designed with a focus on performance-based outcomes pertaining to different levels. The learning goals and objectives of the undergraduate and graduate education program will be based on the performance expectations. They will be articulated as learning goals (why we teach this) and learning objectives (what the students will learn). Using the framework,

students will learn to integrate their knowledge, skills and abilities in a hands-on manner in a professional healthcare setting. These learning goals are divided into nine key areas, though the degree of required involvement may differ across various levels of qualification and professional cadres:

1. Clinical care
2. Communication
3. Membership of a multidisciplinary health team
4. Ethics and accountability at all levels (clinical, professional, personal and social)
5. Commitment to professional excellence
6. Leadership and mentorship
7. Social accountability and responsibility
8. Scientific attitude and scholarship (only at higher level- PhD)
9. Lifelong learning

1. Clinical Care[1]

Using a patient/family-centred approach and best evidence, each student will organize and implement the prescribed preventive, investigative and management plans; and will offer appropriate follow-up services. Program objectives should enable the students to:

- Apply the principles of basic science and evidence-based practice
- Use relevant investigations as needed
- Identify the indications for basic procedures and perform them in an appropriate manner
- Provide care to patients – efficiently and in a cost-effective way – in a range of settings, and maintain foremost the interests of individual patients
- Identify the influence of biological, psychosocial, economic, and spiritual factors on patients' well-being and act in an appropriate manner
- Incorporate strategies for health promotion and disease prevention with their patients

2. Communication[1,2]

The student will learn how to communicate with patients/clients, care-givers, other health professionals and other members of the community effectively and appropriately. Communication is a fundamental requirement in the provision of health care services. Program objectives should enable the students to:

- Provide sufficient information to ensure that the patient/client can participate as actively as possible and respond appropriately to the information
- Clearly discuss the diagnosis and options with the patient, and negotiate appropriate treatment plans in a sensitive manner that is in the patient's and society's best interests

- Explain the proposed healthcare service – its nature, purpose, possible positive and adverse consequences, its limitations, and reasonable alternatives wherever they exist
- Use effective communication skills to gather data and share information including attentive listening, open-ended inquiry, empathy and clarification to ensure understanding
- Appropriately communicate with, and provide relevant information to, other stakeholders including members of the healthcare team
- Use communication effectively and flexibly in a manner that is appropriate for the reader or listener
- Explore and consider the influence that the patient's ideas, beliefs and expectations have during interactions with them, along with varying factors such as age, ethnicity, culture and socioeconomic background
- Develop efficient techniques for all forms of written and verbal communication including accurate and timely record keeping
- Assess their own communication skills, develop self-awareness and be able to improve their relationships with others
- Possess skills to counsel for lifestyle changes and advocate health promotion

3. Membership of a multidisciplinary health team[3]

The student will put a high value on effective communication within the team, including transparency about aims, decisions, uncertainty and mistakes. Team-based health care is the provision of health services to individuals, families, and/or their communities by at least two health providers who work collaboratively to accomplish shared goals within and across settings to achieve coordinated, high quality care. Program objectives will aim at making the students being able to:

- Recognize, clearly articulate, understand and support shared goals in the team that reflect patient and family priorities
- Possess distinct roles within the team; to have clear expectations for each member's functions, responsibilities, and accountabilities, which in turn optimizes the team's efficiency and makes it possible for them to use division of labour advantageously, and accomplish more than the sum of its parts
- Develop mutual trust within the team to create strong norms of reciprocity and greater opportunities for shared achievement
- Communicate effectively so that the team prioritizes and continuously refines its communication channels creating an environment of general and specific understanding
- Recognize measurable processes and outcomes, so that the individual and team can agree on and implement reliable and timely feedback on successes and failures in both the team's functioning and the achievement of their goals. These can then be used to track and improve performance immediately and over time.

4. Ethics and accountability

Students will understand core concepts of clinical ethics and law so that they may apply these to their practice as healthcare service providers. Program objectives should enable the students to:

- Describe and apply the basic concepts of clinical ethics to actual cases and situations
- Recognize the need to make health care resources available to patients fairly, equitably and without bias, discrimination or undue influence
- Demonstrate an understanding and application of basic legal concepts to the practice
- Employ professional accountability for the initiation, maintenance and termination of patient-provider relationships
- Demonstrate respect for each patient's individual rights of autonomy, privacy, and confidentiality

5. Commitment to professional excellence[4]

The student will execute professionalism to reflect in his/her thought and action a range of attributes and characteristics that include technical competence, appearance, image, confidence level, empathy, compassion, understanding, patience, manners, verbal and non-verbal communication, an anti-discriminatory and non-judgmental attitude, and appropriate physical contact to ensure safe, effective and expected delivery of healthcare. Program objectives will aim at making the students being able to:

- Demonstrate distinctive, meritorious and high quality practice that leads to excellence and that depicts commitment to competence, standards, ethical principles and values, within the legal boundaries of practice
- Demonstrate the quality of being answerable for all actions and omissions to all, including service users, peers, employers, standard-setting/regulatory bodies or oneself
- Demonstrate humanity in the course of everyday practice by virtue of having respect (and dignity), compassion, empathy, honour and integrity
- Ensure that self-interest does not influence actions or omissions, and demonstrate regards for service-users and colleagues

6. Leadership and mentorship[5]

The student must take on a leadership role where needed in order to ensure clinical productivity and patient satisfaction. They must be able to respond in an autonomous and confident manner to planned and uncertain situations, and should be able to manage themselves and others effectively. They must create and maximize opportunities for the improvement of the health seeking experience and delivery of healthcare services. Program objectives should enable the students to:

- Act as agents of change and be leaders in quality improvement and service development, so that they contribute and enhance people's wellbeing and their healthcare experience
- Systematically evaluate care; ensure the use of these findings to help improve people's experience and care outcomes, and to shape clinical treatment protocols and services
- Identify priorities and effectively manage time and resources to ensure the maintenance or enhancement of the quality of care
- Recognize and be self-aware of the effect their own values, principles and assumptions may have on their practice. They must take charge of their own personal and professional development and should learn from experience (through supervision, feedback, reflection and evaluation)
- Facilitate themselves and others in the development of their competence, by using a range of professional and personal development skills
- Work independently and in teams. They must be able to take a leadership role to coordinate, delegate and supervise care safely, manage risk and remain accountable for the care given; actively involve and respect others' contributions to integrated person-centred care; yet work in an effective manner across professional and agency boundaries. They must know when and how to communicate with patients and refer them to other professionals and agencies, to respect the choices of service users and others, to promote shared decision-making, to deliver positive outcomes, and to coordinate smooth and effective transition within and between services and agencies.

7. Social Accountability and Responsibility[6]

The students will recognize that allied and healthcare professionals need to be advocates within the health care system, to judiciously manage resources and to acknowledge their social accountability.[7] They have a mandate to serve the community, region and the nation and will hence direct all research and service activities towards addressing their priority health concerns. Program objectives should enable the students to:

- Demonstrate knowledge of the determinants of health at local, regional and national levels and respond to the population needs
- Establish and promote innovative practice patterns by providing evidence-based care and testing new models of practice that will translate the results of research into practice, and thus meet individual and community needs in a more effective manner
- Develop a shared vision of an evolving and sustainable health care system for the future by working in collaboration with and reinforcing partnerships with other stakeholders, including academic health centres, governments, communities and other relevant professional and non-professional organizations
- Advocate for the services and resources needed for optimal patient care

8. Scientific attitude and Scholarship[7]

The student will utilize sound scientific and/or scholarly principles during interactions with patients and peers, educational endeavours, research activities and in all other aspects of their professional lives. Program objectives should enable the students to:

- Engage in ongoing self-assessment and structure their continuing professional education to address the specific needs of the population
- Practice evidence-based by applying principles of scientific methods
- Take responsibility for their educational experiences
- Acquire basic skills such as presentation skills, giving feedback, patient education and the design and dissemination of research knowledge; for their application to teaching encounters

9. Lifelong learning[8] (CONTINUING EDUCATION-CMEs)

The student should be committed to continuous improvement in skills and knowledge while harnessing modern tools and technology. Program objectives will aim at making the students being able to:

- Perform objective self-assessments of their knowledge and skills; learn and refine existing skills; and acquire new skills
- Apply newly gained knowledge or skills to patient care
- Enhance their personal and professional growth and learning by constant introspection and utilizing experiences
- Search (including through electronic means), and critically evaluate medical literature to enable its application to patient care
- Develop a research question and be familiar with basic, clinical and translational research in its application to patient care
- Identify and select an appropriate, professionally rewarding and personally fulfilling career pathway

Introduction of new elements in allied and healthcare education

Competency-based curriculum

A significant skill gap has been observed in the professionals offering healthcare services irrespective of the hierarchy and level of responsibility in the healthcare settings. The large variation in the quality of services is due to the diverse methodologies opted for healthcare education and the difference in expectations from a graduate after completion of a course and at work. What one is expected 'to perform' at work is assumed to be learned during the course, however, the course design focuses on what one is expected 'to know'. The competency-based curriculum thus connects the dots between the 'know what' and 'do how'.

The efficiency and effectiveness of any educational programme largely depends on the curriculum design that is being followed. With emerging medical and scientific knowledge, educators have realized that learning is no more limited to memorizing specific lists of facts and data; in fact, by the time the professional aims to practice in the healthcare setting, the acquired knowledge may stand outdated. Thus, competency-based education is the answer; a curricular concept designed to provide the skills that professionals need. A competency-based program is a mix of skills and competencies based on individual or population needs (such as clinical knowledge, patient care, or communications approaches), which is then developed to teach relevant content across a range of courses and settings. While the traditional system of education focuses on objectives, content, teacher-centric approach and summative evaluation; competency-based education has a focus on competencies, outcomes, performance and accomplishments. In such a case, teaching activities are learner-centred, and evaluation is continuous and formative in structure. The competency-based credentials depend on the demonstration of a defined set of competencies which enables a professional to achieve targeted goals. Competency frameworks comprise of a clearly articulated statement of a person's abilities on the completion of the credential, which allows students, employers, and other stakeholders to set their expectations appropriately.[9] [10]

Considering the need of the present and future healthcare delivery system, the curriculum design depicted in this handbook thus will be based on skills and competencies.

Promoting self-directed learning of the professionals

The shift in the focus from traditional to competency-based education has made it pertinent that the learning processes may also be revisited for suitable changes. It is a known fact that learning is no more restricted to the boundaries of a classroom or the lessons taught by a teacher. The new tools and technologies have widened the platform and introduced innovative modes of how students can learn and gain skills and knowledge. One of the innovative approaches is learner-centric and follows the concept of **self-directed learning.**

Self-directed learning, in its broadest meaning, describes a process in which individuals take the initiative with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying resources for learning, choosing and implementing learning strategies and evaluating learning outcomes (Knowles, 1975).[11]

In self-directed learning, learners themselves take the initiative to use resources rather than simply reacting to transmissions from resources, which helps them learn more in a better way.[12] Lifelong, self-directed learning (SDL) has been identified as an important ability for medical graduates (Harvey, 2003)[13] and so is applicable to other health professionals including A&HPs. It has been proven through many studies worldwide that the self-directed method is better than the teacher-centric method of learning. Teacher-directed learning makes learners more dependent and the orientation to learning becomes subject-centred. If a teacher provides the learning material, the student is usually satisfied with the available material,

whereas if a student is asked to work on the same assignment, he or she invariably has to explore extensive resources on the subject.[12]

Thus the handbook promotes self-directed learning, apart from the usual classroom teaching and opens the platform for students who wish to engage in lifelong learning.

Integrated structure of the curriculum

Vertical integration, in its truest sense, is the interweaving of teaching clinical skills and knowledge into the basic science years and, reinforcing and continuing to teach the applications of basic science concepts during the clinical years. (Many efforts called 'vertical integration' include only the first half of the process).

Horizontal integration is the identification of concepts or skills, especially those that are clinically relevant, that cut across (for example, the basic sciences), and then putting these to use as an integrated focus for presentations, clinical examples, and course materials. e.g. Integration of some of the basic science courses around organ systems, e.g., human anatomy, physiology, pathology; or incorporating ethics, legal issues, finance, political issues, humanities, culture and computer skills into different aspects of a course like the Clinical Continuum.

The aim of an integrated curriculum is to lead students to a level of scientific fluency that is beyond mere fact and concept acquisition, by the use of a common language of medical science, with which they can begin to think creatively about medical problems.[14]

This innovative new curriculum has been structured in a way such that it facilitates horizontal and vertical integration between disciplines; and bridges the gaps between both theory & practice, and between hospital-based practice and community practice. The amount of time devoted to basic and laboratory sciences (integrated with their clinical relevance) would be the maximum in the first year, progressively decreasing in the second and third year of the training, making clinical exposure and learning more dominant.[8] However it may differ from course to course depending on the professional group.

Introduction of foundation course in the curriculum

The foundation course for allied and healthcare professions is an immersive programme designed to impart the required knowledge, skills and confidence for seamless transition to the next semester of a professional allied and healthcare course. This aims to orient the student to national health systems and the basics of public health, medical ethics, medical terminologies, communication skills, basic life support, computer learning, infection prevention and control, environmental issues and disaster management, as well as orientation to the community with focus on issues such as gender sensitivity, disability, human rights, civil rights etc. Though the flexibility to the course designers have been provided in terms of – modifying the required numbers of hours for each foundation subject and appropriate placement of the subject across various semesters.

Learning methodologies

With a focus on self-directed learning, the curriculum will include a foundation course that focuses on communication, basic clinical skills and professionalism; and will incorporate clinical training from the first year itself. It is recommended that the primary care level should have sufficient clinical exposure integrated with the learning of basic and radiotherapy related sciences. There should also be an emphasis on the introduction of case scenarios for classroom discussion/case-based learning.

Table 1 Clinical learning opportunities imparted through the use of advanced echniques

Teaching modality	Learning opportunity examples
Patients	Teach and assess in selected clinical scenarios
	Practice soft skills
	Practice physical examination
	Receive feedback on performance
Mannequins	Perform acquired techniques
	Practice basic procedural skills
	Apply basic science understanding to clinical problem solving
Simulators	Practice teamwork and leadership
	Perform cardiac and pulmonary care skills
	Apply basic science understanding to clinical problem solving
Task under trainers	Tasks pertaining to the RTT training

Assessment methods

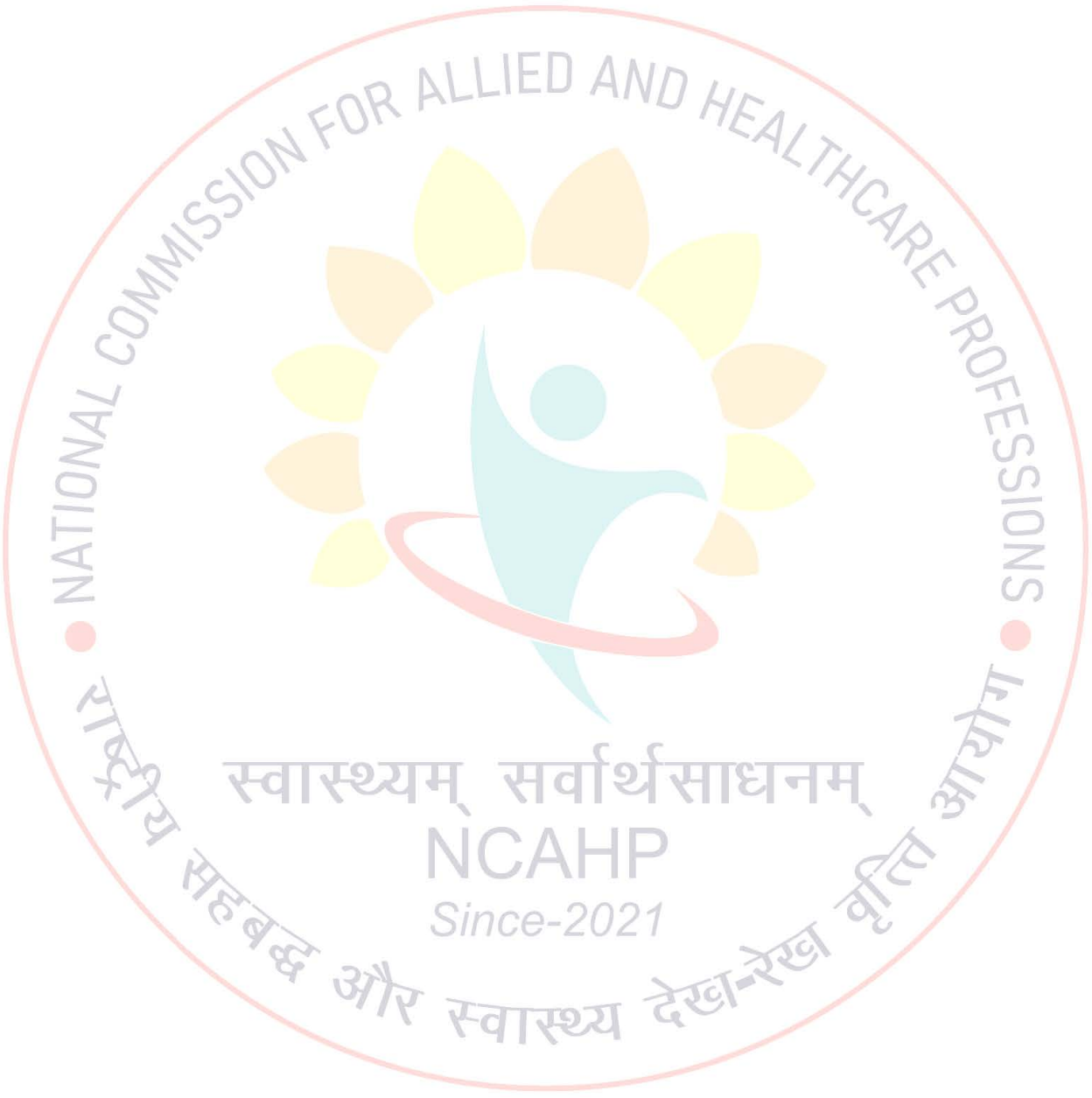
Traditional assessment of students consists of the yearly system of assessments. In most institutions, assessments consist of internal and external assessments, and a theory examination at the end of the year or semester. This basically assesses knowledge instead of assessing skills or competencies. In competency-based training, the evaluation of the students is based on the performance of the skills as per their competencies. Hence, all the three attributes – knowledge, skills, and attitudes – are assessed as required for the particular competency.

Several new methods and tools are now readily accessible, the use of which requires special training. Some of these are given below:

- Objective Structured Clinical Examination(OSCE), Objective Structured Practical Examination (OSPE), Objective Structured Long Examination Record(OSLER)
- Mini Case Evaluation Exercise(CEX)
- Case-based discussion(CBD)

- Direct observation of procedures(DOPs)
- Portfolio
- Multi-source feedback
- Patient satisfaction questionnaire

An objective structured clinical examination (OSCE) is used these days in a number of allied and healthcare courses, e.g. Optometry, Physiotherapy, and Radiography. It tests the performance and competence in communication, clinical examination, and medical procedures/prescriptions. In physiotherapy, orthotics, and occupational therapy, it tests exercise prescription, joint mobilization/manipulation techniques; and in radiography it tests radiographic positioning, radiographic image evaluation, and interpretation of results. The basic essential elements consist of functional analysis of the occupational roles, translation of these roles ("competencies") into outcomes, and assessment of trainees' progress in these outcomes on the basis of demonstrated performance. Progress is defined solely by the competencies achieved and not the underlying processes or time served in formal educational settings. Most methods use predetermined, agreed assessment criteria (such as observation check-lists or rating scales for scoring) to emphasize on frequent assessment of learning outcomes. Hence, it is imperative for teachers to be aware of these developments and they should suitably adopt them in the allied and healthcare education system.[15]


NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
राष्ट्रीय संबद्ध और स्वास्थ्य देख-रेख पेशा आयोग
स्वास्थ्यम् सर्वार्थसाधनम्
NCAHP
Since-2021

Chapter 2

Methodology of Curriculum Development

Chapter 2: Methodology of Curriculum Development.

In accordance with the National Commission for Allied and Healthcare Professions (NCAHP) Act, a structured methodology has been adopted to ensure uniformity, quality, and relevance in the curriculum for allied and healthcare professionals. This process prioritizes a skills- and competency-based approach, aligning with national healthcare needs and global best practices. Steps undertaken in the curricula review process.

The curriculum development followed a **multi-stage, consultative process** involving all the experts who were deliberated on the issues and a consensus was attained on the following thematic areas.

1. **Minimum curricula guidelines** are to be designed for Radiotherapy profession. Curricula should be patient-centric and futuristic. Must include the latest advancement in technology Should be aligned with global standards and allow global mobility

2. **All programs should be delivered in full-time mode** and no institution should deliver anypart-time or distance program in the health care sciences.

3. **Curricula must consider:**
    - Definition of the profession
    - Entry criteria to the profession the
    - Entry qualification to the profession- Bachelor level-programs desired in the profession other than entry qualification Nomenclature of the qualifications
    - Duration of each level of the program with the duration of the internship.
    - Must-have competencies at the end of each level and competencies must drive thecurriculum content.
    - Program evaluation framework/ assessment at the end of each program Number of desired faculty (with hierarchy/ designation) and defined minimum qualifications for each level of the program
    - Batch size and student and faculty ratios
    - Details of reference books, journals and desirable and essential equipment must also be considered.

4. **A pre-determined credit-based system is to be followed for Radiotherapy that ensure a basic minimum competency in essential subjects:**
    - Credits and the number of hours must be allocated to each subject.
    - While lateral entry and bridge programs can be devised for existing professionals forentry, multiple exits may not be implemented.

5. **Common entrance mechanism to be considered for Radiotherapy programs:**

- Universities can consider a common entrance exam along with 50% in 10+2 science (Biology and/or Mathematics as per the requirement of the professions) or equivalent or University/State entrance examination for admissions in the allied and healthcare programs.
- Remedial Biology/ Mathematics is to be considered if knowledge is desired in the domain and the entry criteria allow students without qualifying the same subjects in 10+2 or equivalent.

6. **The medium of teaching should be English.**

- Students from other boards without English as a compulsory subject may be encouraged to pick English as an elective from available resources on Swayamand similar platforms.
- The completion of the course will not lead to any university course credit (non-university course).

7. **Competency framework (including performance criteria and related knowledge, skill and behaviours) to be included in each level of the program.**

- Competencies should be measurable and aligned with assessments.
- Foundations Courses may be spread across the length of the program and weightage to the content/ number of hours/credits may vary as per the requirement of individual professions.
- Soft skills and communication to be focused

8. **All programs must have a mandatory internship**

- The length of the internship will be determined by the extent of competencies tobe attained by the candidate after the program.
- Clinical programs can also mandate rotatory internships to increase the level ofclinical exposure to the students
- Teaching institutions should be accountable for ensuring the internship of thestudents in the affiliated hospital, as it is part of the academic program**.**
- Standalone institutions must have a MoU with either a medical college or hospital or healthcare facility as per the guidelines (desired number of beds/ OPD etc.) defined in the curriculum to ensure practical exposure to the students.
- MoU to also define the clinical supervision of the students -institutional staff or clinical preceptors can be considered.
- Stipend of reasonable amount must be paid for internship students.
- Internships cannot be reflected as work experience as those are part of the academic program.

- Studentship or observer-ship must also be in built into the curriculum.
- Simulation and skill labs can be used for practicing skills specific to the program if available in the initial years of observer-ship/ studentship.
- Some hours in every semester can be considered for seminars/workshops on new developments/ technologies.
- If the clinical facility is not within the same campus, transportation should beprovided to the students and interns.
- All practical skills must be supervised and recorded in a digital Logbook andskills to be evaluated after the completion of the internship

9. **Master's program should be promoted to develop specialization in the field and generate trained faculty inthe field**
    - All Master programs must focus on research and engage with industry partners to promote innovation and development in the field
    - Industry experts can be engaged as guest faculty/ conduct seminars under the frame-work of programs.
    - It was agreed upon that an exit examination (including testing of skills and competencies) can be potentially conducted by a third-party agency or organization as eventually identified by the ICAHP/ NCAHP. This can also evolve as a licensure examination for Radiotherapy professionals
    - A pre-determined credit-based system is to be followed for Radiotherapy that ensure a basic minimum competency in essential subjects:
    - Credits and the number of hours must be allocated to each subject.
    - While lateral entry and bridge programs can be devised for existing professionals forentry, multiple exits may not be implemented.
    - Common entrance mechanism to be considered for Radiotherapy programs:
    - Universities can consider a common entrance exam along with 50% in 10+2 science (Biology and/or Mathematics as per the requirement of the professions) or equivalent or University/State entrance examination for admissions in the allied and healthcare programs.
    - Remedial Biology/ Mathematics is to be considered if knowledge is desired in the domain and the entry criteria allow students without qualifying the same subjects in 10+2 or equivalent.

10. **The medium of teaching should be English**.
    - Students from other boards without English as a compulsory subject may be encouraged to pick English as an elective from available resources on Swayam and similar platforms.
    - The completion of the course will not lead to any university course credit (non-university course).

11. **Competency framework (including performance criteria and related knowledge, skill and behaviours) to be included in each level of the program**.

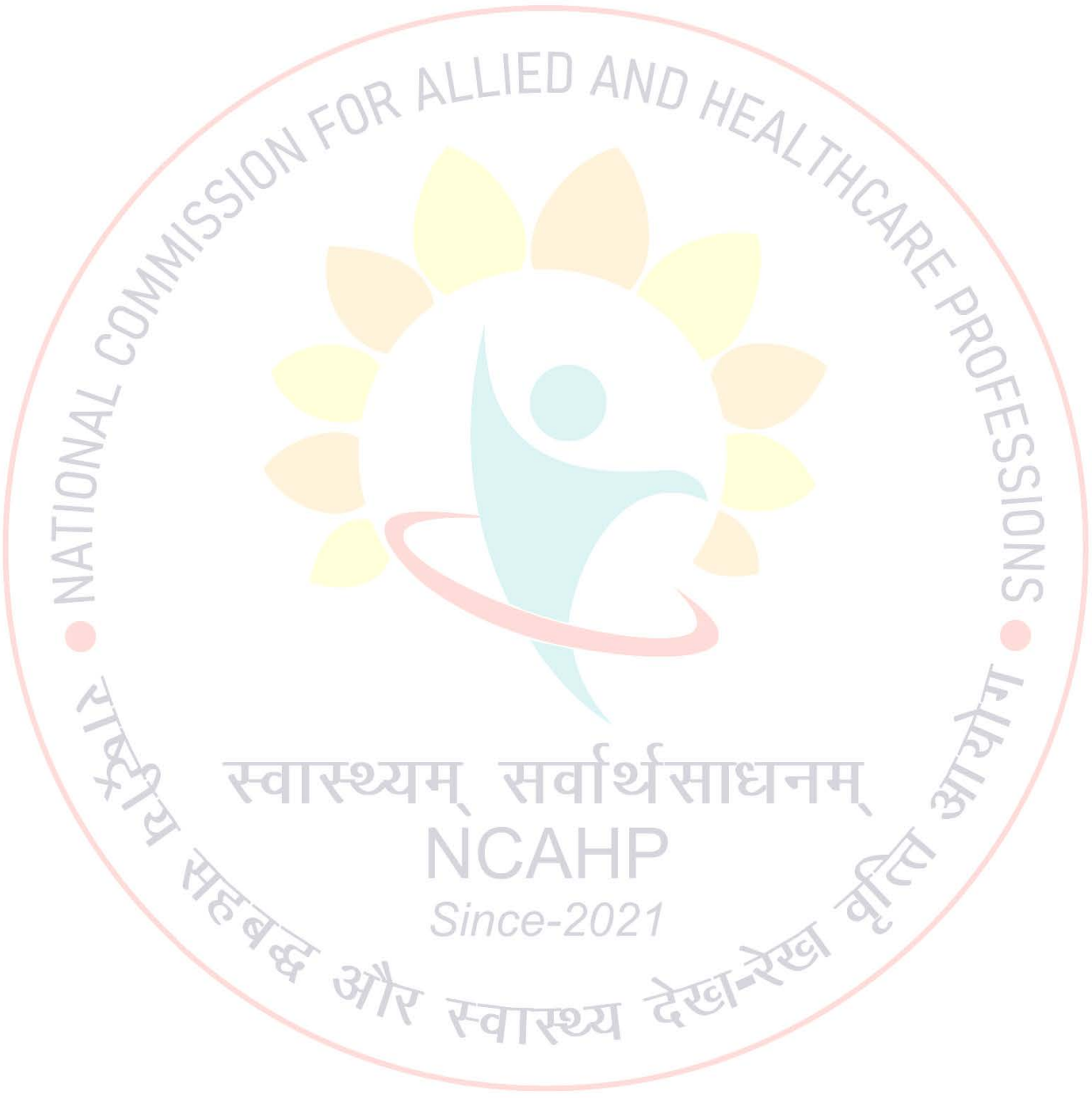
- Competencies should be measurable and aligned with assessments.
- Foundations Courses may be spread across the length of the program and weightage to the content/ number of hours/credits may vary as per the requirement of individual professions.
- Soft skills and communication to be focused

The existing curriculum was updated with the support of a newly appointed task force, comprising experts from various regions across India to ensure broad geographic representation and address the diverse healthcare needs of the nation.

To refine the syllabus structure, feedback was gathered from task force members and institutional representatives on key aspects such as program duration, recent advancements in the field, course sequencing, and credit distribution. The curriculum revision process involved 12 to 15 meetings, each lasting 2 to 3 hours, amounting to a total of 30 to 40 hours of dedicated effort to finalize the framework.

Further refinements were made to assessment methodologies, faculty requirements, and recommended textbooks to align with contemporary education standards. Competencies related to knowledge, skills, and professional attitudes were clearly defined for both undergraduate and postgraduate programs to ensure a comprehensive learning approach.

Once the updated curriculum was submitted to the Ministry, it was released for public feedback. All the response were reviewed by the task force. Following this, members convened for 7 to 8 additional meetings, totalling 20 to 25 hours, to deliberate on the feedback and make necessary modifications. After thorough review and discussion, the final curriculum was successfully formulated, ensuring its relevance, applicability, and alignment with national and global standards.


NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
राष्ट्रीय संबद्ध और स्वास्थ्य देख-रेख पेशा आयोग
स्वास्थ्यम् सर्वार्थसाधनम्
NCAHP
Since-2021

Chapter 3
Background of the profession

Chapter 3: Background of the profession

Statement of Philosophy– Why this profession holds so much importance

Cancer is one of the leading causes of deaths in India, which has nearly three million patients suffering from the disease. Annually, nearly 500,000 people die of cancer in India. The World Health Organization (WHO) said this number is expected to rise to 700,000 by 2015.[16] According to the latest World Cancer Report from the WHO, more women in India are being newly diagnosed with cancer annually. As against 4.77 lakh men, 5.37 lakh women were diagnosed with cancer in India in 2012.[17]According to health ministry data, out of more than 300 cancer centres in India, 40 percent are not adequately equipped with advanced cancer care equipment. India will need at least 600 additional cancer care centres by 2020 to meet the requirements.[18] In India, a skewed doctor-to-patient ratio only worsens the situation.

Discovered more than 100 years ago, radiation therapy is one of the critical pillar in cancer treatment. As per American Cancer Society more than half of all people with cancer get radiation as at least part of their cancer treatment.[19]

Radiation is source of energy transferred as stream of particles or waves forms, which damages the genes (DNA) in the cells. These genes (DNA) are responsible for the division and growth of the cells; when these are damaged the cells loses the ability to grow and eventually die. Which means radiation is a mode to kill the cancer cells and shrink tumours. Radiation therapy is an important tool for treating cancer, and is often used in conjunction with other therapies, such as chemotherapy or tumour-removal surgery.

As the technology advances, it becomes imperative to have skilled professionals who can deliver radiation therapy to the patients and can work with the oncology team. Thus, Radiation Therapist (RTTs) play an important role in the professional health care team, working closely with radiation oncologists and medical physicists in the delivery of optimal treatments, primarily to cancer patients. The RTT's operate radiation equipment to deliver high energy ionising radiation treatments. In addition to delivering treatment to patients, they demonstrate care and empathy to guide the patients through the treatment process. However, the level of decision making within the radiotherapy team may differ in different settings of healthcare facilities.

About Radiotherapy

Radiotherapy, also called radiation oncology, radiation therapy, or therapeutic radiology is the use of ionizing radiation to treat benign and/or malignant disease. The forms of ionizing radiation relevant to the treatment of cancer are X-rays, gamma rays, and particulate radiation beams. The radiation either causes the direct disruption of the cells when it extends through the tissues or leaves enough energy within the tissue which results in fast moving particles causing damage to the tissue and cells.

The ionizing radiation also has the capability to break the double stranded DNA in the nucleus of the cell thereby, preventing replication or decelerating the progression or even reversing the damage due to the malignant disease.

It is imperative to indicate that radiation therapy deals with prescribing radiation for the purpose of treatment, which is distinct from radiology, which uses radiation for the purpose of medical imaging and diagnosis. Radiotherapy is synergistic with chemotherapy, and is used before, during, and/or after chemotherapy in susceptible cancers. [20,21]

Scope of practice

Radiation Therapists also known as therapy radiographers or radiotherapy technicians in India are important allied healthcare professionals in the fight against cancer. They are the crucial link between the clinical and the physical sciences in radiotherapy, being responsible for a critical step in radiotherapy process and verification of setup through basic and advance imaging acquisition 2D, 3D , 4D , VMAT, SGRT and precise matching with different anatomical landmarks with decision making authority to that is delivery of radiation to the cancer patients. Therefore, interacting with clinicians (radiation oncologists), physical scientists (medical physicists) and the patients is an important part of their profession. Apart from handling the radiotherapy equipment, patient immobilization and set-up, they do patient monitoring for radiation related/other visible effects when the patients report for treatment planning/simulation/radiotherapy sessions are other important responsibilities of the RTTs. The RTTs complete the final step in safe and precise treatment delivery to the patients. To discharge these important responsibilities, the RTTs should be equipped with the necessary education and skills during their education and training. There are around 300 cancer treatment centres across the country and more are expected to be established in the coming years to meet the demand. The scope for practice of the RTTs is increasing with advancement of technology and increasing patient load. Therefore, it is necessary to mention that Radiation Therapy Treatment is almost irreversible in nature. The RTT only knows what/where actually Radiation is delivered while in a zone of Mega voltage usage, needs to understand, synthesise and Implement the advanced Technology based treatment techniques.

Recognition of Title and qualification

In order to avoid any confusion/conflict in the role of the RTTs vis-a-vis the other professionals namely radiation oncologists and medical physicists that has potential for adverse impact on treatment and radiological safety

The recommended title thus stands as the Radiation Therapist with the acronym - RTT for this group of professionals

It is a known fact that with the career advancement, the nomenclature will also vary and will also depend on the sector and profile of the professional.

Considering the 10 NSQF levels designed by the ILO, the following level progression table has been proposed by the taskforce to map the nomenclature, career pathways and progression in different sectors of professional practice for RTTs.

The proposed progression is for further discussion and deliberation, the implementation time of the same may vary depending on the current system and regulations in place.

The table 2 below indicates the various channels of career progression in three distinct sectors such as clinical setting, academic and industry (management/sales or technical) route. It is envisaged that the RTT will have two entry pathways – students with diploma or degree. The level of responsibility will increase as the career progresses. The career will start at level four (4) for diploma holders and level five (5) for degree holders. The table also indicates the corresponding level of qualification with experience required by the professional to fulfil the requirements of each level. On the academic front, as per UGC guidelines, to work at the position of a Lecturer/Assistant Professor the candidate must attain a master's degree. For teaching/training of RTTs, apart from radiation oncologists and medical physicists, qualified RTTs are needed. Hence, MSc in RTT will be encouraged at teaching institutions to prepare the teachers/tutors for RTT courses. Also, in the present there a few centres that are awarding PG Diploma in RTT to work as RTTs. A bridge course for PGDRTT holders is needed for certain number of years to bring them at par with the master level courses (MSc in RTT) and thus provide additional tutors/teachers for RTT courses. Eventually, it is envisaged that the PGDRTT will be phased out.

Table 2 Nomenclature based on career progression for Radiation Therapists (RTT) Expected placements:

Nomenclature in various sectors			Qualification and experience
Professional	**Academic**	**Management /Application specialist in industry**	
Junior Radiation Therapist (Grade II)		Junior Technical Associate	Diploma in Radiation Therapy Technology (DRTT)
Junior Radiation Therapist (Grade I)		Technical Associate I	• PGDRTT • BSc. RTT • DRTT with≥ 3 years of post- diploma experience

Radiation Therapist/Technical Officer**	Tutor (BSc. RTT & PGDRTT	Technical Associate II /Manager	• PGDRTT with ≥ 5 years' post-PGRTT experience • BSc. RTT with ≥ 5 years' post-BSc. RTT experience • DRTT with ≥ 8 years' of post-diploma experience
Senior Radiation Therapist/ Sr Technical Officer**	Senior Tutor((BSc. RTT, PGDRTT MSc RTT	Senior Technical Associate/ Senior Manager Grade I	• MSc. RTT • PGDRTT with ≥ 10 years' post-PG diploma experience • BSc. RTT with ≥ 10 years' of post-BSc. RTT experience • Diploma RTT with ≥ 13 years of post-diploma experience
Chief Radiation Therapist/ Chief Technical Officer**	Assistant Professor RTT (PGDRT & MSc RTT	Chief Radiation Therapist/ Senior Manager Grade II	• MSc. RTT with ≥ 5 years post MSc. RTT • PGDRTT with ≥ 15 years post-PG diploma experience • BSc. RTT with ≥ 15years post-BSc. RTT experience • Diploma RTT with ≥ 18 year of post diploma experience
Additional Technical Director	Radiation Therapy -Professor (PGDRT & MSc RTT)	DEPUTY GENERAL MANAGER (DGM)	MSc RT / PGD RT with 16- 20 years B.Sc. RT 21-25 year experience
Technical Director	Principal	GENERAL MANAGER (GM)	MSc RT/ PGD RT with 21-25 years B.Sc. RT 26-30 year experience

**The nomenclature / career progression is prevailing at premier medical institutions such as AIIMS, New Delhi.

BRIDGE COURSE FOR ACADEMIC UPGRADATION

Under Graduate 2 Year Diploma - Can enter 3rd semester or 2nd year BSc
Post Graduate 2 Year Diploma --- Can enter 2nd year/4th semester of MSc

IT IS RECOMMENDED THAT EXISTING PROFESSIONAL HAVING PGDRT /BSc/Diploma QUALIFICATION AND WORKING AS TEACHING FACULTIES MANDATARILY GIVEN OPURTUINITY TO UPGRADE THIR QUALIFICATION & if possible reserve seats for these professionals

Definition of Radiation Therapist (RTT)

The Radiation Therapist (RTT) is a member of the multidisciplinary team comprised primarily of the clinician (radiation oncologist), medical physicist and support staff as considered necessary in the local setting. They are the professionals with direct responsibility for the daily administration of radiotherapy treatment to cancer patients.

This includes treatment preparation, planning assistance, simulation, patient immobilisation, treatment delivery, patient counselling and QA data collection wherever prescribed during irradiation on a daily basis. As the professional in daily contact with the patient it also includes monitoring of side effects and appropriate referral.

Education of the Radiation Therapist

From the scope of practice it is evident that an RTT should be (a) a good communicator to effectively interact with not only the staff/other categories of professionals but also with the patients and their relatives (ii) He/she should have knowledge of the clinical aspects of cancer, its treatment and visible side-effects especially related to radiotherapy (iii) should have knowledge of the various types of radiations, radiation generating eqpt and their functioning (iv) Should have knowledge of radiation interactions, and dosimetry techniques (v) Should have knowledge of the various steps/processes involved in treatment planning (vi) Should be competent to operate the radiotherapy eqpt (vii) Should be competent in patient handling, immobilization techniques and patient positioning/set-up for treatment/simulation (viii) Should be competent in handling and checking the treatment related data and data transfer among the various radiotherapy systems (ix) Should be competent in monitoring the radiation treatment delivery in terms of both equipment and patient parameters that include data acquisition related to patient QA, and daily machine QA as per the departmental protocol (x) Should have knowledge about radiological safety issues in radiotherapy and also about the procedures/processes adopted in an emergency situation. He/she should be competent to perform his/her role effectively in an emergency situation (xi) should be competent to handle data/record keeping and documentation, and patient management that includes providing treatment slots.

The curriculum should be accordingly designed to meet the requirements. Also, scope for progression in academic qualification and commensurate career progression should be kept in mind. India, being a large, populous and diverse country, fast augmentation of such high-skilled human resource for expanding cancer care programmes is urgently needed. Any training programme should first keep in mind the need of the country while still imparting training that is internationally relevant.

A **2-year diploma programme** for training the RTTs in India to meet the fast emerging needs. This programme should be a balanced mix of class room teaching and hands-on training to impart the basic knowledge/ concepts of the subjects and to develop and

hone the skills of the students towards attaining competency in the desired areas. It can be easily appreciated that initially observational and later hands-on training should form the core of the training programme. (Program needs to be phased out)

A **degree programme Bachelor in RTT (Total 4 years including 1 year internship)** should cover additional topics and training as compared to the diploma programme in specialized and complex radiotherapy processes to develop competency in the same. More exposure towards imaging modalities such as CT, MRI, PET should be given to develop competency in the delivery of image guided radiotherapy. Scientific basis of radiotherapy such as radiobiology, recent advances in the field of RT, patient care in radiotherapy, introduction to research methodology, operational issues in RT, coordination with ROs and MPs in implementing new technologies for treatment should be covered in the degree programme. **Lateral entry to diploma holders for the degree should be provided at third year level (III/V semester).**

A **postgraduate programme (Masters in RTT)** should primarily cater towards creating trainers/teachers for the RTT diploma/degree RTT programmes. also, the course should contain clinical research, pedagogical and teaching methodologies, data analysis, and human resource planning and management. It should provide opportunity to the RTTs to increase the academic qualification and career progression primarily in an academic institution.

The following curriculum aims to focus on skills and competencies based approach for learning and is designed accordingly. The curriculum is prescriptive and is designed with an aim to standardize the content across the nation.

Entry requirements

As per the AERB guidelines it is recommended that the students entering the RTT programme should have completed the recognized secondary school studies as the qualification stipulated for RTT course (diploma/degree) is **10+2 or equivalent examination with science subjects PCB (mandatory)/ Mathematics (optional), if only PCM (remedial Biology)** from a recognized university or board which would provide the foundation for and prepare them for higher education studies.[22]

Course duration

It is recommended that any programme developed from this curriculum should have a minimum of the following duration to qualify as an entry level professional in radiation therapy -

- **2.5 year programme : Diploma level (2-year academic & 06 months internship) to be phased out in 5 years**
- **4 years programme: Bachelor's degree level (3-year academic & 1 year internship)**
- **2 years programme: Master's degree level (2 years including dissertation)**

The emphasis initially should be on the academic content establishing a strong scientific basis and in the latter year on the application of theory to clinical/reflective practice. In Bachelor degree programme minimum 6 months should be devoted to clinical practice and this should be on a continuum of rotation from theory to practice over the programme.

A 2-year master's degree programme to provide scope for academic progression and create a resource of teachers/trainers for the RTT courses. In addition to building the capacity of the students as future RTT course teachers, including research methodologies in the curriculum of the master's course can provide a valuable resource for clinical research in the field of radiotherapy. Two or 3-year management courses post BSc (RTT) as offered by many institutions in hospital management or related fields could be another career progression ladder for the RTTs.

Teaching faculty and infrastructure

The importance of providing an adequate learning environment for the students cannot be over emphasized. Both the physical infrastructure and the teaching staff must be adequate.

Teaching areas should facilitate different teaching methods. Where students share didactic lectures with other disciplines (e.g. diagnostic radiographers, nurses) large lecture theatres may be appropriate, but smaller teaching areas should also be provided for tutorial and problem/case-based learning approaches. In all venues where students are placed the health and safety standards must be adhered to.
It is also recommended that RTT faculty in initial stage may not be having qualification as per UGC norms due to non-araciality of master's programme in RT , therefore highest available RT degree and PGDRT may be consider at par with master level courses .
It is recommended that a faculty and student ratio of **1:10** to be followed. The other details should be as per the Atomic Energy Regulatory Board (AERB) guidelines. Some of the radiation facilities covered under AERB jurisdiction are placed at Annex – 2. List of institutes recognized by AERB for the Radiation Therapist course are placed at Annex– 3. Use AERB guidelines

INTERNSHIP COMPETENCY

During internship placement the student will develop as a health care professional and gain an understanding of:

- how the radiotherapy department relates to and interacts with the other departments in the clinical environment;
- the patient pathway and the personnel involved at each stage;
- the radiotherapy team and the wider multidisciplinary team;
- their role and the appropriate communication skills and professional attitude in the clinical setting.

The learning outcomes that are related directly to clinical placement and the application of the areas covered in the academic programme are that the student should:

- Demonstrate an understanding of a typical patient pathway;
- Demonstrate an understanding of basic psychology and sociology and how these apply to the cancer patient;
- Apply their knowledge of the areas in radiotherapy, to the treatment of the patient with a professional and caring attitude;
- Explain the need for accuracy in treatment of the cancer patient;
- Demonstrate a sensitive and caring attitude to patients and discuss the necessity for good communication skills;
- Demonstrate a professional attitude and ability to reflect on their role;
- Apply principles of moving and handling for all practical manoeuvres;
- Reflect on their experience and how it has influenced their thinking.

Introduction and orientation to Hospital other specialities

During internship concerned institute will pay stipend to student per month

MINIMUM STANDARDS/INFRASTRUCTURE TO START A COURSE:

This can broadly be classified into 3 categories:

A) Equipment's/Machinery in the Dept. of Radiotherapy
B) Departments/ Units.
C) Qualified Personnel in the Radiotherapy Dept viz. Radiation Therapists, Radiation Oncologists, and Medical Physicists and also the Faculties of Anatomy and Physiology. Other personnel include Nursing staff, Clerical Staff and Labour Staff of the Hospital
D) Library.

A) The following minimum Facilities in a Radiotherapy Dept. for students of Diploma / Degree of Radiation therapy Technology includes:

1) A Teletherapy Unit
2) A Brachytherapy Unit
3) A Conventional or a C.T – Simulator
4) Mould Room.
5) Treatment Planning System(2D/3D)

B) Postings of students should include the following Departments/Units:

1) **Radiotherapy Dept. with mandatory postings** on above mentioned 5 units- these postings will equip the students with necessary skills to perform their tasks efficiently.
2) **Radiology and Nuclear Medicine Dept**. – to understand the role of imaging in Radiotherapy

3) **OPD of Radiation Oncology, Medical Oncology and Surgical Oncology** – To give a basic understanding of "Disease Management in Oncology" and "Management of Side effects of Radiotherapy and Chemotherapy"
4) **Wards, Day Care and Casualties**- to understand how the hospital functions and how are given Care at these places
5) **Biomedical and Waste Management Disposal System**- these postings will help students in the management of waste in their respective Departments
6) **CSSD (Central Sterile Supply Department)** - understanding the process of Sterilisation of Brachytherapy Applicators, Cotton and Gauze used for patients and Tools used in Patient Assessment like Speculum, forceps, Tongue Depressors, Laryngoscopes etc.

C) The Qualified Staff in the Dept of Radiation Oncology viz Radiation Therapists, Radiation Oncologists, and Medical Physicist will be responsible for taking lectures, Practical's and overall assessment of a student in Theory and Practical in the subjects of Radiotherapy Technology, Radiation Oncology and Medical Physics respectively.
The Faculties of Anatomy and Physiology will give these students the foundation of Human Biology and Diseases.
The interaction of students with Nursing staff will enable the students to understand the essentials of basic patient care that will help them better their work of Delivering Radiotherapy.
The Interaction of Students with Clerical Staff and Labour Staff will help the students understand the administrative aspects of their work

D) LIBRARY:

- The Library for Radiotherapy technology Students should be part of common Library in the Dept. Of Radiation Oncology which contains books for Radiation Oncologists and Radiation Physics.
- The library must include General books on Anatomy, Physiology, Pathology, Biochemistry, Patient Care in Oncology, General Nursing Books, Hospital Administration, Nutrition for Cancer patients undergoing Chemotherapy and Radiotherapy, Diagnostic Procedures in Labs, Radiodiagnosis and Nuclear medicines, Blood banking Technology, Medical records, O.T Techniques, Biomedical Waste Management, CSSD Procedures, First Aid Procedures, Medical Laws and Ethics, etc.
- A minimum of 150 books in General Oncology and in the specialised subjects of Radiation Oncology, Medical Oncology and Surgical Oncology. Also books on Radiation Physics and Dosimetry in the domain of Radiodiagnosis, Radiotherapy and Nuclear medicine must be available whenever required. Journals on Radiology, Radiotherapy and Radiation Physics must be made available for Research and Dissertation.
- 3 kinds of magazines, 3 kinds of newspapers and other kinds of current health related literature should be available in the library to be updated with latest trends in Oncology.

- A Library room should be large enough for
    i. storage of books, magazines and Journals
    ii. Rack as a baggage counter
    iii. Tables with provision of electric power and Internet connectivity for charging Laptops and accessing internet
    iv. Provisions for Printers

A list of Essential and Recommended Books for Students of Radiation therapy Technology:

1) Anatomy:

i) Handbook of General Anatomy by B.D Chaurasia
ii) Human Anatomy by B.D Chaurasia
iii) Anatomy and Physiology in Health and Illness by Ross and Wilson
iv) Pocket Sectional Anatomy Vol 1 and 2 by Moller and Rief, Thieme Publications

2) Physiology and Pathology:

i) Anatomy and Physiology in Health and Illness by Ross and Wilson
ii) A text book of Medical Physiology by Guyton and Hall
iii) First Aid L.C.Gupta Jaypee
iv) Basic pathology by Robbins
v) Textbook of Medical Physiology by G.K. Pal (Theory)

3) Hospital Administration:

i) Hospital Waste Management and its Monitoring: Maduri Sharma Jaypee
ii) Hospital Administration and Management by Joydeep das Gupta

4) Radiation Oncology:

i) Walter and Millers Textbook of Radiotherapy
ii) Principles and Practice of Radiation Oncology by Perez and Brady
iii) Text book of Radiation Oncology by Philips, Hope and Roach
iv) Principles and Practice of Brachytherapy by Joslin, Flynn and Hall
v) Brachytherapy Applications and techniques by Phillip M. Devlin

5) Radiotherapy techniques:

i) Treatment Planning in Radiation Oncology by F.M. Khan
ii) Washington & Leaver's Principles and Practice of Radiation Therapy
iii) Radiation Therapy Planning - Gunilla Bentel
iv) The Physics & Technology of Radiation Therapy - McDermott and Orton
v) Practical Radiotherapy Planning 3rd and 4th edition by Jane Dobbs

vi) Clinical Target Volumes in Conformal and Intensity Modulated Radiation Therapy by Gregoire, Scalliet , Ang by Springer Publications
vii) Radiotherapy Treatment Planning – Richard F Mould

6) Imaging in Oncology:

i) Radiology Fundamentals, Introduction to Imaging and technology by Harjit Singh published by Springer
ii) Oncologic Imaging by Bragg, Rubin , Hrisack W.B. Saunders Publication
iii) Basics of PET Imaging by Gopal. B. Saha Springer publications
iv) Essentials of Radiographic Physics and Imaging by James Johnston and Terry Fauber
v) Bushong, S.C., Radiological Sciences for Technologists, Mosby Elsevier (2009).
vi) Diagnostic Radiology Physics Handbook for Teachers and Students by IAEA

7) Radiation Physics and Dosimetry:

i) The Physics of Radiation Therapy by F.M. Khan
ii) The Physics of Radiology Harold Elford Johns John Robert Cunningham.
iii) Radiobiology for the radiologist. Eric J Hall; Amato J Giaccia
iv) ICRU report 83
v) ICRP Report 103
vi) Radiation Detection and measurement – Glenn F. Knoll.
vii) Radiation Dosimetry – H.E.Johns
viii) Text book of physics applied to Radiotherapy and Radio-diagnosis – Massey and Meredith.
ix) Practical Radiotherapy - Physics and Equipment by Pam Cherry , Angela Duxberry
x) Radiation Oncology Physics by E.B. Podgorsak published by IAEA

8) **Radiation Protection**:

i) Principles of Radiation Protection – K. Z. Morgan and J. E. Turner.
ii) Physics for Radiation Protection – James E. Martin
iii) ICRP Report 103
iv) Radiation protection in Medical radiography – Mary Alice
v) An introduction to Radiation Protection – Allen Martin & Samuel
vi) Latest reports on AERB safety code: Safety code for Medical diagnostic x-ray
vii) Safety code for Radiation Therapy Sources, Equipment and Installations

STUDENT TO PATIENT RATIO:

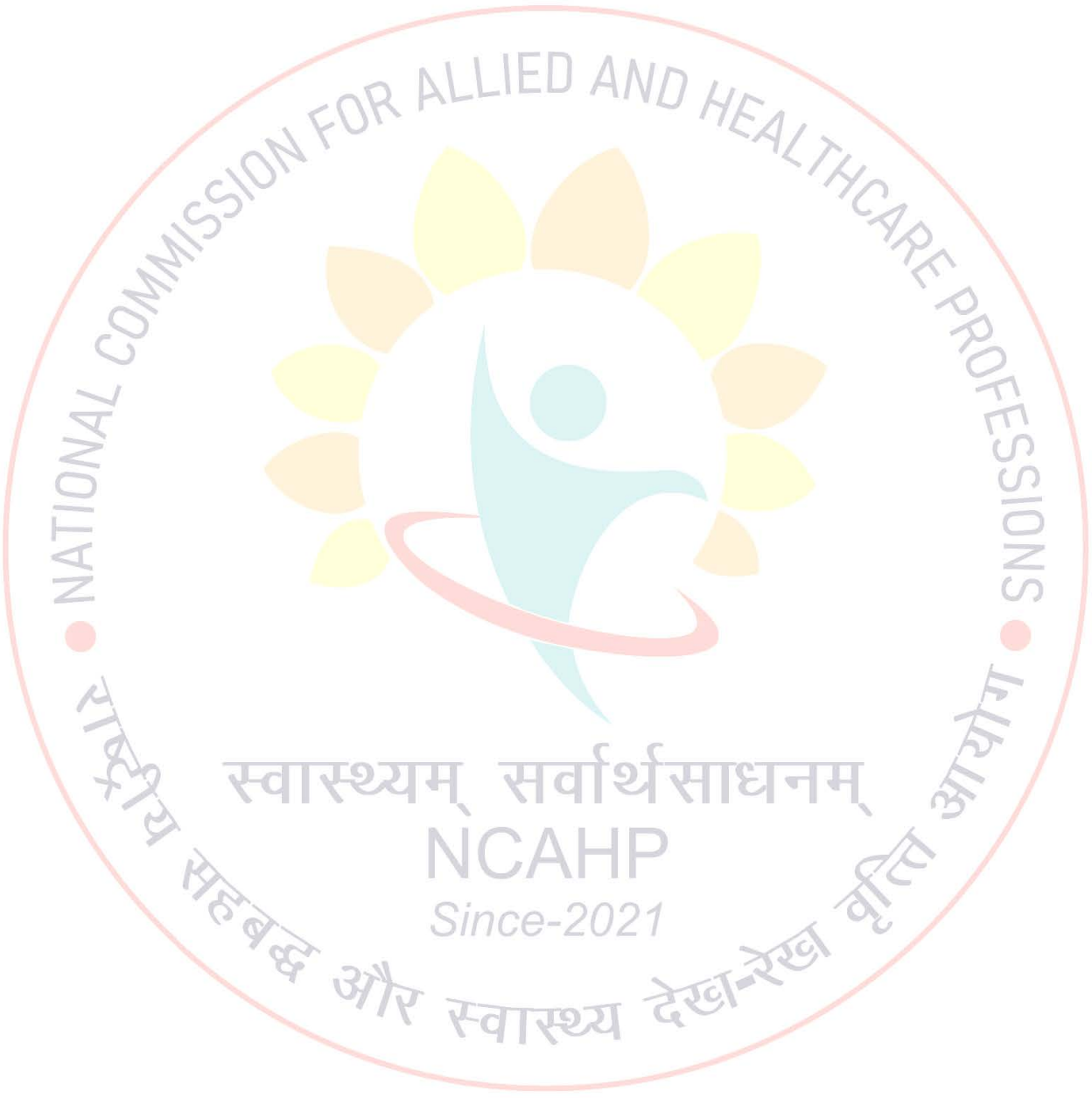
This is a significant aspect of academics as there ought to be enough number of patients for students to gain enough theoretical and practical experience. Radiotherapy Departments with adequate patients on each equipment is essential for better learning outcomes of a student. This also discourages institutions with lesser patients and staff to conduct such courses.

Place of Posting	Semester	Minimum No. of Patients attended to. During a posting
Simulator & Mould Room	1,2	3
Simulator & Mould Room	3,4,5 and 6	5
Simulator & Mould Room	Internship	8
Teletherapy	1,2	8
Teletherapy	3,4,5 and 6	12
Teletherapy	Internship	20 (includes conventional and conformal techniques)
Brachytherapy	1,2	1 or as per availability
Brachytherapy	3,4,5 and 6	2 or as per availability
Brachytherapy	Internship	2 or as per availability
TPS	Only Students/ No Interns	As per availability

Job availability

As per ILO documentation, employers worldwide are looking for job applicants who not only have technical skills that can be applied in the workplace, but who also can communicate effectively, including with customers; can work in teams, with good interpersonal skills; can solve problems; have good ICT skills; are willing and able to learn; and are flexible in their approach to work.[23] Diploma and degree holders can expect to be employed in hospitals and private practices as RTTs. A career in research, following the completion of a higher degree is an option chosen by some graduates. Graduates are eligible for employment overseas where their qualifications, training and experience are highly regarded. The trained RTTs after some clinical experience may be employed by medical equipment manufacturers and development specialists.

An ageing population requiring increased medical radiation services, together with the continuing introduction of hi-tech equipment, ensures strong demand for this profession.


NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
राष्ट्रीय संबद्ध और स्वास्थ्य देख-रेख पेशा आयोग
स्वास्थ्यम् सर्वार्थसाधनम्
NCAHP
Since-2021

Chapter 4

Curriculum of Radiotherapy Technology Courses

Chapter 4: Model Curriculum

Background

The need for accuracy in treatment delivery is a critical component of modern radiotherapy and requires knowledge and understanding of the basic sciences as well as the interaction between the technology used in radiotherapy and the site within the body that is irradiated. In an era of greater complexity of technology and techniques, the role of the Radiation Therapist (RTT) and his/her level of responsibility is continually evolving and expanding. Education programmes should provide the RTT with the scientific theoretical foundation of the profession and enable them, as practitioners, to be able to synthesize, evaluate and apply their knowledge in a clinical setting.

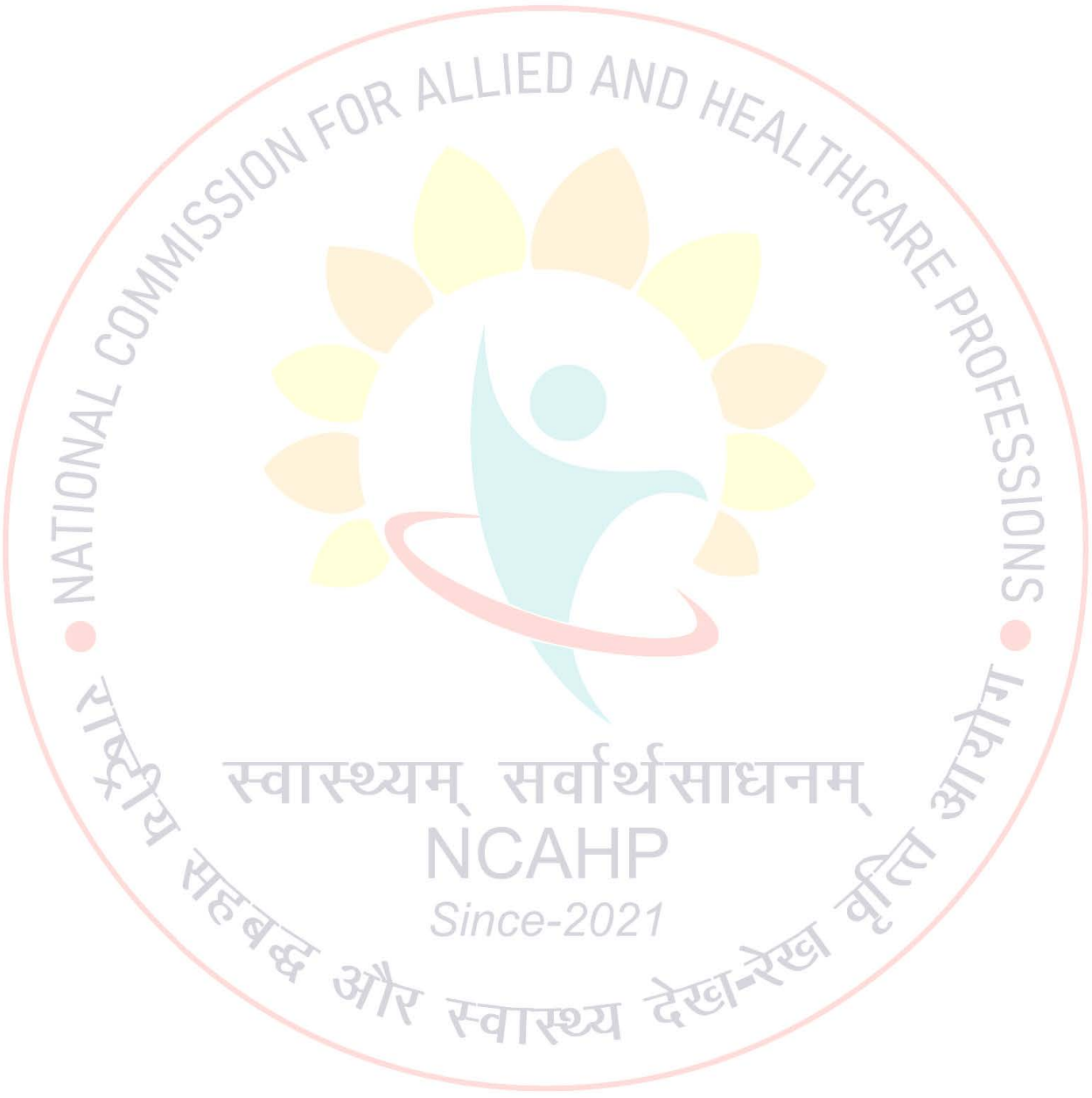
The aims of the recommended curriculum are to produce RTTs who are

- Technically and clinically competent;
- Aware of radiation safety issues w.r.t Patient Safety and Equipment Safety
- Importance of Quality Assurance
- Understand the theoretical basis of the practice;
- Effective members of the multidisciplinary team;
- Prepared to participate in research in the practice;

All aspects of radiation therapy have been considered in the development of this curriculum together with the identification of the roles expected for different levels of RTTs based on their qualification and experience. The need for connecting the dots between the education and employment practices has been the road map for devising this curriculum.

The National Curriculum Taskforce on Radiation therapy has successfully designed the career and qualification map indicating the growth opportunities for a professional in the career pathway based on the level as indicated in the National Skills Qualification Framework (NSQF). The career pathway indicates **level 4 as the entry level** after the completion of a minimum 2.5-year of diploma level programme on radiation therapy (Diploma in Radiotherapy Technology) as well as **level 5 as the entry level** after completion of a minimum 3.5-years of degree programme (Bachelor of Science in Radiotherapy Technology). The component of the programmes starting from diploma and above have been detailed out in the coming chapters.

Foundation course has also been designed to bring all the students at the same level of understanding with respect to basic healthcare related norms before the start of a career in a healthcare professional course. The foundation course is mandatory for all the allied health professional courses and for both entry level courses – diploma as well as degree. If a diploma holder has completed the foundation course and is willing to pursue the degree course, the candidate will directly get entry for next semester, however a pre- qualifier skill test will have to be satisfactorily completed, if not, then the candidate will have to undergo the first semester of foundation course again.


NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
राष्ट्रीय संबद्ध और स्वास्थ्य देख-रेख पेशा आयोग
स्वास्थ्यम् सर्वार्थसाधनम्
NCAHP
Since-2021

4.1 Diploma in Radiotherapy Technology

Diploma in Radiotherapy Technology

Introduction:

Learning Objectives: At the completion of this course, the student should be -

1. Able to execute all routine radio therapeutic procedures as per prescription and direction of Radiation Oncologist.
2. Able to operate the radiotherapy equipment independently and maintain the equipment under the supervision of a Medical Physicist.
3. Able to handle radiological safety issues as per the role of RTT including any emergency situation keeping in mind the radiation protection of staff, patients and public.

Expectation from the future diploma holders:

1. The coursework is designed to train students to work in conjunction with radiation oncology team including radiation oncologist, medical physicists, RTTs and other members, in the application of prescribed doses of ionizing radiation for the treatment of malignant or benign disease.
2. Course work includes physics, anatomy and physiology, dosimetry, clinical oncology and radiological safety. The student will be skilled in treatment management, administration of prescribed radiation treatment, and provision of patient support.
3. After the completion of the course, the diploma holder is expected to register with the Atomic Energy Regulatory Board (AERB) and /or with other regulatory/standardizing body instituted by Ministry of Health and Family Welfare. The student is also expected to keep updated information on the live register (as it is instituted) and must re-register after every 5 years to ensure employability in the market.
4. A diploma holder may pursue further qualification to attain senior positions in teaching institutions/industry.

Eligibility for admission:

Selection procedure:

1. 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 (50%) in Science Subjects.
2. Candidates who have studied abroad and have passed the equivalent qualification as determined by the Association of Indian Universities will form the guideline to determine the eligibility and must have passed in the subjects: Physics, Chemistry, Biology and English up to 12th Standard level.

3. Candidates who have passed the Senior Secondary school Examination of National Open School with a minimum of 5 subjects with any of the following group subjects.

    a. English, Physics, Chemistry, Botany, Zoology
    b. English, Physics, Chemistry, Biology and any other language

4. He/she has attained the age of 17 years as on - (current year) & maximum age limit is 30 years.
5. 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.

Duration of the course

Duration of the course is of 2.5 years with internship / it includes 2 years or 4 semesters (academic) with 890 hours of Theory & 1270 hours of Practical Classes and another one semester (720 hours) dedicated for internship.

Total number of hours – 2880 for the total course

Medium of instruction:

English shall be the medium of instruction for all the subjects of study and for examination of the course.

Attendance:

A candidate has to secure minimum -

1. 75% attendance in theoretical
2. 80% in Skills training (practical) for qualifying to appear for the final examination.

No relaxation, whatsoever, will be permissible to this rule under any ground including indisposition etc.

Assessment:

Assessments should be completed by the academic staff, based on the compilation of the student's theoretical & clinical performance throughout the training programme. To achieve this, all assessment forms and feedback should be included and evaluated.

Exit Examination:

The pattern of examination would be Semester based. Each Semester would typically last for 5 months which would be followed by a short vacation.

The Student should meet the criteria for Attendance (75% Attendance for Theory and 80% Attendance for Practical) and Assessment Criteria (based on periodic test and maintenance of Log book /Practical Work book) for every Semester.

This would be followed by Theory Examination and Practical Examination which would mark the end of each semester. A student has to secure minimum 40% marks in each theory subject and minimum 40% marks in the Practical Examination to get promoted to the next Semester. Marksheet will be provided at the end of each Semester Examination which would display the passed subjects and the failed subjects. The Marksheet will also mention if the student has passed or has been detained during a particular semester

Arrears Examination:

Maximum Backlog of 2 subjects per semester will be allowed in the case of students not securing the minimum passing marks and having failed the theory/practical examination. The backlog subject will need to be cleared in the subsequent semester along with the present semester. The total backlog during any semester will not exceed 2 subjects.

If a student has failed in more than 2 subjects in a particular semester or has an overall backlog of more than 2 subjects during any semester, the student will be detained during that semester and will be promoted to next semester only if he has cleared the backlog subjects or has a maximum backlog of 2 subjects during any semester.

Backlog examination can also be taken up during the period of Internship.

Passing Certificate:

A student will be provided a Passing Certificate only after successful completion of all the Semesters and the 6-month period of Internship. 80% attendance will be required for the entire duration of the internship.

Curriculum Outline

First Semester– Foundation Course

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
DRTT-001	Introduction to Healthcare Delivery System in India	60	0	60
DRTT-002	Basic computers and information Science	10	40	50
DRTT-003	Communication and soft skills	20	10	30
DRTT-004	Medical Terminology and Record keeping (including anatomical terms)	40	0	40
DRTT-005	Medical Law and Ethics	40	0	40
DRTT-006	Introduction to Quality and Patient safety (including Basic emergency care and life support skills, Infection prevention and control, Biomedical waste management, Disaster management and Antibiotic resistance)	40	60	100
DRTT-007	Professionalism and values	20	0	20
DRTT-008	Biostatistics	40	20	60
DRTT-009	Principals of Management	40	0	40
DRTT-010	Community orientation and clinical visit (including related practical to course 001)*	0	100	100
TOTAL		310	230	540

Teaching resources (tutors) should be made available at every institute for basic subjects such as – Biology and English for students who wish to undertake the extra classes for the same.

Second Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
DRTT-011	Elementary Mathematics and Physics	30	10	40
DRTT-012	Human Anatomy and Physiology	60	60	120
DRTT-013	Radiographic Anatomy	20	40	60
DRTT-014	Oncology Science(include basic pathology) I	60	20	80
DRTT-015	Principles of radiotherapy and radiotherapy techniques	40	20	60
DRTT-016	Radiation Quantities, Units and Detection/Measurement	20	20	40
	RTT Directed Clinical Education – part I (studentship)	-	140	140
TOTAL		230	310	540

Third Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
DRTT-017	Basic Radiation Physics	60	40	100
DRTT-018	Oncology Science-II	40	20	60
DRTT-019	Radiotherapy Equipment –I	50	50	100
DRTT-020	Radiation Safety	40	40	80
DRTT-021	Patient care, positioning and immobilization	40	20	60
	RTT Directed Clinical Education – part II (studentship)	-	140	140
TOTAL		230	310	540

Fourth Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
DRTT-022	Radiotherapy Equipment –II	20	50	80
DRTT-023	Quality Assurance in Radiotherapy	30	50	100
DRTT-024	Basic Radiotherapy Physics	40	15	80
DRTT-025	Biological Effects of Radiation	10	5	15
DRTT-026	Patient Care/Mould Room Techniques	20	20	40
	RTT Directed Clinical Education – part III (studentship)	-	280	280
TOTAL		120	420	540

Fifth Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
	RTT Internship		720	720

First Semester- Foundation course

Introduction to National Healthcare System

The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world. Topics to be covered under the subject are as follows:

1. Introduction to healthcare delivery system
    a. Healthcare delivery system in India at primary, secondary and tertiary care
    b. Community participation in healthcare delivery system
    c. Health system in developed countries.
    d. Private Sector
    e. National Health Mission
    f. National Health Policy
    g. Issues in Health Care Delivery System in India
2. National Health Programme- Background objectives, action plan, targets, operations, achievements and constraints in various National Heath Programme.
3. Introduction to AYUSH system of medicine
    a. Introduction to Ayurveda.
    b. Yoga and Naturopathy
    c. Unani
    d. Siddha
    e. Homeopathy
    f. Need for integration of various system of medicine
4. Health scenario of India- past, present and future
5. Demography & Vital Statistics-
    a. Demography – its concept
    b. Vital events of life & its impact on demography
    c. Significance and recording of vital statistics
    d. Census & its impact on health policy
6. Epidemiology
    a. Principles of Epidemiology
    b. Natural History of disease
    c. Methods of Epidemiological studies
    d. Epidemiology of communicable & non-communicable diseases, disease transmission, host defence immunizing agents, cold chain, immunization, disease monitoring and surveillance.

Medical terminologies and record keeping

This course introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes, and suffixes. Topics include: origin, word building, abbreviations and symbols, terminology related to the human anatomy, reading medical orders and reports, and terminology specific to the student's field of study. Spelling is critical and will be counted when grading tests.[24]Topics to be covered under the subject are as follows:

1. Derivation of medical terms.
2. Define word roots, prefixes, and suffixes.
3. Conventions for combined morphemes and the formation of plurals.
4. Basic medical terms.
5. Form medical terms utilizing roots, suffixes, prefixes, and combining roots.
6. Interpret basic medical abbreviations/symbols.
7. Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.
8. Interpret medical orders/reports.
9. Data entry and management on electronic health record system.

Basic computers and information science

The students will be able to appreciate the role of computer technology. The course has focus on computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation. Topics to be covered under the subject are as follows:

1. Introduction to computer: Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.
2. Input output devices: Input devices(keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices(monitors, pointers, plotters, screen image projector, voice response systems).
3. Processor and memory: The Central Processing Unit (CPU), main memory.
4. Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.
5. Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).

6. Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.
7. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.
8. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.
9. Introduction of Operating System: introduction, operating system concepts, types of operating system.
10. Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.
11. Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.
12. Application of Computers in clinical settings.

Practical on fundamentals of computers -

1. Learning to use MS office: MS word, MS PowerPoint, MS Excel.
2. To install different software.
3. Data entry efficiency

Medical law and ethics

Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care. Advances in medical sciences, growing sophistication of the modern society's legal framework, increasing awareness of human rights and changing moral principles of the community at large, now result in frequent occurrences of healthcare professionals being caught in dilemmas over aspects arising from daily practice.[25]

Medical ethics has developed into a well based discipline which acts as a "bridge" between theoretical bioethics and the bedside. The goal is "to improve the quality of patient care by identifying, analysing, and attempting to resolve the ethical problems that arise in practice".[25] Doctors are bound by, not just moral obligations, but also by laws and official regulations that form the legal framework to regulate medical practice. Hence, it is now a universal consensus that legal and ethical considerations are inherent and inseparable parts of good medical practice across the whole spectrum. Few of the important and relevant topics that need to focus on are as follows:

1. Medical ethics - Definition - Goal - Scope
2. Introduction to Code of conduct
3. Basic principles of medical ethics – Confidentiality

4. Malpractice and negligence - Rational and irrational drug therapy
5. Autonomy and informed consent - Right of patients
6. Care of the terminally ill- Euthanasia
7. Organ transplantation
8. Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects.
9. Professional Indemnity insurance policy
10. Development of standardized protocol to avoid near miss or sentinel events
11. Obtaining an informed consent.

Communication and soft skills

Major topics to be covered under Communication course[26] –

1. Basic Language Skills: Grammar and Usage.
2. Business Communication Skills. With focus on speaking - Conversations, discussions, dialogues, short presentations, pronunciation.
3. Teaching the different methods of writing like letters, E-mails, report, case study, collecting the patient data etc. Basic compositions, journals, with a focus on paragraph form and organization.
4. Basic concepts & principles of good communication
5. Special characteristics of health communication
6. Types & process of communication
7. Barriers of communication & how to overcome

Introduction to Quality and patient safety

1. Quality assurance and management - The objective of the course is to help students understand the basic concepts of quality in health Care and develop skills to implement sustainable quality assurance program in the health system.
    - Concepts of Quality of Care
    - Quality Improvement Approaches
    - Standards and Norms
    - Quality Improvement Tools
    - Introduction to NABH guidelines

2. Basics of emergency care and life support skills - Basic life support (BLS) is the foundation for saving lives following cardiac arrest. Fundamental aspects of BLS include immediate recognition of sudden cardiac arrest (SCA) and activation of the emergency response system, early cardiopulmonary resuscitation (CPR), and rapid defibrillation with an automated external defibrillator (AED). Initial recognition and

response to heart attack and stroke are also considered part of BLS. The student is also expected to learn about basic emergency care including first aid and triage. Topics to be covered under the subject are as follows:

- Vital signs and primary assessment
- Basic emergency care – first aid and triage
- Ventilations including use of bag-valve-masks (BVMs)
- Choking, rescue breathing methods
- One- and Two-rescuer CPR
- Using an AED (Automated external defibrillator).
- Managing an emergency including moving a patient

At the end of this topic, focus should be to teach the students to perform the manoeuvrers in simulation lab and to test their skills with focus on airways management and chest compressions. At the end of the foundation course, each student should be able to perform and execute/operate on the above mentioned modalities.

3. Bio medical waste management and environment safety- The aim of this section will be to help prevent harm to workers, property, the environment and the general public. Topics to be covered under the subject are as follows:
    - Definition of Biomedical Waste
    - Waste minimization
    - BMW – Segregation, collection, transportation, treatment and disposal (including colour coding)
    - Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
    - BMW Management & methods of disinfection
    - Modern technology for handling BMW
    - Use of Personal protective equipment (PPE)
    - Monitoring & controlling of cross infection (Protective devices)

4. Infection prevention and control - The objective of this section will be to provide a broad understanding of the core subject areas of infection prevention and control and to equip AHPs with the fundamental skills required to reduce the incidence of hospital acquired infections and improve health outcomes. Concepts taught should include –
    - Evidence-based infection control principles and practices [such as sterilization, disinfection, effective hand hygiene and use of Personal protective equipment (PPE)],
    - Prevention & control of common healthcare associated infections,
    - Components of an effective infection control program, and
    - Guidelines (NABH and JCI) for Hospital Infection Control

5. Antibiotic Resistance-
    - History of Antibiotics
    - How Resistance Happens and Spreads
    - Types of resistance- Intrinsic, Acquired, Passive
    - Trends in Drug Resistance
    - Actions to Fight Resistance
    - Bacterial persistence
    - Antibiotic sensitivity
    - Consequences of antibiotic resistance
    - Antimicrobial Stewardship- Barriers and opportunities, Tools and models in hospitals

6. Disaster preparedness and management- The objective of this section will be to provide knowledge on the principles of on-site disaster management. Concepts to be taught should include-
    - Fundamentals of emergency management,
    - Psychological impact management,
    - Resource management,
    - Preparedness and risk reduction,
    - Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and institutional mechanisms.

Professionalism and Values

The module on professionalism will deliver the concept of what it means to be a professional and how a specialized profession is different from a usual vocation. It also explains how relevant is professionalism in terms of healthcare system and how it affects the overall patient environment.

1. Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality
2. Personal values- ethical or moral values
3. Attitude and behaviour- professional behaviour, treating people equally
4. Code of conduct , professional accountability and responsibility, misconduct
5. Differences between professions and importance of team efforts
6. Cultural issues in the healthcare environment

Biostatistics

The objective of this module is to help the students understand the significance of data and data analysis needed for research purposes

1. Basic Concepts of Biostatistics
2. Types of Data
3. Research tools and Data collection methods
4. Sampling methods
5. Developing a research proposal

Principles of Management

The course is intended to provide a knowledge about the basic principles of Management.

1. Introduction to management
2. Strategic Management
3. Foundations of Planning
4. Planning Tools and Techniques
5. Decision Making, conflict and stress management
6. Managing Change and Innovation
7. Understanding Groups and Teams
8. Leadership
9. Time Management
10. Cost and efficiency

Community orientation and clinical visit

The objective of this particular section of the foundation course is to sensitize potential learners with essential knowledge; this will lay a sound foundation for their learning across the under-graduate program and across their career. Innovative teaching methods should be used to ensure the attention of a student and make them more receptive such as group activities, interactive fora, role plays, and clinical bed-side demonstrations.[27]

1. The community orientation and clinical visit will include visit to the entire chain of healthcare delivery system -Sub centre, PHC, CHC, SDH, DH and Medical college, private hospitals, dispensaries and clinics.
2. The student will also be briefed regarding governance at village level including interaction and group discussion with village panchayat and front line health workers.
3. Clinical visit to their respective professional department within the hospital.

Second Semester

Elementary mathematics & physics:

Physics is a key component of all education programmes for RTTs and should comprise a significant proportion of the overall syllabus. The physics modules will provide the scientific basis to understand the functioning of the radiotherapy equipment, dosimetry, and basis of radiation protection and safe practice. Students should be able to draw, read, and report on graphs, charts and tables/ calculate ratios/ measure time, temperature, distance, make estimates and approximations and judge the reasonableness of the results and demonstrate an ability to evaluate and draw conclusions.

1. **Elementary Mathematics**
    a. Calculation of percentage, Profit & Loss, Simple interest, compound interest, time & work ,Ratio & proportion, Surds, Indices, Logarithm, Inverse Square Law,
    b. Geometry of triangles, similar triangles, Properties of Triangles.
    c. Trigonometry: Height & Distance.
    d. Graphical Representation of Exponential and Inverse exponential functions, Linear and semi log graphs.

2. **Basic Physics, Electrostatics, Magnetism & Current Electricity**
    a. Units & Dimension, Newton's Laws of Motion, Velocity & Speed, Force, Momentum etc.
    b. Coulomb's Law, Electric field & potential, Capacitance, Ohm's Law, Heating effect of current, Biot–Savart 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.
    c. Instruments: Electrometer, Galvanometer, Ammeter, & Voltmeter

Human Anatomy and Physiology

Anatomy is a key component of all education programmes for RTTs and should have a strong focus on organ position, orientation and relationships. The topics provide the student with an understanding of the structure and relationships of the systems and organs of the body which is essential in patient positioning, treatment planning and accurate treatment delivery. The radiographic anatomy component will enable RTTs to evaluate images for treatment planning and verification.

Similarly, Physiology provides the students with knowledge of the function of systems and organs and their relationships and underpins the understanding of how cancer treatments can affect the function of normal tissue leading to late side effects. Physiology is important to all programmes with increased depth of content required where RTTs are being required to take a more active role in side effect recognition and management. This may be in departments where RTTs are increasingly taking some responsibility in this area or in resource constrained environments where nursing or medical staff are limited.

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 Gland 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 Reticule-endothelial system (Gross outline only)- Position and function of Lymph Nodal regions (Including Neck, Axilla, Mediastinum, para-aortic, Inguinal) Extra nodal Lymphatic Tissues(Waldeyer's Ring, Spleen and Liver, Malt, Bone Marrow, Thymus) and Re System; Lymphatic Drainage.
11. Digestive System- Organs of digestion, histology of the digestive organs (stomach, small intestine, liver, pancreas), process of digestion, absorption and assimilation of food, Vitamins and minerals
12. Respiratory System- Organs of respiration and their histology (lungs and trachea), Respiration (Definition and Mechanism), gas exchange in the lungs, regulation of respiration, basal metabolic rate
13. The skin (Structure and functions)

14. The excretory system- Organs of excretion (kidneys, ureter, bladder), histology of kidney and its functions, formation of urine and its composition, structure of nephron
15. Circulatory System- Composition and functions of blood, the heart anatomy and physiology, the chambers of heart, various vessels and valves present in heart, Circulation of blood, the cardiac cycle and heart sounds, blood pressure, arteries and veins.
16. Nervous System- Central nervous system (Brain and Spinal cord), Peripheral nervous system (cranial and spinal nerves), The reflex action and reflex arc, The transmission of nerve impulse, sense organs (eye, ear, tongue and nose); structure and functions
17. Endocrine System- short description of various endocrine glands and their functions
18. Reproductive System- Male and female reproductive system, Histology of Gonads, ovarian cycle and ovulation, Fertilization, Fertility control

Imaging in oncology

Emphasis on plain and cross-sectional radiographic anatomy

1. Surface anatomy
2. Plain film / conventional radiographs
3. Mammography
4. Computed Tomography (CT)
5. Magnetic Resonance Imaging (MRI)
6. Ultrasound
7. Nuclear medicine
8. Digitally Reconstructed Radiographs (DRR)
9. Portal imaging

Oncology Science- I

This subject puts cancer, the treatment methods available and the patient pathway into context. It provides the student with an understanding of the other disciplines involved in the management of patients from diagnosis to follow up and how they interact with the radiotherapy department in the overall management of the cancer patient. This underpins how the information gained at the various stages can be used most effectively and appropriately. The topics related specifically to radiotherapy will enable students to analyse and evaluate treatment options and the associated side effects and how this information is used in defining the most appropriate treatment for each individual patient. It will provide students with knowledge of other therapies that patients may avail of and how quality of life issues can be addressed.

1. Pathology- general pathology of tumours
2. Malignancies- local and general effects of tumours and its spread
3. Carcinogenesis

4. Co-morbidities
5. Etiology and epidemiology
6. Genetics
7. Prevention
8. Early detection
9. Signs and symptoms
10. Public awareness on early signs and symptoms
11. High risk groups
12. Staging of tumours

Principles of Radiotherapy and Radiotherapy Techniques

This paper is designed for students to have complete knowledge about various basic treatment techniques in the field of radiation therapy. In this paper, the students study the various technical aspects of treatment techniques, such as FIX, ROTATION, ARC & SKIP therapy techniques, for individual patients. The students study about the various treatment accessories such as Mid Line Block (MLB), customized blocks, wedges, etc., for various sites of interest.

1. Effects of various radiation on normal tissues and malignant tumour: Early and late reaction on Skin, Mucous membrane, GI tract, Genito urinary system, respiratory system, CNS
2. Application of radiotherapy in benign conditions
3. Application of radiotherapy in malignant condition
4. Single and multiple field techniques for all treatment sites (from Head to Feet) with appropriate immobilizing device(s).
5. Fix, Rotation, Arc and Skip therapy procedures.
6. Use of Rubber traction, POP, Orfit, Body Frame in treatment technique.
7. Evaluation of patient setup for simple techniques.
8. Use of Beam Modifying devices, such as wedges, Tissue compensators, Mid Line Block (MLB) in the treatment of respective sites.
9. Customized shielding blocks and its properties.
10. Asymmetric jaws
11. Motorized wedges
12. Simulation procedures including CT simulation

Radiation Quantities, Units and Detection/Measurement

In this paper the students will learn about the various radiation quantities, their measuring units and various types of survey meters/dosimeters.

1. Radioactivity, Flux, Fluence, Kerma, Exposure, Absorbed Dose, Equivalent Dose, Weighting Factors, Effective Dose, Natural Background Radiation, Occupational Exposure Limits, Dose limits to Public.
2. Detection and measurement of radiation - Ionisation of gases, Fluorescence and phosphorescence, Effect on photographic emulsion, Ionisation chambers, Proportional Counters, G.M. Counters, Scintillation Detectors, Liquid scintillator, Pocket Dosimeters, TL Dosimeters and their use in personnel monitoring badges. Advantages and disadvantages of various detectors, appropriateness of different types of detectors for different types of radiation measurement.

RTT Directed Clinical Education – part I (studentship)

Students will observe the basic operations of the radiation oncology clinic while interacting with the multidisciplinary team members involved in providing optimal care to cancer patients. The student will be introduced to oncology terminology, equipment, and techniques used for treatment

Third Semester

Basic Radiation physics

1. Atomic Structure, Nucleus, Atomic No., Mass No., Electron orbit and energy levels, Isotopes and isobars, Radioactivity, Radioactive decay, Half-life, Particle radiation, Electromagnetic Radiation, Production of X-rays, Continuous X-ray spectrum, Bremsstrahlung radiation Characteristic X-rays, Filters, Quality of X-rays, Effect of voltage and current on the intensity of X-rays, Properties of X-rays.
2. Interaction of Radiation with Matter : Photoelectric effect, Compton Effect, Pair production, Ionisation of matter, Energy absorbed from X-rays, X-rays Scattering, X-rays transmission through the medium, linear and mass attenuation coefficient, HVT and TVT, Interaction of charged particle and neutrons with matter.

Oncology Science- II

This subject puts cancer, the treatment methods available and the patient pathway into context. It provides the student with an understanding of the other disciplines involved in the management of patients from diagnosis to follow up and how they interact with the radiotherapy department in the overall management of the cancer patient. This underpins how the information gained at the various stages can be used most effectively and appropriately. The topics related specifically to radiotherapy will enable students to analyse and evaluate treatment options and the associated side effects and how this information is used in defining the most appropriate treatment for each individual patient. It will provide students with knowledge of other therapies that patients may avail of and how quality of life issues can be addressed.

1. Clinical examination
2. Biopsy
3. Laboratory tests
4. Imaging methods
5. Staging and grading
6. TNM staging system, other commonly used systems
7. Treatment intent- radical, adjuvant , palliative
8. Non-malignant diseases
9. Primary management of malignancy
10. Performance status

Radiotherapy Equipment -I

In this paper, the students acquire knowledge about various teletherapy machines, such as telecobalt machines, linear accelerators etc. wherein the student learns about the operational and functional aspects of accelerators along with machine properties. Also, in this paper the student studies about equipment accessories needed during treatment.

1. Brachytherapy- Design features, Radiation sources, Technique, High dose-rate (HDR), Low dose-rate (LDR), Pulsed dose-rate (PDR), and various types of applicators.
2. Teletherapy Machines & Accessories:
    a. Telecobalt Machines
    b. Medical linear accelerators.
    c. Tomotherapy
    d. Machine properties.
    e. Beam directing, modifying and defining devices.
    f. Other accessories.

Radiation safety

The radiation therapy needs to be carried out carefully with adequate measuring system for the radiation workers, such as Radiation Therapists, which helps in knowing the dose level he/she has received while working in the radiation area.

1. **Radiation Hazard evaluation and control-**Philosophy of radiation protection, Effect of Time, Distance and Shielding, Calculation of workload, Calculation of Weekly dose to the radiation worker and general public, good work practices in diagnostic radiology and/or radiotherapy practices (including teletherapy and Brachytherapy), Planning consideration for radiology and/or radiotherapy installation including work load, use factor & occupancy factors, effect of different shielding material.
2. **Radiation Emergency Preparedness** - Safety and security of radiation sources, case histories of emergency situations and preparedness, equipment's and tools including role of Gamma Zone Monitor, Regulatory requirements and prevention of emergency, Preventive maintenance and Safety Culture, Role of RTT in handling radiation emergencies.
3. **Regulatory requirements**
   National Regulatory Body, Responsibilities, organization, Safety Standards, Codes and Guides, Responsibilities of licensees, registrants and employers and Enforcement of Regulatory requirements
    - **Demonstration:** Time, Distance and Shielding, measurement of HVT & TVT
    - Familiarization of radiation survey meters and their functional performance checks
    - Radiological Protection Survey of Radiotherapy, Simulator and CT Simulator Installations
    - QA on X-ray, Simulator and Radiotherapy Equipment(s)
    - Procedures followed for calibration of measuring and monitoring instruments

Patient care, positioning and immobilization

In this context, patient care refers to all non-radiotherapy related aspects of the work that the RTT does while interacting with patients. This ranges from communication to the identification and referral for radiation related toxicities to cardio-pulmonary resuscitation. The RTT must also be able to apply the principles of positioning to the preparation of the immobilization device. Consideration must be taken of the practical aspects of immobilization device preparation.

1. Hospital procedure: Hospital staffing and organization; records relating to patients and departmental statistics, professional attitude of the Radiation Therapist 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.
4. Principles of positioning and immobilization
    a. Positioning aids-Breast boards, Lung boards, Belly boards, Head-and-neck fixation devices, Vacuum packs, Stereotactic systems
    b. Internal organ motion control- Bite blocks, Gating systems, Active breathing control, Diaphragm compression, Prostate immobilization, Tracking systems. Laser/ positioning systems
    c. Marking systems
    d. Isocentre determination
    e. Reference points
    f. Treatment couch
    g. Image acquisition for planning (and/or verification)
    h. Modalities for image acquisition for planning
    i. Simulation- Conventional Simulation, CT Simulation, Virtual Simulation
    j. Image processing and archiving
    k. Treatment verification
    l. Protocols- Imaging protocols: development and implementation, Non-action levels (NAL), On-line/off-line corrections, Matching/co-registration procedures, Geometric uncertainties, Documentation, Adaptive radiotherapy, Information management[28]

RTT Directed Clinical Education – part II (studentship)

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a registered radiation therapist. Students are tested on intermediate clinical radiation therapy skills.

Fourth Semester

Radiotherapy Equipment -II

In this paper, the students learn more about the accessories used along with radiotherapy equipment such as on-board imaging, dosimetry accessories, use of computers in RT and various types of networking used in RT:

1. Familiarization with treatment planning systems-external beam planning and brachytherapy
2. Various types of phantoms including the water-phantoms, RFA
3. Various types of dosimeters including in-vivo dosimeters
4. EPID and other on-board imaging systems
5. Record and Verify Systems, Oncology Information Systems, Image/Patient data archiving, storage and transfer.
6. CT Simulator

Quality Assurance in Radiotherapy

Quality assurance (QA) refers to the systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled. It is the systematic measurement, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention and provides accuracy of treatment. The following topics will be covered:
Accessories and tools used for QA tests in Radiotherapy such as Front pointer, Back pointer, Laser Alignment etc. Optical and radiation field congruence, Beam 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 telecobalt /Linear Accelerator / Brachytherapy/ Gamma knife/Simulator/CT Simulator machines.

Basic Radiotherapy Physics

Historical developments in Radiotherapy, Physical components of Telecobalt Unit / Linear Accelerator Unit / Remote After Loading Brachytherapy Unit / Gamma Knife Unit / Simulator /Brachytherapy units 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.

Biological Effects of Radiation

The Cell, effect of ionising radiation on cell, chromosomal aberration and its application for the biological dosimetry, Somatic effects and hereditary effects, stochastic and deterministic effects, Acute exposure and Chronic exposure, LD50/60. Role of RTT in managing the acute effects of radiation.

RTT Directed Clinical Education – part III (studentship)

S01btudents will improve their skills in clinical procedures. Progressive interaction with patients and professional personnel are monitored as students practice radiation therapy in a supervised setting. Additional areas include problem solving, identifying machine components and basic side effect management. Students will demonstrate competence in beginning, intermediate, and advanced procedures.

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 customize shielding block for Cobalt unit.
5. Preparation of patient set-up in SAD technique.
6. Study of difference between SSD & SAD technique.

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 After loader Brachytherapy Unit.

Demonstration:

1. Time Distance and Shielding, measurement of HVT & TVT
2. Familiarization 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. Familiarization 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.

Fifth Semester – Internship

The internship time period provides the students the opportunity to continue to develop confidence and increased skill in simulation and treatment delivery. Students will demonstrate competence in beginning, intermediate, and advanced procedures in both areas. Students will participate in advanced and specialized treatment procedures. The student will complete the clinical training by practicing all the skills learned in classroom and clinical instruction. The students are expected to work for minimum 8 hours per day and this may be more depending on the need and the healthcare setting.

Skills based outcomes and monitorable indicators for Radiotherapy Technician

Competency statements

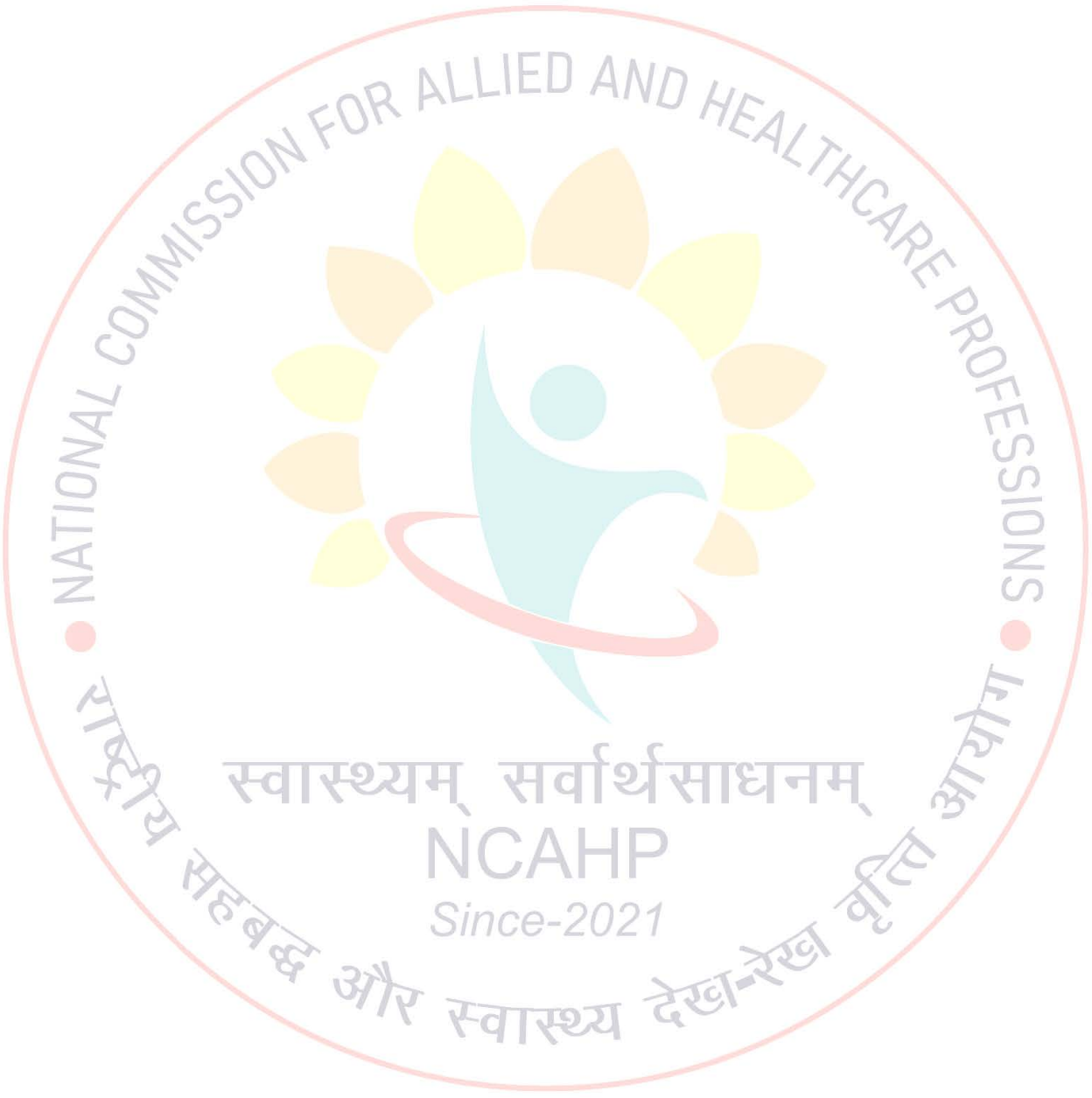
1. Demonstrate the ability to correctly anticipate and perform the RTTs role during the planning process
2. Communicates relevant information to other members and completes accurate documentation
3. Demonstrates ability to correctly position the patient
4. Demonstrates ability to prepare the shielding devices
5. Conducts the simulation and mark-up procedure for all standard treatment techniques
6. Demonstrates ability to carry out the daily organization of the treatment unit
7. Demonstrates knowledge of accurate position and ability to immobilize all patients as per instructions
8. Practices accurate treatment documentation
9. Demonstrates ability to interpret, apply and disseminate information as a member of the radiotherapy team
10. Demonstrates professional behaviour
11. Demonstrates a sensitive and caring attitude towards the patient

Sl. no	Learning outcomes/competency	Knowledge/ comprehension	Applications / synthesis /evaluation	Hours
1	Demonstrate the understanding of various steps required in planning a radiotherapy treatment process	Competency in appropriate patient positioning for simulation and treatment and scanning/radiography protocols	Produce appropriate radiographic/CT images for further planning	200
		Know the protocols used in the department	Interpret and understand all planning techniques for the clinical site/s	

Sl. no	Learning outcomes/competency	Knowledge/ comprehension	Applications / synthesis /evaluation	Hours
2	Be able to transfer all relevant information and complete accurate documentation	Recognize the importance of accurate transfer of information to allow for accurate treatment set-up according to the treatment plan and prescription	Construct the most appropriate device for the individual patient within the context of the protocol	200
		Know what should be included	Apply the necessary precautions in production	
		Know to whom or where the documentation and information should be sent	Implement correct QC, storage and handling procedures for shielding devices	
3	Be able to correctly position the patient	Define the common co morbid conditions that patients may suffer from	Evaluate the patient condition and the limitations that may result from any co-morbid conditions	200
		Be familiar with the techniques and equipment used	Analyse the information and integrate to define the optimal patient position	
		Know the protocols used in the department		
4	Be able to prepare the shielding devices	Know the shielding devices/methods available	Construct the most appropriate device for the individual patient within the context of the protocol	150
		Know how to use these devices	Apply the necessary precautions in production	
		Recognize the associated health and safety issues	Implement correct QC, storage and handling procedures for immobilization devices	

Sl. no	Learning outcomes/competency	Knowledge/ comprehension	Applications / synthesis /evaluation	Hours
5	Be able to conduct the simulation and mark-up procedure for all standard treatment techniques	Be familiar with the techniques and equipment used	Prepare the patient for treatment according to departmental protocols	50
		Know the protocols used in the department	Prepare the simulation equipment safely and accurately	
			Implement correct QC, procedures for simulation equipment and mark-up procedures	
6	Be able to carry out the daily organization of the treatment unit	Recognize the importance of team interactions	Participate in the organization of the daily work schedule to maximize efficiency	100
		Explain the principles of effective communication		
7	Be able to accurately position and immobilize all patients as per instructions	Be familiar with the treatment plans for all patients on the treatment unit	Prepare the equipment as per instructions	100
		Identify the co-morbidities that will impact on patient position	Identify the patient in accordance with recognized procedures and consistent with the department protocol	
		Recognize the signs and symptoms associated with treatment in different sites		
8	Be able to complete accurate treatment documentation	Recognize the importance of accurate documentation	Complete the treatment documentation accurately	50
		Know what should be included		

Sl. no	Learning outcomes/competency	Knowledge/ comprehension	Applications / synthesis /evaluation	Hours
9	Be able to interpret, apply and disseminate information as a member of the radiotherapy team	Define and explain the data that must be disseminated	Identify the appropriate personnel to whom specific information should be disseminated	50
			Communicate the correct, relevant and appropriate information	
10	Be able to demonstrate professional behaviour	Explain the legal and ethical guidelines related to the profession	Practice in accordance with legislation regulations and ethical guidelines	100
		Be aware of your own competency levels	Promote collaborative practice	
		Identify the elements that reflect professional appearance and manner		
11	Be able to demonstrate a sensitive and caring attitude to patients	Explain the components of good communication	Self-awareness of their own personality traits	50
		Be aware of the patient' gender, age, cultural background, educational level and social situation	Analyse how the differences in personality influence approach	
	Total			1250


NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
राष्ट्रीय संबद्ध और स्वास्थ्य देख-रेख पेशा आयोग
स्वास्थ्यम् सर्वार्थसाधनम्
NCAHP
Since-2021

4.2 Bachelor of Radiation Therapy Technology (BRTT)

Bachelor of Radiation Therapy Technology

Introduction:

Learning Objectives: At the completion of this course, the student should be -

1. Able to execute all routine radio therapeutic procedures as per prescription and direction of Radiation Oncologist.
2. Able to operate the radiotherapy equipment used in treatment of cancer patient independently and maintain the equipment under the guidance of Medical Physicist.
3. Able to demonstrate and apply adequate knowledge about the safe handling of medical radiation sources, keeping in mind the radiation protection of staff, patients and public.
4. Able to demonstrate patient management skills.

Expectation from the future graduate in the providing patient care.

1. The coursework is designed to train students to work in conjunction with radiation oncology team including radiation oncologist, medical physicists and other members, in the application of prescribed doses of ionizing radiation for the treatment of malignant or benign disease.
2. Course work includes physics, anatomy and physiology, dosimetry, clinical oncology and radiation safety. The student will be skilled in management, administration of prescribed radiation treatment, and provisions of patient support.
3. Employment opportunities can be found in hospitals in both private and public sectors as well as in independent cancer treating centres.
4. After the completion of the course, the graduate is expected to register with the Atomic Energy Regulatory Board (AERB) or with other regulatory/standardizing body instituted by Ministry of Health and Family Welfare. The student is also expected to keep updated information on the live register and must re-register after every 5 years to ensure employability in the market.
5. RTT graduate is encouraged to pursue further qualification to attain senior position in the professional field, also to keep abreast with the advances and new technology, the professional should opt for continuous professional education credits offered by national and international institutes.

Eligibility for admission:

Selection procedure:

1. 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 (50%) in science subjects.

   OR

   Diploma in Radiotherapy Technology after completing 12th class/ 10 +2 of CBSE or equivalent with minimum aggregate of 50% marks in science subjects.

2. Candidates who have studied abroad and have passed the equivalent qualification as determined by the Association of Indian Universities will form the guideline to determine the eligibility and must have passed in the subjects: Physics, Chemistry, Biology/Mathematics and English up to 12th Standard level.
3. Candidates who have passed the Senior Secondary school Examination of National Open School with a minimum of 5 subjects with any of the following group subjects.
   a. English, Physics, Chemistry, Botany, Zoology
   b. English, Physics, Chemistry, Biology and any other language
4. He/she has attained the age of 17 years as on - (current year) & maximum age limit is 30 years.
5. 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.
6. Admission to B.Sc. Radiotherapy Technology course shall be made on the basis of eligibility and an entrance test to be conducted for the purpose. No candidate will be admitted on any ground unless he/she has appeared in the admission test and interview.
   a. Entrance test, to be conducted by the university as per the syllabus under 10 +2 scheme of CBSE, subject-wise distribution of questions will be as 30% in Physics, 40% in Biology, 20% in Chemistry, 10% in English (Language & Comprehension) and in General Awareness about health-related methods.
   b. Successful candidates on the basis of written test will be called for the counselling & shall have face an interview board. The interview board should be chaired by an experienced RTT and having hospital administrator and HR Expert apart from other nominees, whose recommendations shall be final for the selection of the students.
   c. During subsequent counselling (s) the seat will be allotted as per the merit of the candidate depending on the availability of seats on that particular day.
   d. Candidate who fails to attend the Medical Examination on the notified date(s) will forfeit the claim for admission and placement in the waiting list except permitted by the competent authority under special circumstances.

e. The name of the student(s) who remain(s) absent from classes for more than 15 days at a stretch after joining the said course will be struck off from the college rolls without giving any notice.

Provision of Lateral Entry:

Lateral entry to second year for allied health science courses for candidates who have passed diploma program from the Government Boards and recognized by State/Central University, fulfilling the conditions specified and these students are eligible to take admission on lateral entry system only if the same subject have been studied at diploma level.

Duration of the course

Duration of the course: 4 years that includes 06 month of internship. 03 years or 6 semesters of academic (1060 hours of Theory & 2180 hours of Practical Classes) and 06 months (720 hours minimum) of internship

Total hours - 3960

Medium of instruction:

English shall be the medium of instruction for all the subjects of study and for examination of the course.

Attendance:

A candidate has to secure minimum-

1. 75% attendance in theoretical
2. 80% in Skills training (practical) for qualifying to appear for the final examination.

No relaxation, whatsoever, will be permissible to this rule under any ground including indisposition etc.

Assessment:

Assessments should be completed by the academic staff, based on the compilation of the student's theoretical &clinical performance throughout the training programme. To achieve this, all assessment forms and feedback should be included and evaluated.

Exit Examination:

The pattern of examination would be Semester based. Each Semester would typically last for 5 months which would be followed by a short vacation.

The Student should meet the criteria for Attendance (75% Attendance for Theory and 80% Attendance for Practical) and Assessment Criteria (based on periodic test and maintenance of Log book /Practical Work book) for every Semester.

This would be followed by Theory Examination and Practical Examination which would mark the end of each semester. A student has to secure minimum 40% marks in each theory subject and minimum 40% marks in the Practical Examination to get promoted to the next Semester. Marksheet will be provided at the end of each Semester Examination which would display the passed subjects and the failed subjects. The Marksheet will also mention if the student has passed or has been detained during a particular semester

Arrears Examination:

Maximum Backlog of 2 subjects per semester will be allowed **i**n the case of students not securing the minimum passing marks and having failed the theory/practical examination. The backlog subject will need to be cleared in the subsequent semester along with the present semester. The total backlog during any semester will not exceed 2 subjects.

If a student has failed in more than 2 subjects in a particular semester or has an overall backlog of more than 2 subjects during any semester, the student will be detained during that semester and will be promoted to next semester only if he has cleared the backlog subjects or has a maximum backlog of 2 subjects during any semester.

Backlog examination can also be taken up during the period of Internship.

Passing Certificate:

A student will be provided a Passing Certificate only after successful completion of all the Semesters and the 1 year period of Internship. 80% attendance will be required for the entire duration of the internship.

Curriculum Outline

First Semester– Foundation Course

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
BRTT-001	Introduction to Healthcare Delivery System in India	60	0	60
BRTT-002	Basic computers and information Science	10	40	50
BRTT-003	Communication and soft skills	20	10	30
BRTT-004	Medical Terminology and Record keeping (including anatomical terms)	40	0	40
BRTT-005	Medical Law and Ethics	40	0	40
BRTT-006	Introduction to Quality and Patient safety (including Basic emergency care and life support skills, Infection prevention and control, Biomedical waste management, Disaster management and Antibiotic resistance)	40	60	100
BRTT-007	Professionalism and values	20	0	20
BRTT-008	Biostatistics and introduction to research methodology	40	20	60
BRTT-009	Principals of Management	40	0	40
BRTT-010	Community orientation and clinical visit (including related practical to course 001)*	0	100	100
TOTAL		310	230	540

Second Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
BRTT -011	Elementary Mathematics and Physics	30	10	40
BRTT -012	Human Anatomy and Physiology	60	60	120
BRTT -013	Radiographic Anatomy	20	40	60
BRTT -014	Oncology Science- I	60	20	80
BRTT -015	Principles of radiotherapy and radiotherapy techniques	40	20	60
BRTT -016	Radiation Quantities, Units and Detection/Measurement	40	20	60
	RTT Directed Clinical Education – part I (studentship)	-	120	120
TOTAL		250	290	540

Third Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
BRTT -017	Basic Radiation Physics	60	40	100
BRTT -018	Oncology Science-II	40	20	60
BRTT -019	Radiotherapy Equipment –I	50	50	100
BRTT -020	Radiation Safety	40	40	80
BRTT -021	Patient care, positioning and immobilization	40	20	60
	RTT Directed Clinical Education – part II (studentship)	-	140	140
	TOTAL	230	310	540

Fourth Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
BRTT -022	Radiotherapy Equipment –II	40	60	100
BRTT -023	Quality Assurance in Radiotherapy-I	30	50	80
BRTT -024	Basic Radiotherapy Physics	40	25	65
BRTT -025	Biological Effects of Radiation	10	5	15
	RTT Directed Clinical Education – part III (studentship)	-	280	280
	TOTAL	120	420	540

Fifth Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
BRTT -026	Clinical Radiobiology	40	40	80
BRTT -027	Mould Room /Motion Management Techniques	30	60	90
BRTT -028	Special RT Techniques and Recent advances	20	50	70
	RTT Directed Clinical Education – part IV (studentship)		300	300
	TOTAL	90	450	540

Sixth Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
BRTT -029	Radiological/Nuclear Medicine/Other Imaging Techniques in Radiotherapy Planning	20	60	80
BRTT -030	Radiotherapy treatment delivery	20	60	80
BRTT -031	Operational Issues in Radiation Therapy	20	60	80
	RTT Directed Clinical Education – part V (studentship)		300	300
	TOTAL	60	480	540

Seventh Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
	RTT Internship /Externship **INTERNSHIP – minimum 720 hours (calculation based on 8 hours per day for 90 working days in a semester)**		1440	1440

First Semester- Foundation course

Introduction to National Healthcare System

The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world. Topics to be covered under the subject are as follows:

1. Introduction to healthcare delivery system
    a. Healthcare delivery system in India at primary, secondary and tertiary care
    b. Community participation in healthcare delivery system
    c. Health system in developed countries.
    d. Private Sector
    e. National Health Mission
    f. National Health Policy
    g. Issues in Health Care Delivery System in India
2. National Health Programme- Background objectives, action plan, targets, operations, achievements and constraints in various National Heath Programme.
3. Introduction to AYUSH system of medicine
    a. Introduction to Ayurveda.
    b. Yoga and Naturopathy
    c. Unani
    d. Siddha
    e. Homeopathy
    f. Need for integration of various system of medicine
4. Health scenario of India- past, present and future
5. Demography & Vital Statistics-
    a. Demography – its concept
    b. Vital events of life & its impact on demography
    c. Significance and recording of vital statistics
    d. Census & its impact on health policy
6. Epidemiology
    a. Principles of Epidemiology
    b. Natural History of disease
    c. Methods of Epidemiological studies
    d. Epidemiology of communicable & non-communicable diseases, disease transmission, host defence immunizing agents, cold chain, immunization, disease monitoring and surveillance.

Medical terminologies and record keeping

This course introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes, and suffixes. Topics include: origin, word building, abbreviations and symbols, terminology related to the human anatomy, reading medical orders and reports, and terminology specific to the student's field of study. Spelling is critical and will be counted when grading tests.[24] Topics to be covered under the subject are as follows:

1. Derivation of medical terms.
2. Define word roots, prefixes, and suffixes.
3. Conventions for combined morphemes and the formation of plurals.
4. Basic medical terms.
5. Form medical terms utilizing roots, suffixes, prefixes, and combining roots.
6. Interpret basic medical abbreviations/symbols.
7. Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.
8. Interpret medical orders/reports.
9. Data entry and management on electronic health record system.

Basic computers and information science

The students will be able to appreciate the role of computer technology. The course has focus on computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation. Topics to be covered under the subject are as follows:

1. Introduction to computer: Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.
2. Input output devices: Input devices(keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices(monitors, pointers, plotters, screen image projector, voice response systems).
3. Processor and memory: The Central Processing Unit (CPU), main memory.
4. Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.
5. Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).

6. Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.
7. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.
8. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.
9. Introduction of Operating System: introduction, operating system concepts, types of operating system.
10. Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.
11. Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.
12. Application of Computers in clinical settings.

Practical on fundamentals of computers -

1. Learning to use MS office: MS word, MS PowerPoint, MS Excel.
2. To install different software.
3. Data entry efficiency

Medical law and ethics

Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care. Advances in medical sciences, growing sophistication of the modern society's legal framework, increasing awareness of human rights and changing moral principles of the community at large, now result in frequent occurrences of healthcare professionals being caught in dilemmas over aspects arising from daily practice.[25]

Medical ethics has developed into a well based discipline which acts as a "bridge" between theoretical bioethics and the bedside. The goal is "to improve the quality of patient care by identifying, analysing, and attempting to resolve the ethical problems that arise in practice".[25] Doctors are bound by, not just moral obligations, but also by laws and official regulations that form the legal framework to regulate medical practice. Hence, it is now a universal consensus that legal and ethical considerations are inherent and inseparable parts of good medical practice across the whole spectrum. Few of the important and relevant topics that need to focus on are as follows:

1. Medical ethics - Definition - Goal - Scope
2. Introduction to Code of conduct
3. Basic principles of medical ethics – Confidentiality

4. Malpractice and negligence - Rational and irrational drug therapy
5. Autonomy and informed consent - Right of patients
6. Care of the terminally ill- Euthanasia
7. Organ transplantation
8. Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects.
9. Professional Indemnity insurance policy
10. Development of standardized protocol to avoid near miss or sentinel events
11. Obtaining an informed consent.

Communication and soft skills

Major topics to be covered under Communication course[26] –

1. Basic Language Skills: Grammar and Usage.
2. Business Communication Skills. With focus on speaking - Conversations, discussions, dialogues, short presentations, pronunciation.
3. Teaching the different methods of writing like letters, E-mails, report, case study, collecting the patient data etc. Basic compositions, journals, with a focus on paragraph form and organization.
4. Basic concepts & principles of good communication
5. Special characteristics of health communication
6. Types & process of communication
7. Barriers of communication & how to overcome

Introduction to Quality and patient safety

1. Quality assurance and management - The objective of the course is to help students understand the basic concepts of quality in health Care and develop skills to implement sustainable quality assurance program in the health system.
    a. Concepts of Quality of Care
    b. Quality Improvement Approaches
    c. Standards and Norms
    d. Quality Improvement Tools
    e. Introduction to NABH guidelines

2. Basics of emergency care and life support skills - Basic life support (BLS) is the foundation for saving lives following cardiac arrest. Fundamental aspects of BLS include immediate recognition of sudden cardiac arrest (SCA) and activation of the emergency response system, early cardiopulmonary resuscitation (CPR), and rapid defibrillation with an automated external defibrillator (AED). Initial recognition and response to heart attack and stroke are also considered part of BLS. The student is also expected to learn about basic emergency care including first aid and triage. Topics to be covered under the subject are as follows:
    a. Vital signs and primary assessment
    b. Basic emergency care – first aid and triage
    c. Ventilations including use of bag-valve-masks (BVMs)
    d. Choking, rescue breathing methods
    e. One- and Two-rescuer CPR
    f. Using an AED (Automated external defibrillator).
    g. Managing an emergency including moving a patient

    At the end of this topic, focus should be to teach the students to perform the manoeuvres in simulation lab and to test their skills with focus on airways management and chest compressions. At the end of the foundation course, each student should be able to perform and execute/operate on the above mentioned modalities.

3. Bio medical waste management and environment safety- The aim of this section will be to help prevent harm to workers, property, the environment and the general public. Topics to be covered under the subject are as follows:
    a. Definition of Biomedical Waste
    b. Waste minimization
    c. BMW – Segregation, collection, transportation, treatment and disposal (including colour coding)
    d. Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
    e. BMW Management & methods of disinfection
    f. Modern technology for handling BMW
    g. Use of Personal protective equipment (PPE)
    h. Monitoring & controlling of cross infection (Protective devices)

4. Infection prevention and control - The objective of this section will be to provide a broad understanding of the core subject areas of infection prevention and control and to equip AHPs with the fundamental skills required to reduce the incidence of hospital acquired infections and improve health outcomes. Concepts taught should include –
    a. Evidence-based infection control principles and practices [such as sterilization, disinfection, effective hand hygiene and use of Personal protective equipment (PPE)],
    b. Prevention & control of common healthcare associated infections,

c. Components of an effective infection control program, and
d. Guidelines (NABH and JCI) for Hospital Infection Control

5. Antibiotic Resistance-
    a. History of Antibiotics
    b. How Resistance Happens and Spreads
    c. Types of resistance- Intrinsic, Acquired, Passive
    d. Trends in Drug Resistance
    e. Actions to Fight Resistance
    f. Bacterial persistence
    g. Antibiotic sensitivity
    h. Consequences of antibiotic resistance
    i. Antimicrobial Stewardship- Barriers and opportunities, Tools and models in hospitals

6. Disaster preparedness and management- The objective of this section will be to provide knowledge on the principles of on-site disaster management. Concepts to be taught should include-
    a. Fundamentals of emergency management,
    b. Psychological impact management,
    c. Resource management,
    d. Preparedness and risk reduction,
    e. Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and institutional mechanisms.

Professionalism and values

The module on professionalism will deliver the concept of what it means to be a professional and how a specialized profession is different from a usual vocation. It also explains how relevant is professionalism in terms of healthcare system and how it affects the overall patient environment.

1. Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality
2. Personal values- ethical or moral values
3. Attitude and behaviour- professional behaviour, treating people equally
4. Code of conduct , professional accountability and responsibility, misconduct
5. Differences between professions and importance of team efforts
6. Cultural issues in the healthcare environment

Research Methodology and Biostatistics

The objective of this module is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings.

1. Introduction to research methods
2. Identifying research problem
3. Ethical issues in research
4. Research design
5. Basic Concepts of Biostatistics
6. Types of Data
7. Research tools and Data collection methods
8. Sampling methods
9. Developing a research proposal

Principals of Management

The course is intended to provide a knowledge about the basic principles of Management.

1. Introduction to management
2. Strategic Management
3. Foundations of Planning
4. Planning Tools and Techniques
5. Decision Making, conflict and stress management
6. Managing Change and Innovation
7. Understanding Groups and Teams
8. Leadership
9. Time Management
10. Cost and efficiency

Community orientation and clinical visit

The objective of this particular section of the foundation course is to sensitize potential learners with essential knowledge; this will lay a sound foundation for their learning across the under-graduate program and across their career. Innovative teaching methods should be used to ensure the attention of a student and make them more receptive such as group activities, interactive fora, role plays, and clinical bed-side demonstrations. [27]

1. The community orientation and clinical visit will include visit to the entire chain of healthcare delivery system -Sub centre, PHC, CHC, SDH, DH and Medical college, private hospitals, dispensaries and clinics.
2. The student will also be briefed regarding governance at village level including interaction and group discussion with village panchayat and front line health workers.
3. Clinical visit to their respective professional department within the hospital.

Second Semester

Elementary mathematics & physics:

Physics is a key component of all education programmes for RTTs and should comprise a significant proportion of the overall syllabus. The physics modules will provide the scientific basis of dose calculation and treatment planning, the principles of the equipment used routinely in the administration of radiotherapy and an understanding of the basis of radiation protection and safe practice. Students should be able to draw, read, and report on graphs, charts and tables/ calculate ratios/ measure time, temperature, distance, make estimates and approximations and judge the reasonableness of the results and demonstrate an ability to evaluate and draw conclusions.

1. **Elementary Mathematics**
    a. Calculation of percentage, Profit & Loss, Simple interest, compound interest, time & work ,Ratio & proportion, Surds, Indices, Logarithm, Inverse Square Law,
    b. Geometry of triangles, similar triangles, Properties of Triangles.
    c. Trigonometry: Height & Distance.
    d. Graphical Representation of Exponential and Inverse exponential functions, Linear and semi log graphs.
2. Basic Physics, Electrostatics, Magnetism & Current Electricity
    a. Units & Dimension, Newton's Laws of Motion, Velocity & Speed, Force, Momentum etc.
    b. Coulomb's Law, Electric field & potential, Capacitance, Ohm's Law, Heating effect of current, Biot–Savart 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.
    c. Instruments: Electrometer, Galvanometer, Ammeter, & Voltmeter

Human Anatomy and Physiology

Anatomy is a key component of all education programmes for RTTs and should have a strong focus on organ position, orientation and relationships. The topics provide the student with an understanding of the structure and relationships of the systems and organs of the body which is essential in patient positioning, treatment planning and accurate treatment delivery. The radiographic anatomy component will enable RTTs to evaluate images for treatment planning and verification.

Similarly, Physiology provides the students with knowledge of the function of systems and organs and their relationships and underpins the understanding of how cancer treatments can affect the function of normal tissue leading to late side effects. Physiology is important to all programmes with increased depth of content required where RTTs are being required to take a more active role in side effect recognition and management. This may be in departments where RTTs are increasingly taking some responsibility in this area or in resource constrained environments where nursing or medical staff are limited.

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 Gland 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, para-aortic, Inguinal) Extra nodal Lymphatic Tissues(Waldeyer's Ring, Spleen and Liver, Malt, Bone Marrow, Thymus) and Re System; Lymphatic Drainage.
11. Digestive System- Organs of digestion, histology of the digestive organs (stomach, small intestine, liver, pancreas), process of digestion, absorption and assimilation of food, Vitamins and minerals
12. Respiratory System- Organs of respiration and their histology (lungs and trachea), Respiration (Definition and Mechanism), gas exchange in the lungs, regulation of respiration, basal metabolic rate
13. The skin (Structure and functions)

14. The excretory system- Organs of excretion (kidneys, ureter, bladder), histology of kidney and its functions, formation of urine and its composition, structure of nephron
15. Circulatory System- Composition and functions of blood, the heart anatomy and physiology, the chambers of heart, various vessels and valves present in heart, Circulation of blood, the cardiac cycle and heart sounds, blood pressure, arteries and veins.
16. Nervous System- Central nervous system (Brain and Spinal cord), Peripheral nervous system (cranial and spinal nerves), The reflex action and reflex arc, The transmission of nerve impulse, sense organs (eye, ear, tongue and nose); structure and functions
17. Endocrine System- short description of various endocrine glands and their functions
18. Reproductive System- Male and female reproductive system, Histology of Gonads, ovarian cycle and ovulation, Fertilization, Fertility control.

Imaging in oncology

Emphasis on plain and cross-sectional radiographic anatomy

1. Surface anatomy
2. Plain film / conventional radiographs
3. Mammography
4. Computed Tomography (CT)
5. Magnetic Resonance Imaging (MRI)
6. Ultrasound
7. Nuclear medicine
8. Digitally Reconstructed Radiographs (DRR)
9. Portal imaging

Oncology Science- I

This subject puts cancer, the treatment methods available and the patient pathway into context. It provides the student with an understanding of the other disciplines involved in the management of patients from diagnosis to follow up and how they interact with the radiotherapy department in the overall management of the cancer patient. This underpins how the information gained at the various stages can be used most effectively and appropriately. The topics related specifically to radiotherapy will enable students to analyse and evaluate treatment options and the associated side effects and how this information is used in defining the most appropriate treatment for each individual patient. It will provide students with knowledge of other therapies that patients may avail of and how quality of life issues can be addressed.

1. Pathology- general pathology of tumours
2. Malignancies- local and general effects of tumours and its spread
3. Carcinogenesis
4. Co-morbidities
5. Etiology and epidemiology
6. Genetics
7. Prevention
8. Early detection
9. Signs and symptoms
10. Public awareness on early signs and symptoms
11. High risk groups
12. Staging of tumours

Principles of Radiation and Radiotherapy Techniques

This paper is designed for students to have complete knowledge about various basic treatment techniques in the field of radiation therapy. In this paper, the students study the various technical aspects of treatment techniques, such as FIX, ROTATION, ARC & SKIP therapy techniques, for individual patients. In this paper, the students also study about the utility of various immobilizing devices during patient setup, which are evaluated properly for accurate treatment delivery to the volume of interest. The students study about the various treatment accessories such as Mid Line Block (MLB), customized blocks, wedges, etc., for various sites of interest.

1. Effects of various radiation on normal tissues and malignant tumour: Early and late reaction on Skin, Mucous membrane, GI tract, Genito urinary system, respiratory system, CNS
2. Application of radiotherapy in benign conditions
3. Application of radiotherapy in malignant condition
4. Single and multiple field techniques for all treatment sites (from Head to Feet) with appropriate immobilizing device(s).
5. Fix, Rotation, Arc and Skip therapy procedures.
6. Use of Rubber traction, POP, Orfit, Body Frame in treatment technique.
7. Evaluation of patient setup for simple techniques.
8. Use of Beam Modifying devices, such as wedges, Tissue compensators, Mid Line Block (MLB) in the treatment of respective sites.
9. Customized shielding blocks and its properties.
10. Asymmetric jaws
11. Motorized wedges
12. Simulation procedures including CT simulation

Radiation Quantities, Units and Detection/Measurement

In this paper the students will learn about the various radiation quantities, their measuring units and various types of survey meters/dosimeters.

1. Radioactivity, Flux, Fluence, Kerma, Exposure, Absorbed Dose, Equivalent Dose, Weighting Factors, Effective Dose, Natural Background Radiation, Occupational Exposure Limits, Dose limits to Public.
2. Detection and measurement of radiation - Ionisation of gases, Fluorescence and phosphorescence, Effect on photographic emulsion, Ionisation chambers, Proportional Counters, G.M. Counters, Scintillation Detectors, Liquid scintillator, Pocket Dosimeters, TL Dosimeters and their use in personnel monitoring badges. Advantages and disadvantages of various detectors, appropriateness of different types of detectors for different types of radiation measurement.

RTT Directed Clinical Education – part I (studentship)

Students will observe the basic operations of the radiation oncology clinic while interacting with the multidisciplinary team members involved in providing optimal care to cancer patients. The student will be introduced to oncology terminology, equipment, and techniques used for treatment

Third Semester

Basic Radiation physics

1. Atomic Structure, Nucleus, Atomic No., Mass No., Electron orbit and energy levels, Isotopes and isobars, Radioactivity, Radioactive decay, Half-life, Particle radiation, Electromagnetic Radiation, Production of X-rays, Continuous X-ray spectrum, Bremsstrahlung radiation Characteristic X-rays, Filters, Quality of X-rays, Effect of voltage and current on the intensity of X-rays, Properties of X-rays.
2. Interaction of Radiation with Matter : Photoelectric effect, Compton Effect, Pair production, Ionisation of matter, Energy absorbed from X-rays, X-rays Scattering, X-rays transmission through the medium, linear and mass attenuation coefficient, HVT and TVT, Interaction of charged particle and neutrons with matter.

Oncology Science- II

This subject puts cancer, the treatment methods available and the patient pathway into context. It provides the student with an understanding of the other disciplines involved in the management of patients from diagnosis to follow up and how they interact with the radiotherapy department in the overall management of the cancer patient. This underpins how the information gained at the various stages can be used most effectively and appropriately. The topics related specifically to radiotherapy will enable students to analyse and evaluate treatment options and the associated side effects and how this information is used in defining the most appropriate treatment for each individual patient. It will provide students with knowledge of other therapies that patients may avail of and how quality of life issues can be addressed.

1. Clinical examination
2. Biopsy
3. Laboratory tests
4. Imaging methods
5. Staging and grading
6. TNM staging system, other commonly used systems
7. Treatment intent- radical, adjuvant , palliative
8. Non-malignant diseases
9. Primary management of malignancy
10. Performance status

Radiotherapy Equipment -I

In this paper, the students acquire knowledge about various teletherapy machines, such as telecobalt machines, linear accelerators etc wherein the student learns about the operational and functional aspects of accelerators along with machine properties. Also, in this paper the student studies about equipment accessories needed during treatment.

1. Brachytherapy- Design features, Radiation sources, Technique, High dose-rate (HDR),Low dose-rate (LDR),Pulsed dose-rate (PDR), various types of applicators.
2. Teletherapy Machines & Accessories:
    a. Telecobalt Machines
    b. Medical linear accelerators.
    c. Tomotherapy
    d. Machine properties.
    e. Beam directing, modifying and defining devices.
    f. Other accessories.

Radiation safety the composition of committee should include an experienced RTT

The radiation therapy needs to be carried out carefully with adequate measuring system for the radiation workers, such as Radiation Therapists, which helps in knowing the dose level he/she has received while working in the radiation area.

1. **Radiation Hazard evaluation and control**

    Philosophy of radiation protection, Effect of Time, Distance and Shielding, Calculation of workload, Calculation of Weekly dose to the radiation worker and general public, good work practices in diagnostic radiology and/or radiotherapy practices (including teletherapy and Brachytherapy), Planning consideration for radiology and/or radiotherapy installation including work load, use factor & occupancy factors, effect of different shielding material.

2. **Radiation Emergency Preparedness**

    Safety and security of radiation sources, case histories of emergency situations and preparedness, equipment's and tools including role of Gamma Zone Monitor, Regulatory requirements and prevention of emergency, Preventive maintenance and Safety Culture, Role of RTT in handling radiation emergencies.

3. **Regulatory requirements**

    National Regulatory Body, Responsibilities, organization, Safety Standards, Codes and Guides, Responsibilities of licensees, registrants and employers and Enforcement of Regulatory requirements.

4. **Demonstration:**
    - Time, Distance and Shielding, measurement of HVT & TVT
    - Familiarisation of radiation survey meters and their functional performance checks
    - Radiological Protection Survey of Radiotherapy, Simulator and CT Simulator Installations
    - QA on X-ray, Simulator and Radiotherapy Equipment(s)
    - Procedures followed for calibration of measuring and monitoring instruments

Patient care, positioning and immobilization

In this context, patient care refers to all non-radiotherapy related aspects of the work that the RTT does while interacting with patients. This ranges from communication to the identification and referral for radiation related toxicities to cardio-pulmonary resuscitation. The RTT must also be able to apply the principles of positioning to the preparation of the immobilization device. Consideration must be taken of the practical aspects of immobilization device preparation.

1. Hospital procedure: Hospital staffing and organization; records relating to patients and departmental statistics, professional attitude of the Radiation Therapist 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.
4. Principles of positioning and immobilization
    a. Positioning aids-Breast boards, Lung boards, Belly boards, Head-and-neck fixation devices, Vacuum packs, Stereotactic systems
    b. Internal organ motion control- Bite blocks, Gating systems, Active breathing control, Diaphragm compression, Prostate immobilization, Tracking systems. Laser/ positioning systems
    c. Marking systems
    d. Isocentre determination
    e. Reference points
    f. Treatment couch
    g. Image acquisition for planning (and/or verification)

h. Modalities for image acquisition for planning
i. Simulation- Conventional Simulation, CT Simulation, Virtual Simulation
j. Image processing and archiving
k. Treatment verification
l. Protocols- Imaging protocols: development and implementation, Non-action levels (NAL), On-line/off-line corrections, Matching/co-registration procedures, Geometric uncertainties, Documentation, Adaptive radiotherapy, Information management[29]

RTT Directed Clinical Education – part II (studentship)

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a registered radiation therapist. Students are tested on intermediate clinical radiation therapy skills.

Fourth Semester

Radiotherapy Equipment -II

In this paper, the students learn more about the accessories used along with radiotherapy equipment such as on-board imaging, dosimetry accessories, use of computers in RT and various types of networking used in RT:

1. Familiarization with treatment planning systems-external beam planning and brachytherapy
2. Various types of phantoms including the water-phantoms, RFA
3. Various types of dosimeters including in-vivo dosimeters
4. EPID and other on-board imaging systems
5. Record and Verify Systems, Oncology Information Systems, Image/Patient data archiving, storage and transfer.
6. CT Simulator

Quality Assurance in Radiotherapy

Quality assurance (QA) refers to the systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled. It is the systematic measurement, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention and provides accuracy of treatment. The following topics will be covered:
Accessories and tools used for QA tests in Radiotherapy such as Front pointer, Back pointer, Laser Alignment etc. Optical and radiation field congruence, Beam 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 telecobalt /Linear Accelerator / Brachytherapy/ Gamma knife/Simulator/CT Simulator machines.

Basic Radiotherapy Physics

Historical developments in Radiotherapy, Physical components of Telecobalt Unit / Linear Accelerator Unit / Remote After Loading Brachytherapy Unit / Gamma Knife Unit / Simulator /Brachytherapy units 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.

Biological Effects of Radiation

The Cell, Effect of ionising radiation on Cell, Chromosomal aberration and its application for the biological dosimetry, Somatic effects and hereditary effects, stochastic and deterministic effects, Acute exposure and Chronic exposure, $LD_{50/60}$. Role of RTT in managing the acute effects of radiation.

RTT Directed Clinical Education – part III (studentship)

Students will improve their skills in clinical procedures. Progressive interaction with patients and professional personnel are monitored as students practice radiation therapy in a supervised setting. Additional areas include problem solving, identifying machine components and basic side effect management. Students will demonstrate competence in beginning, intermediate, and advanced procedures.

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 customize shielding block for Cobalt unit.
5. Preparation of patient set-up in SAD technique.
6. Study of difference between SSD & SAD technique.

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 After loader Brachytherapy Unit.

Demonstration:

1. Time Distance and Shielding, measurement of HVT & TVT
2. Familiarization 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. Familiarization 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.

Fifth Semester

Clinical Radiobiology

In simplest terms, radiobiology is the study of the action of ionizing radiation on living structures and organisms. Radiobiology is the basic science behind radiotherapy and it can explain, and occasionally also predict responses of tumours and normal tissues to radiation. Knowledge of the principles of radiobiology allows the RTT to comprehend the effects of different types of radiation, fractionation schemes, the use of radio sensitizers and other interactions he/she observes on a daily basis.

1. Cell kinetics
2. Cell cycle control mechanisms
3. Tumour biology
4. The five 'R's of radiobiology
5. Tissue structure and radiation effect
6. The Linear Quadratic (LQ) model
7. Tumour control probability (TCP), Normal Tissue Complications Probability (NTCP) models
8. Acute and late side effects
9. Sensitizers/protectors/side effect reduction
10. Fractionation
11. Treatment combinations
12. Treatment scheduling

Mould Room /Motion Management Techniques

Mould room and motion management techniques are essential part of modern precision radiotherapy. An RTT has to be competent in designing various types of moulds for patient immobilization and applicator fixation (in brachytherapy) as well as in various motion management techniques:

1. Historical evolution of the mould materials and techniques to make moulds
2. Thermoplastic moulds
3. Breath hold, motion reduction, tracking and gating techniques

Special RT Techniques and Recent advances

1. Wedges-tissue compensator-irregular field-SSD&SAD technique-oblique field-arc-rotational and moving field
2. Mantle field-irregular field-Hemi body irradiation-whole body irradiation-total body skin irradiation
3. Special techniques in Radiation Therapy, (SRT) – Stereo tactic Radio surgery (SRS) –. Methods – BRW and CRW frames – angiographic localizer box – preparation of target sheets – Quality Assurance – Isocentric check – Treatment execution – care to be taken – check list.
4. Conformal Radiotherapy: Principles of 3 D treatment.

5. Recent developments in radiotherapy and treatment techniques
6. Proton therapy and carbon ion therapy
7. artificial intelligence

RTT Directed Clinical Education – part IV (studentship)

The course provides students the opportunity to continue to develop confidence and increased skill in simulation and treatment delivery. Students will demonstrate competence in beginning, intermediate, and advanced procedures in both areas. Students will participate in advanced and specialized treatment procedures.

Sixth Semester

Radiological/Nuclear Medicine/Other Imaging Techniques in Radiotherapy Planning

An RTT should understand the role of various types of imaging in radiotherapy planning. Also he should be well versed with various types of imaging modalities.

1. 2D (radiography, fluoroscopic, USG), 3D (CT, MRI) and functional (PET/SPECT) imaging and their application in radiotherapy planning
2. Understand Gross Tumour Volume (GTV), Clinical Target Volume (CTV), Internal Target Volume (ITV), Planning Target Volume (PTV), Organs at Risk (OAR) delineation
3. Conduct image fusion at the treatment machine console
4. Do bony matching
5. Do soft tissue matching for estimating the preliminary data for applying shifts
6. Prepare documentation
7. The RTT should understand the principles of: Four-dimensional (4D) planning and be familiarized with IMRT and IGRT planning.

Radiotherapy treatment delivery

Based on Bloom's taxonomy, students should be able to analyse, synthesize and evaluate the information acquired in the radiotherapy specific modules in radiotherapy preparation, delivery and patient support. From Bloom's taxonomy, 'analysis' is the ability to break down the information into its component parts and look for interrelationships and ideas, 'synthesis' is combining information from a range of settings or experiences and 'evaluation' is judging the value of the information and how it is best applied.

1. Orthovoltage / superficial
2. Supervoltage / Megavoltage
3. Brachytherapy
4. Stereotactic radiotherapy- Stereotactic radiosurgery, Stereotactic radiotherapy, Cranial Extra cranial (Stereotactic body radiotherapy SBRT), Total Body Irradiation (TBI),Total Skin Electron Irradiation (TSEI),Radiation therapy with neutrons, protons, and heavy ions

Operational Issues in Radiotherapy.

Course content is designed to focus on various radiation therapy operational issues. Accreditation, CQI development and assessment techniques will be presented. Human resource issues and regulations impacting the radiation therapist will be examined. Topics include the role of network information systems within the radiation oncology department.

RTT Directed Clinical Education – part V (studentship)

This course is the final in a series of five directed clinical courses. The student will complete the clinical training by practicing all the skills learned in classroom and clinical instruction.

Seventh and Eighth Semester

The internship time period provides the students the opportunity to continue to develop confidence and increased skill in simulation and treatment delivery. Students will demonstrate competence in beginning, intermediate, and advanced procedures in both areas. Students will participate in advanced and specialized treatment procedures. The student will complete the clinical training by practicing all the skills learned in classroom and clinical instruction.

The internship will span at least 06 months (1 semester). This will include 8 hours (min) of practice a day, totalling to 720 hours for one semester assuming 90 working days in a semester. As a part of this, the students will choose a relevant subject and prepare an in-depth project report of not less than 1000 words which will be handed over to the supervisor or trainer. The report can include objective, scope of the project and an in-depth report.

Skills based outcomes and monitorable indicators for Radiation Therapist

Competency statements

1. Demonstrate knowledge to interpret and evaluate a treatment prescription
2. Understands the place of treatment planning processes in RT and performs RTTs role in it (appropriate patient-set-up, immobilization and image scanning with relevant protocols).
3. Communicates relevant information to other members and completes accurate documentation
4. Demonstrates ability to prepare the shielding devices
5. Conducts the simulation and mark-up procedure for all standard treatment techniques
6. Demonstrates ability to carry out the daily organization of the treatment unit
7. Practices accurate treatment documentation
8. Demonstrates ability to interpret, apply and disseminate information as a member of the radiotherapy team
9. Demonstrates professional behaviour
10. Demonstrates a sensitive and caring attitude towards the patient
11. Demonstrates ability to accurately and consistently set-up and treat the patient
12. Demonstrates ability to prepare the patient for their first treatment
13. Evaluates and monitors the patient performance status
14. Monitors, manages and records the patient's side effects throughout the course of treatment
15. Advises patient on appropriate nutrition, sexual function, rest, skin care, nausea and other symptoms
16. Demonstrates skill to support and care for the patient during a brachytherapy procedure
17. Demonstrates ability to carry out the necessary data transfer checks

18. Acquires the initial verification images
19. Demonstrates ability to carry out treatment verification as per protocol/under supervision
20. Demonstrates ability to carry out corrective actions as per instructions
21. Follows health and safety procedures
22. Demonstrates ability to interpret, apply and disseminate information as a member of the radiotherapy team
23. Follows necessary radiation protection regulations as per instructions
24. Demonstrates knowledge and skills to carry out the daily patient related QA as per protocols.
25. Participates in research activities

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
1	Be able to interpret and -understand the treatment prescription	Identify the area for treatment.	Discuss the tumour stage in the context of treatment	200
		Quantify the practical problems associated with machine and accessory equipment limitations	Accurately deliver the treatment plans	
2	Be able to conduct the simulation and mark-up procedure for all standard treatment techniques	Be familiar with the techniques and equipment used	Analyse the information to prepare the patient for treatment according to departmental protocols	200
		Know the protocols used in the department	Operate the simulation equipment safely and accurately	
			Perform daily QA procedures for simulation equipment and mark-up procedures as per protocol.	
3	Understand the role and importance of treatment planning in the radiotherapy process.	Be familiar with the TPS used	Decide and finalize with other RT team members suitable patient position and appropriate immobilization system. Prepare the patient and perform imaging/ scanning for planning as per protocols.	200
		Know the protocols used in the department	Understand all planning techniques for the clinical site/s	
4	Be able to transfer all relevant information and complete accurate documentation	Recognize the importance of accurate transfer of information to allow for accurate treatment set-up according to the treatment plan and prescription	Construct the most appropriate device for the individual patient within the context of the protocol	100
		Know what should be included	Apply the necessary precautions in production	
		Know the process for workflow for documentation and information	Implement correct QC, storage and handling procedures for shielding devices	
		Be aware of the legal issues relating to documentation		

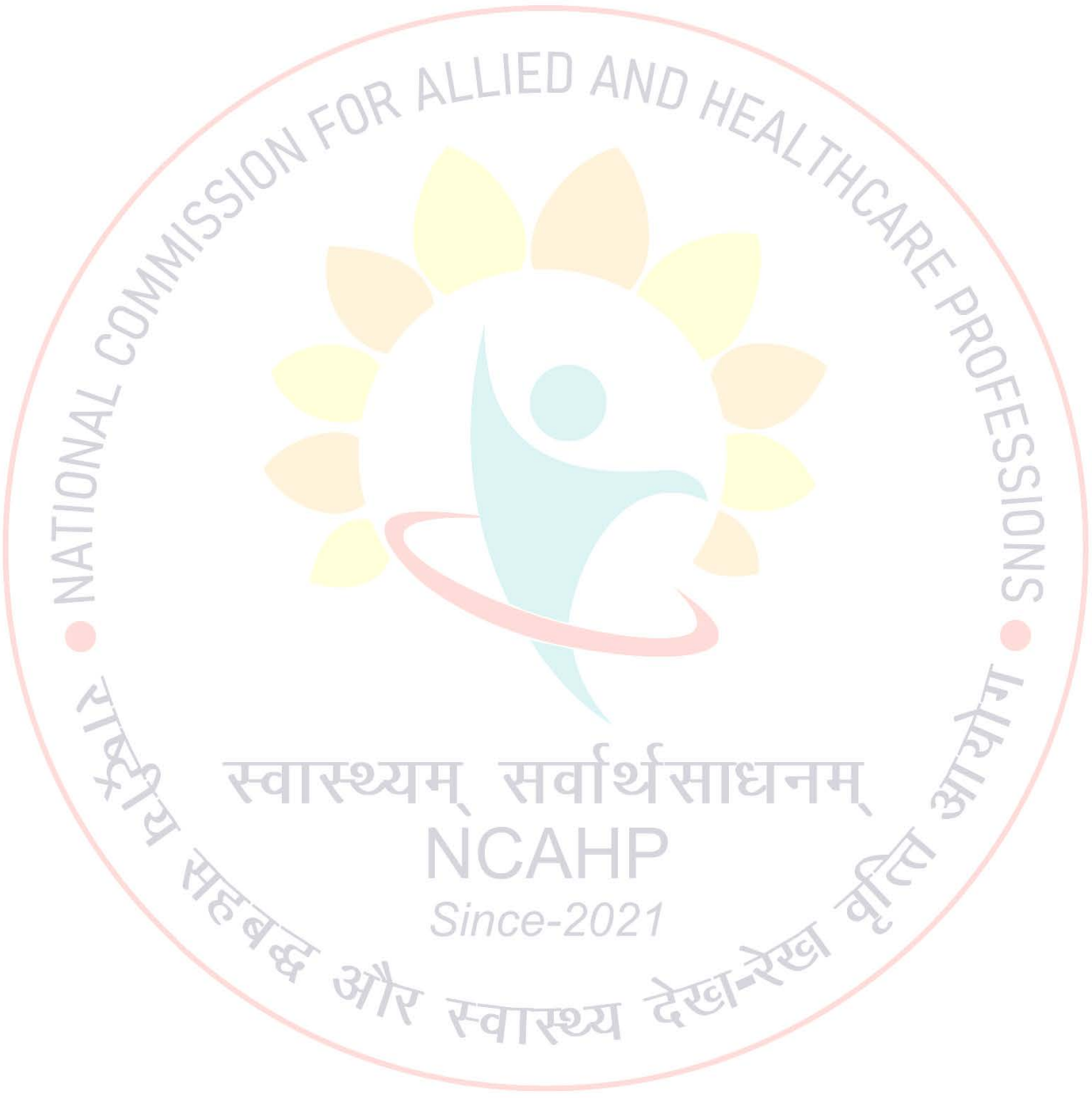
Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
5	Be able to prepare the shielding devices	Know the shielding devices/methods available	Construct the most appropriate device for the individual patient as per the protocol	100
		Know how to use these devices	Apply the necessary precautions in production	
		Recognize the associated health and safety issues	Implement correct QC, storage and handling procedures for immobilization devices	
6	Be able to organize and manage treatment unit	Recognize the importance of team interactions	Participate in the organization of the daily work schedule to maximize efficiency	50
		Explain the principles of effective communication	Inform the patient about the procedure	
		Review the individual patient requirements		
7	Be able to accurately position and immobilize all patients	Discuss the importance of patient identification and how it should be carried out	Interpret the treatment plan and use the equipment accordingly	100
		Be familiar with the treatment plans for all patients on the treatment unit	Identify the patient in accordance with recognized procedures and consistent with the department protocol	
		Identify the co-morbidities that will impact on patient position	Evaluate the patient's general condition prior to commencing positioning	
		Recognize the signs and symptoms associated with treatment in different sites	Analyse the information and integrate to define the optimal patient position	
8	Be able to accurately and consistently set-up and treat the patient	Able to interpret the set-up information	Interpret the treatment plan and set-up the patient accordingly	200
		Discuss the importance of reproducible treatment delivery	Work in a team to check setup and treatment parameters and to avoid random errors	
		Be familiar with the treatment plans and techniques for all patients on the treatment unit	Monitor the patient during each treatment	

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
9	Be able to prepare the patient for their first treatment	Be familiar with the treatment plan	Inform and educate the patient as to the treatment procedures	30
		Identify preparatory procedures	Identify and explain the possible side effects to each patient	
			Assess the physical and psychological status of the patient	
			Check all preparatory procedures have been completed	
10	Be able to complete accurate treatment documentation	Recognize the importance of accurate documentation	Complete the treatment documentation accurately	50
		Know what should be included	Ensure all legal requirements have been met	
		Be aware of the legal issues relating to treatment documentation		
11	Be able to evaluate the patient performance status	Identify the systems used for evaluation of performance status	Assess the patient performance status in view of their diagnosis and comorbidities according to institutional guidelines	50
12	Be able to monitor, manage and record the patient's side effects throughout the course of treatment	Identify the side effects associated with the individual treatment	Assess the daily physical and psychological status of the patient prior to treatment	50
		Define the effects of concomitant treatment	Record all side effects and any intervention recommended	
		Be familiar with the follow up procedures		
		List support groups that might benefit patients		
13	Advise patient on appropriate nutrition, sexual function, rest, skin care, nausea and other symptoms	Explain the impact of nutritional status on patient tolerance of treatment	Assess the patient's nutritional status	50

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
14	Be able to support and care for the patient during a brachytherapy procedure	Be familiar with the treatment procedure	Inform and educate the patient as to the treatment procedure	50
		Identify preparatory procedures	Identify and explain the possible side effects to each patient	
		Know what patient care is relevant for the procedure	Assess the physical and psychological status of the patient	
15	Be able to carry out the necessary data transfer checks	Define and explain the data that must be transferred	Check and verify all treatment parameters	50
			Confirm approval and signatures	
16	Be able to acquire the initial verification images	Explain the different modalities/ methods used to generate verification images	Select the correct settings for imaging	50
			Acquire an appropriate image as per instructions	
17	Be able to carry out treatment verification	Distinguish between systematic and random errors and understand the geometric errors	Compare and contrast bony anatomy and soft tissue matching	50
18	Be able to carry out corrective actions as per instructions	Recognize the critical structures on the verification images	Make corrections in accordance with the protocol/under supervision	50
		Identify the correct imaging protocol	Record any corrections	
19	Be able to check the dose delivered	Understand the Identify the relationship between the prescribed dose, the entrance and exit dose and the dose level of critical organs to the monitor unit or timer setting	Carry out in vivo dosimetry as per the protocol under supervision	50
20	Be able to follow health and safety procedures	Understand the health and safety features/procedures	Assess the safety features and adhere to the same	50

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
21	Be able to interpret, apply and disseminate information as a member of the radiotherapy team	Define and explain the data that must be disseminated	Identify the appropriate personnel to whom specific information should be disseminated	50
			Communicate the correct, relevant and appropriate information	
22	Be able to demonstrate professional behaviour	Explain the legal and ethical guidelines related to the profession	Practice in accordance with legislation regulations and ethical guidelines	200
		Be aware of your own competency levels	Promote collaborative practice	
		Identify the elements that reflect professional appearance and manner		
23	Be able to demonstrate a sensitive and caring attitude to patients	Explain the components of good communication	Self-awareness of their own personality traits	50
		Describe the main personality types	Analyse how the differences in personality influence approach	
		Be aware of the patient' gender, age, cultural background, educational level and social situation		
24	Be able to ensure radiation protection legislation is adhered to	Describe the radiation hazards and how they are managed	Routinely inspect the area to ensure that radiation protection measures are in place and functional	50
		Explain the legislation relating to radiation protection		
25	Be able to carry out the daily/weekly Quality Control (QC) checks of patient and related data	Explain Quality management System (QMS), Quality Assurance (QA) and Quality Control (QC)	Perform the daily/weekly QC procedures related to patient treatment data	50
26	Be able to review the literature	Define search terms for specific treatment sites	Identify the appropriate literature in the area of interest	30
27	Be able to follow research findings	Identify relevant sources of Research	Evaluate research with respect to current departmental practice	10

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
28	Be able to successfully undertake project work.	Identify literature to support research proposal	Review the literature in the area	10
		Be involved in ways to define the necessary steps in preparing and carrying out research	Help in formulating a research question	
	Total Hours			2180


NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
राष्ट्रीय संबद्ध और स्वास्थ्य देख-रेख पेशा आयोग
स्वास्थ्यम् सर्वार्थसाधनम्
NCAHP
Since-2021

4.3 Master of Radiation Therapy Technology – (MRTT)

Master of Radiation Therapy Technology

Introduction:

Learning Objectives: At the completion of this course, the student should be -

1. Able to execute all routine radio therapeutic procedures as per prescription of Radiation Oncologist.
2. Able to assist the radiation oncologist and medical physicist in treatment of cancer patients, radiotherapy planning & procedures, and implementation of new equipment/technology.
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.
4. Able to transfer knowledge and skills to students as well as younger professionals.
5. Able to actively participate and also independently work in research in the field of radiotherapy delivery/clinical research/trials and related areas.

Expectation from the future graduate in the providing patient care.

1. The coursework is designed to train students to work in conjunction with radiation oncology team including radiation oncologists, medical physicists and other members, in the application of prescribed doses of ionizing radiation for the treatment of malignant or benign disease.
2. Course work includes physics, anatomy and physiology, dosimetry, clinical oncology, radiation safety, research methodology, patient and data management, and teaching methodologies. The student will be skilled in management of patients, administration of prescribed radiation treatment, provision of patient support, and imparting education to students and young professionals in the field.
3. Employment opportunities can be found in hospitals in both private and public sectors as well as in independent cancer treating centres.
4. After the completion of the course, the degree holder is expected to register with the Atomic Energy Regulatory Board (AERB) or with other regulatory/standardizing body instituted by Ministry of Health and Family Welfare. The student is also expected to keep updated information on the live register and must re-register after every 5 years to ensure employability in the market.
5. RTT post-graduate is encouraged to keep abreast with the emerging technologies and research activities. The professional should opt for continuous professional education credits offered by national and international institutes.

Eligibility for admission:

Selection procedure:

1. He/she has passed the BSc in Radiotherapy Technology or equivalent examination of a recognized Indian University or a duly constituted Board with pass marks (50%).
2. 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.
3. Admission to M.Sc. RTT course shall be made on the basis of eligibility and an entrance test to be conducted for the purpose. No candidate will be admitted on any ground unless he/she has appeared in the admission test and interview.
    a. Entrance test, to be conducted by the university as per the syllabus.
    b. Successful candidates on the basis of written test will be called for the interview & may face an interview board. The interview board will at least have one senior radiation oncologist and one senior medical physicist as members, and one eligible RT Tech.
    c. During subsequent counselling (s) the seat will be allotted as per the merit of the candidate depending on the availability of seats on that particular day.
    d. Candidate who fails to attend the Medical Examination on the notified date(s) will forfeit the claim for admission and placement in the waiting list except permitted by the competent authority under special circumstances.
    e. The name of the student(s) who remain(s) absent from classes for more than 15 days at a stretch after joining the said course will be struck off from the college rolls without giving any notice.

Duration of the course

Duration of the course: 2 years or 4 semesters. (690 hours of Theory & 1490 hours of Practical Classes) and mandatory submission of research thesis.

Total hours - 2180

Medium of instruction:

English shall be the medium of instruction for all the subjects of study and for examination of the course.

Attendance:

A candidate will be permitted to appear for the University Examination for any semester if he / she secure not less than 75% of attendance in the number of instructional days/ practical at industry during the calendar year, failing which he / she should complete the number of days/hours and undergo the next semester/final examination conducted by the university.

Assessment:

The examination to the first/second year shall be open to a student who:

Has remained on the rolls of the course concerned for full on academic year preceding the examination and having attendant not less than 75% of the full course of lectures and 80% practical separately held for the purpose in each year.

Exit Examination:

The pattern of examination would be Semester based. Each Semester would typically last for 5 months which would be followed by a Residency &/short vacation

The Student should meet the criteria for Attendance (75% Attendance for Theory and 80% Attendance for Practical) and Assessment Criteria (based on periodic test and maintenance of Log book /Practical Work book) for every Semester.

This would be followed by Theory Examination and Practical Examination which would mark the end of each semester. A student has to secure minimum 40% marks in each theory subject and minimum 40% marks in the Practical Examination to get promoted to the next Semester. Marksheet will be provided at the end of each Semester Examination which would display the passed subjects and the failed subjects. The Marksheet will also mention if the student has passed or has been detained during a particular semester

Arrears Examination:

Maximum Backlog of 2 subjects per semester will be allowed **i**n the case of students not securing the minimum passing marks and having failed the theory/practical examination. The backlog subject will need to be cleared in the subsequent semester along with the present semester. The total backlog during any semester will not exceed 2 subjects.

If a student has failed in more than 2 subjects in a particular semester or has an overall backlog of more than 2 subjects during any semester, the student will be detained during that semester and will be promoted to next semester only if he has cleared the backlog subjects or has a maximum backlog of 2 subjects during any semester.

Backlog examination can also be taken up during the period of Internship.

Passing Certificate:

A student will be provided a Passing Certificate only after successful completion of all the Semesters and the Dissertation. 80% attendance will be required for the entire duration of the Residency. Exit Examination:

The pattern of examination would be Semester based. Each Semester would typically last for 5 months which would be followed by a short vacation.

The Student should meet the criteria for Attendance (75% Attendance for Theory and 80% Attendance for Practical) and Assessment Criteria (based on periodic test and maintenance of Log book /Practical Work book) for every Semester.

This would be followed by Theory Examination and Practical Examination which would mark the end of each semester. A student has to secure minimum 40% marks in each theory subject and minimum 40% marks in the Practical Examination to get promoted to the next Semester. Marksheet will be provided at the end of each Semester Examination which would display the passed subjects and the failed subjects. The Marksheet will also mention if the student has passed or has been detained during a particular semester

Arrears Examination:

Maximum Backlog of 2 subjects per semester will be allowed in the case of students not securing the minimum passing marks and having failed the theory/practical examination. The backlog subject will need to be cleared in the subsequent semester along with the present semester. The total backlog during any semester will not exceed 2 subjects.

If a student has failed in more than 2 subjects in a particular semester or has an overall backlog of more than 2 subjects during any semester, the student will be detained during that semester and will be promoted to next semester only if he has cleared the backlog subjects or has a maximum backlog of 2 subjects during any semester.

Backlog examination can also be taken up during the period of Internship.

Passing Certificate:

A student will be provided a Passing Certificate only after successful completion of all the Semesters and the 12 month period of Internship. 80% attendance will be required for the entire duration of the internship.

Curriculum Outline

First Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
MRTT-001	Human Anatomy & Physiology (refresher)	30	30	60
MRTT-002	Pathology & terminology	30	50	80
MRTT-003	Imaging Modalities (on line/off line) related to radiotherapy	30	70	100
MRTT-004	Equipment Operation, Safety and Maintenance	30	70	100
MRTT-005	Patient care and evaluation-I	30	70	100
	Residency – part I		100	100
	TOTAL	150	410	540

Second Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
MRTT-006	Hospital Management	30	70	100
MRTT-007	Patient Care & Evaluation-II	30	50	80
MRTT-008	Radiation Hazards, Evaluation and Control	30	50	80
MRTT-009	Adoption of New RT Technology in an RT centre	30	50	80
MRTT-010	Research Methodology and Biostatistics	30	50	80
	Residency – part II		120	120
	TOTAL	150	390	540

Third Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
MRTT-011	Clinical Radiobiology /Radiation Toxicities	40	50	90
MRTT-012	Stereotactic Radiotherapy/Radiosurgery/SBRT Radiotherapy	50	50	100
MRTT-013	Motion Management in RT	50	50	100
MRTT-014	Nuclear Medicine Imaging & its role in RT	30	40	70
MRTT-015	Teaching/Training Tools/Methodology	30	10	40
	Residency – part III		140	140
	TOTAL	200	340	540

Fourth Semester

Sl. No.	Course Titles	Hours		
		Theory	Practical	Total
MRTT-016	Special RT Procedures	50	50	100
MRTT-017	Recent Advances in Radiotherapy	50	50	100
MRTT-018	Radiotherapy Patient and Data Management	50	50	100
	Residency – part IV – Dissertation	40	200	240
	TOTAL	190	350	540

First Semester

Human anatomy & physiology:

Introduction:

- Overview of the structure
- Organization of the human body
- Anatomical terminology as a communicative device.

Cell-

- Cell morphology and diversity
- Introduction to ultra-structure and function of cell organelles and cell inclusions.

Tissues-

Macroscopic and microscopic studies of epithelial tissue, general connective tissue, cartilaginous tissue, bone tissue, muscle tissue, nervous tissue and the integument, major functional advantages of each tissue type.

Skeletal Muscles-

Major skeletal muscles of the head, Neck, Thorax, Abdomen and upper and lower limbs.

General Osteology-

- General morphology of bones
- Structural classification of bones
- Identification and naming of individual bones of the skeleton
- Development and growth of skeletal tissue and bones.

General Astrology-

- Structural and functional classification of joints
- General morphology of a synovial joint and associated structures
- Movements made available by synovial joints
- Detailed Osteology and Astrology-
- Naming and identification of osteological features of individual human bones
- Naming, Identification and application of classifications to the major joints of the human body
- Examples of variability in the human skeleton.

Cardiovascular System:

- Macroscopic features, function and location of the adult and foetal heart and the location of major arteries and veins
- Macroscopic features of blood vessels including arteries, veins and capillaries; morphological features of the cellular components of blood.

Lymphatic System-

Macroscopic features, Major function and location of the lymphatic vascular structures, Lymph nodes, Tonsils and other mucosa-associated lymphatic tissue, Spleen and thymus; Microscopic anatomy of lymph nodes.

Nervous System-

- Macroscopic features and major functions of the brain and spinal cord
- Morphological features and major functions of the contents of the peripheral nervous system and autonomic nervous system.

Respiratory System-

- Macroscopic features and major functions of the nasal cavity
- Paranasal sinuses
- Pharynx, Larynx, Trachea, Bronchi, Lungs and Thoracic wall including the thoracoabdominal diaphragm
- General microscopic anatomy of the epithelium of the respiratory tract and the lungs.

Digestive System-

Macroscopic features and major functions of the Mouth, Salivary glands, Pharynx, esophagus, stomach, small and large intestines, liver pancreas, biliary system and peritoneal cavity; general microscopic anatomy of the esophagus, stomach, small intestine, pancreas and liver.

Urinary System:

Macroscopic features, Major functions and location of the kidneys, Ureters, Urinary bladder and the urethra; Microscopic anatomy of the kidney.

Endocrine System –

- Macroscopic features
- Location and basic function of the hypothesis cerebri
- Thyroid gland
- Parathyroid glands
- Suprarenal glands
- Pineal gland and organs with a minor endocrine function
- Microscopic anatomy of the hypothesis cerebri
- Thyroid gland, Bulbourethral glands.

Male Reproductive System-

Macroscopic features, Major functions and location of the scrotum, Testes, Epididymis, Ductus deferens, Inguinal canal, Seminal vesicles, Prostate gland, Bulbourethral gland and penis; Microscopic anatomy of the testis.

Female Reproductive System-

- Macroscopic features
- Major functions and location of the ovaries
- Uterine tubes, Uterus, Vagina and external genitalia; Microscopic anatomy of the ovary.

Special Senses-

Macroscopic features and major functions of the contents of the orbital cavity, the eyeball, Lacrimal apparatus, and external, Middle and internal ear; Microscopic anatomy of the photosensitive retina.

Upper Limb:

- Relevant osteology
- Detailed plain radiographic anatomy of skeletally mature and immature individuals
- Regional and surface anatomy of the shoulder, axilla, and upper limb with an emphasis on blood and lymphatic vessels
- MRI and axial sectional anatomy of the glen humeral joint.

Lower Limb-

- Relevant osteology
- Detailed plain radiographic anatomy of skeletally mature and immature individuals
- Regional and surface anatomy of the hip, thigh, crus and pes, with an emphasis on blood and lymphatic vessels
- MRI of the knee joints; angiography of the lower limb.

Head and Neck-

- Relevant osteology of the skull and cervical vertebrae, Surface anatomy, Lymphatic,
- Major blood vessels and nerves of the head and neck

Regional anatomy of the brain and its meanings-

- Axial, Coronal and Sagittal sectional anatomy of the head and axial sectional anatomy of the neck
- Plain radiographic anatomy
- Computerized tomography
- MRI and angiography of the head and neck.

Cross sectional anatomy of body:

- Radiographic anatomy of different radiographs in various projections
- Surface anatomy and applied anatomy pertaining to Radiology.

General Physiology:

- Structure of cell membrane.
- Transport across cell membrane and Homeostasis
- Blood- A B O System & mismatch-transfusion
- WBC plasma protein Erythrocytes
- Haemoglobin. Normal values of Blood (composition & function)

Nerve Neuron AHC- Structure, Classification & Properties

- R.M.P., Action potential
- Propagation of nerve impulse
- Degeneration & regeneration
- Reaction of degeneration.

Muscle- Structure -properties -classification -excitation/contraction coupling, Motor, EMG - factors affecting muscle transmission, neuromuscular transmission.

C.N.S. & P.N.S. - Receptor Physiology:

- Classification & properties
- Synapse structure
- Properties, & transmission
- Reflexes-structure, properties, & transmission
- Sensory & Motor Tracts -effect of transaction (Complete & Incomplete) at various levels Physiology of Touch , Pain, Temperature & Perception
- Physiology of Muscle Tone (muscle spindle), Stretch, Vestibular Apparatus mainly organ Anatomy, Function of Basal ganglia, Thalamus, Hypo-Thalamus, Pre-Frontal lobe, P.A.S., Sensory / motor cortex, Sensory / motor cortex, Limbic System, Learning , memory & condition reflex, Physiology of Voluntary movement.

Excretory System

- Kidneys-(short note) -structure & function, urine formation
- Maturation - neural control- neurogenic bladder, Temperature Regulation, Circulation of the skin-body fluid-electrolyte balance, Endocrine, Secretion - regulation & function of Pituitary-thyroid-parathyroid Pancreas

Reproductive System-

- Functions of Estrogen
- Progesterone & Testosterone

Puberty & Menopause Special senses

Eye-Errors of refraction-accommodation-reflexes-dark & light Adaptation photosensitivity Ear, skin.

Respiratory System-

- Introduction
- General organization
- Mechanics of respiration
- Pulmonary Volumes & capacities
- Anatomical &Physiological Dead space- ventilation/perfusion ratio
- Alveolar ventilation
- Transport of respiratory gases
- Nervous & Chemical control of respiration
- Pulmonary function tests-Direct & indirect method of measurement
- Physiological changes with altitude & acclimatization

Cardiovascular System-

- Structure & properties of cardiac muscle
- Cardiac cycle
- Heart rate regulation-factors affecting Heart Rate
- Blood pressure-
- Definition -regulation-factors affecting

Cardiac output-

- Regulation & function affecting
- Peripheral resistance
- Venous return
- Regional circulation-coronary-muscular
- Cerebral, Normal ECG

Pathology & terminology:

Introductory Pathology:

- Cellular adaptation and cell death
- Inflammation and repair; infection; circulatory disorders; immune defence
- Genetics of disease
- Neoplasia
- Cell injury and adaptation-
- Atrophy, Hypertrophy, Metaphase, Hyperplasia
- Classification of tumours, Premalignant lesion
- Types of inflammation & system manifestations of inflammation
- Disorders of vascular flow & shock (Brief introduction)
- Oedema, Hyperemia or congestion, Thrombosis, Embolism, Infarction shock, Ischemia, Over hydration, Dehydration
- The Response to infection
- Categories of infectious agents, Host barriers to infection
- How disease is caused
- Inflammatory response to infectious agents
- Hematopoietic and Lymphoid System-
- Haemorrhage, Various type of Anaemia, Leukopenia, Leucocytosis, Bleeding disorders coagulation mechanism.

Fundamentals of Medical Terminology:

- Word Roots, Prefix, Suffix, Abbreviations & Symbols
- Introduction to Anatomy & Physiology
- Organs & Systems
- Gastro intestinal, Respiratory, Circulatory, Renal, Reproductive, Nervous, Common 2
- Diseases & Procedures, Gastro intestinal, Cholecystitis, Cholelithiasis, Appendicitis, Intestinal Obstruction, Peritonitis Gastro copy- Endoscopy, Laparotomy, laparoscopy, Common Diseases & Procedures, Respiratory, Tuberculosis, Bronchial Asthma, Respiratory Failure, Pulmonary Emboli son, Pneumonia, Bronchoscopy, Pulmonary Function test, Cardio-Pulmonary, Resuscitation.

Fundamentals of Medical Terminology-II:

Circulatory ,Hypertension ,Coronary Artery Disease ,Arrhythmias, Cardiac Arrest ,Shock, Deep Vein thrombosis (DVT) , ECG,2D Echo Cardiogram, Coronary Angiography, Cardiac Catheterization, Stress test, Pacemaker, Renal, Nephrotic Syndrome ,Urinary Tract Infection Renal /Bladder Stones Intravenous Pyelography, Cystoscopy, Urinalysis, Haemodialysis, Peritoneal Dialysis ,Reproductive, Female - breast cancer /Self Examination, Menstrual Disorders, Dysmenorrhea, Premenstrual Syndrome (PMS), Menorrhagia Ovarian, Cyst, Fibroids, Malignancy, Infertility Mammography, Ultra Sound, Laparoscopy, IV F, Tubectomy, D& C, Male - Prostate Enlargement, Hydrocele, Impotence, T transurethral Research of Prostate, Nervous Stroke (Cerebral Vascular Accident),Brain Tumour, Brain Injuries, Spinal Cord Injuries, Lumbar Puncture, Myelography, CT Scan, MRI, EEG, EMG, Oncology, Investigations, Tumour markers, RECIST Criteria for response evolution

Imaging Modalities (off/on line) related to radiotherapy

Patient imaging holds crucial importance in radiotherapy. An RTT has to be well versed with various imaging modalities that are used in radiotherapy.

1. Positioning Terminology in Radiology
2. Ultrasonography
3. Radiography and fluoroscopy
4. CT
5. MRI
6. PET/SPECT
7. MV and kV CBCT
8. Optical Imaging
9. Angiography

The students will serve a rotation in the radiology wing of the hospital to acquire the skill needed to use the imaging equipment in radiotherapy.

Equipment Operation, Safety and Maintenance

In addition to refreshing the knowledge of various radiotherapy equipment their functioning and operations, the students will focus on safety and maintenance aspects of the advanced equipment namely a dual energy linac with on- and off-line imaging, HDR brachytherapy system and the sophisticated immobilization and stereotactic RT accessories.

Patient care and evaluation-I.

Patients of all ages and performance status come for radiotherapy. An RTT has to be skilled to handle these patients physically and psychologically. This also requires managing the attendants of the patients.

- Procedures for patient transfer such as table to table, table to wheelchair, wheelchair to bed, bed to stretcher, the three-man lift, and draw sheet lift
- Procedures for turning patients who have severe trauma, Unconsciousness, Disorientation, or Amputated limbs
- Radiographic procedures

Management of infectious patients:

- Psychological considerations for the management of infectious patients
- The vital signs used to assess patient condition
- Measurements of temperature, pulse, blood pressure, and respiration
- Clinical measurement and recording of temperature, pulse, blood pressure and respiration.
- Symptoms of cardiac arrest, anaphylactic shock, convulsion, seizure, hemorrhage, apnea, emesis, aspiration, fractures and diabetic coma/insulin reaction
- Acute care procedures for cardiac arrest, Anaphylactic shock, Convulsion, Seizure,
- Hemorrhage, Apnea, Emesis, Aspiration, Fractures, and diabetic coma/insulin reaction

  Use of medical equipment and supplies in treating medical emergencies.

Residency part –I

In the residency the professional is expected to work and contribute in the radiation therapy unit.

Second Semester

Hospital management:

Health care – an overview:

- Functions of Hospital administration
- Modern techniques in Hospital management
- Challenges and strategies of Hospital management

Administrative Functions:

- Planning, Organizing, Staffing, Leading and Controlling Organizational Structure, Motivation and leadership.
- Designing health care organization.

Hospital Management:

- Medical record, House-keeping services.
- Laboratory performance.
- Management of biomedical waste.
- Total patient care – indoor and outdoor.
- Nursing and ambulance resources.
- Evaluation of hospital services. Quality assurance.
- Record reviews and medical audit.

Patient care & evaluation-II

The teaching/training in patient care/ handling continues with the view to take on more responsibility for the same. Communication with other care givers including the ones from out-side the radiation oncology system for better and efficient management of patient care.

Radiation hazards, evaluation and control

Concept of Time , Distance and Shielding, Calculation of workload, Calculation of Weekly dose to the radiation worker and general public, good work practices in radiotherapy/ diagnostic radiology, planning consideration for radiotherapy installation including work load, use factor & occupancy factors, effect of different shielding material. Biological effect of radiation, role of RTT in predicting and managing acute and late radiation toxicities.

Adoption of New RT Technology in an RT centre

Any sophisticated RT equipment commissioned for treatment is operated by an RTT. Before using the equipment for treatment, the operation and safety aspects of the new technology have to be thoroughly understood by the operating RTT.

Take lead in learning the various steps required to adopt the technology: Training/learning from the application specialist and equipment manual about all the functional/safety features of the equipment. Organize/manage the user's training classes/demonstrations with the trainers.

Research Methodology & Biostatistics

The objective of this course is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings. The research methods course will cover an introduction to health systems, health systems research, ethical issues in research, defining a research problem, research design, research tools besides basics of data management and report writing

- Introduction to Health systems
- Identifying research problem
- Ethical issues in research
- Developing a research proposal
- Research design
- Research tools and Data collection methods
- Sampling methods
- Bias and confounding
- Introduction to program evaluation
- Data management
- Analysing information for drawing inferences
- Report writing
- Group presentations

Biostatistics: The objective of this module is to help the students understand the significance of data and data analysis needed for research purposes

1. Concepts of Biostatistics
    - Sample and population. Statistical definitions. Random sampling. Testing of hypothesis.
    - Statistical tools for collection, presentation and analysis of data relating to causes and one incidence of diseases.
    - Measurement of central tendency.
    - Measures of variation. Frequency distribution.
    - Concept of Probability: Laws of Probability. Probability Distribution: Binomial, Normal and Chi-square distribution
    - Commonly used procedures and test of significance and estimation
    - Correlation and regression
    - Test of significance namely Z test, T test, Chi square test, F test
    - Analysis of variance.

2. Types of Data
3. Research tools and Data collection methods

4. Sampling methods
5. Developing a research proposal

Residency part –II

In the residency the professional is expected to work and contribute in the radiation therapy unit.

Clinical Radiobiology & Radiation Toxicities

Concepts of clinical radiobiology are needed to appreciate the basis of radiotherapy and fractionation in radiotherapy:

1. Cell Survival
2. 5 Rs of Radiotherapy
3. History of radiation effect modelling
4. LQ model and BED concepts
5. TC/NTCP and therapeutic ratio
6. Radiobiology of hyper and hypo-dose fractionation
7. Early and late reacting tissues
8. Managing radiation toxicities

Stereotactic Radiotherapy (SRT)/Radiosurgery (SRS)/SBRT Radiotherapy

1. Technical, Physical and Biological aspects
2. Patient set-up and immobilization
3. Safety aspects
4. Patient scheduling and management

Motion Management in RT

Managing the motions (intra-fraction/inter-fraction) is crucial for successful outcome of radiotherapy. From immobilization till treatment delivery all steps need constant and consistent monitoring to reduce the errors/uncertainties. Various methods of motion management such as breath control, motion restriction, gating and tracking need to be taught and clearly understood by the student.

Nuclear Medicine Imaging & its role in RT

For tumour delineation and follow-up nuclear medicine scanning namely SPECT and PET are used. Also, therapeutic radiation doses are also given in nuclear medicine for example iodine therapy for cancer of thyroid and bone pain palliation. Isotopes used in nuclear medicine, imaging methods, patient care should be well understood by the student. Precautions/procedures during nuclear medicine scans for radiotherapy planning. Radionuclide scanning including thyroid up takes measurement Rectilinear scanner Gamma camera, PET, SPECT-their principles working applications and advancements

Teaching/Training Tools/Methodology

1. Teaching/ training aids for RTT
2. Micro teaching and communication

3. Assessing methodology for performance
4. Concepts of clinical research/trials

Residency part –III

In the residency the professional is expected to work and contribute in the radiation therapy unit.

Fourth Semester

Special RT Procedures

1. Total body irradiation
2. Intraoperative EBRT
3. Intra/preoperative brachytherapy
4. Electronic brachytherapy

Recent advancements in modern radiotherapy:

1. Unflat/ Heterogenous photon beams
2. Proton and heavy ion therapy
3. 4-D and biologically guided radiotherapy
4. Newer isotopes for brachytherapy
5. Optical/EM probes for motion management

Radiotherapy Patient and Data Management

Managing patient demographic, diagnostic and RT data including 3D imaging data, integrity of data transfer among various workstations in RT, scheduling patient appointment based on the treatment technique, easy data retrieval for research.

Residency part IV - Dissertation:

Each candidate will have to carry out of a dissertation on the related subject. The dissertation will be guided by one or two members of the faculty (radiation oncologists/medical physicists/RTT) of the department. The dissertation will be evaluated by the External/Internal Examiners. The final dissertation duly approved by the External/Internal examiners will be submitted to the Dean's office with the result. The dean's office will send the dissertation to the library for record.

Skills based outcomes and monitorable indicators for Senior Radiation Therapist

Competency statements

1. Demonstrate knowledge to interpret and evaluate a treatment prescription
2. Demonstrate understanding of treatment planning in the radiotherapy process and performs the necessary patient positioning/immobilization and imaging protocols.
3. Communicates relevant information to other members and completes accurate documentation
4. Demonstrates knowledge of accurate position and ability to immobilize all patients as per instructions
5. Demonstrates ability to prepare the shielding devices as per protocol
6. Conducts the simulation and mark-up procedure for all standard treatment techniques
7. Demonstrates ability to carry out the daily organization of the treatment unit
8. Practices accurate treatment documentation

9. Demonstrates ability to interpret, apply and disseminate information as a member of the radiotherapy team
10. Demonstrates professional behaviour
11. Demonstrates a sensitive and caring attitude towards the patient
12. Demonstrates ability to accurately and consistently set-up and treat the patient
13. Demonstrates ability to prepare the patient for their first treatment
14. Evaluates and monitors the patient performance status
15. Monitors, manages and records the patient's side effects throughout the course of treatment
16. Advises patient on appropriate nutrition, sexual function, rest, skin care, nausea and other symptoms
17. Demonstrates skill to support and care for the patient during a brachytherapy procedure
18. Demonstrates ability to carry out the necessary data transfer checks
19. Acquires the initial verification images
20. Demonstrates ability to carry out geometric treatment verification
21. Demonstrates ability to carry out corrective actions as per instructions
22. Demonstrates knowledge to check the dose delivered as per laid down protocol
23. Implements health and safety procedures
24. Demonstrates ability to interpret, apply and disseminate information as a member of the radiotherapy team
25. Follows the departmental radiological safety protocol and assists in protocol formulation
26. Demonstrates knowledge and skills to carry out the daily/weekly Quality Control (QC) checks on patient treatment/prescription data.
27. Participates in clinical research activities and able to formulate research problems
28. Demonstrates skills for teaching/communication

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
1	Be able to interpret and evaluate a treatment prescription	Identify the area for treatment.	Discuss the tumour stage in the context of treatment	10
		Quantify the practical problems associated with mechanical machine and accessory equipment limitations	Deliver the treatment plan	
2	Be able to conduct the simulation and mark-up procedure for all standard treatment techniques	Be familiar with the techniques and equipment used	Analyse the information to prepare the patient for treatment according to departmental protocols	20
		Know the protocols used in the department	Operate the simulation equipment safely and accurately	
			Implement correct QC, procedures for simulation equipment and mark-up procedures	
3	Understand the place of treatment planning in the radiotherapy process and be familiar with the treatment planning system	Be familiar with the treatment planning processes and procedures	Prepare the patient for treatment planning in terms of suitable positioning, immobilization and imaging as per protocols.	20
		Know the protocols used in the department	Interpret and understand all planning techniques for the clinical site/s	
4	Be able to transfer all relevant information and complete accurate documentation	Recognize the importance of accurate transfer of information to allow for accurate treatment set-up according to the treatment plan and prescription	Instruct the most appropriate device for the individual patient within the context of the protocol	20
		Know what should be included	Apply the necessary precautions in production	
		Be aware of the legal issues relating to documentation	Implement correct QC, storage and handling procedures for shielding devices	

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
5	Be able to instruct correctly on how to position the patient	Be familiar with the techniques and equipment used	Evaluate the patient condition and the limitations that may result from any co-morbid conditions	10
		Know the protocols used in the department	Analyse the information and integrate to define the optimal patient position	
6	Be able to instruct how to prepare the shielding devices	Know the shielding devices/methods available	Instruct the most appropriate device for the individual patient within the context of the protocol	10
		Know how to use these devices	Apply the necessary precautions in production	
		Recognize the associated health and safety issues	Implement correct QC, storage and handling procedures for immobilization devices	
7	Be able to instruct the simulation and mark-up procedure for all standard treatment techniques	Be familiar with the techniques and equipment used	Analyse the information and instruct to prepare the patient for treatment according to departmental protocols	10
		Know the protocols used in the department	Instruct on how to operate the simulation equipment safely and accurately	
			Implement correct QC, procedures for simulation equipment and mark-up procedures	

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
8	Be able to instruct on how to carry out the daily organization of the treatment unit	Recognize the importance of team interactions	Plan and instruct in the organization of the daily work schedule to maximize efficiency	30
		Explain the principles of effective communication	Inform the patient about the procedure	
		Review and explain the individual patient requirements		
9	Be able to accurately position and immobilize all patients	Discuss the importance of patient identification and how it should be carried out	Interpret the treatment plan and instruct on the use of the equipment accordingly	50
		Be familiar with the treatment plans for all patients on the treatment unit	Identify the patient in accordance with recognized procedures and consistent with the department protocol	
10	Be able to accurately and consistently set-up and treat the patient	Able to interpret the set-up information	Interpret the treatment plan and instruct on how to set-up the patient accordingly	50
		Discuss the importance of reproducible treatment delivery	Work in a team to check setup and treatment parameters and to avoid random errors	
		Discuss types of errors and how to avoid these	Monitor the patient during each treatment	

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
11	Be able to prepare the patient for their first treatment	Be familiar with the treatment plan	Inform and educate the patient as to the treatment procedures	10
		Identify preparatory procedures	Identify and explain the possible side effects to each patient	
			Assess the physical and psychological status of the patient	
			Check all preparatory procedures have been completed	
12	Be able to ensure complete accurate treatment documentation	Be aware of the legal issues relating to treatment documentation	Ensure all legal requirements have been met	10
13	Be able to evaluate the patient performance status	Identify the systems used for evaluation of performance status	Assess the patient performance status in view of their diagnosis and comorbidities according to institutional guidelines	50
14	Be able to monitor, manage and record the patient's side effects throughout the course of treatment	Identify the side effects associated with the individual treatment	Assess the daily physical and psychological status of the patient prior to treatment	50
		Define the effects of concomitant treatment	Advise the patient on management of side effects in accordance with departmental protocol	
		Be familiar with the follow up procedures	Refer the patient as appropriate	
		List support groups that might benefit patients	Record all side effects and any intervention recommended	
			Advise patient on immediate post treatment care and inform of the follow up procedures	

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
15	Be able to advise patient on appropriate nutrition, sexual function, rest, skin care, nausea and other symptoms	Explain the impact of nutritional status on patient tolerance of treatment	Assess the patient's nutritional status	20
16	Be able to support and care for the patient during a brachytherapy procedure and also instruct the same to the fellow RRT	Be familiar with the treatment procedure	Inform and educate the patient as to the treatment procedure	20
		Identify preparatory procedures	Identify and explain the possible side effects to each patient	
		Know what patient care is relevant for the procedure	Assess the physical and psychological status of the patient	
17	Be able to carry out the necessary data transfer checks	Define and explain the data that must be transferred	Check and verify all treatment parameters	50
			Confirm approval and signatures	
18	Be able to instruct on how to acquire the initial verification images	Explain the different modalities/ methods used to generate verification images	Select the correct settings for imaging	50
			Instruct to acquire an appropriate image	
19	Be able to carry out treatment verification	Distinguish between systematic and random errors. Define geometric errors.	Compare and contrast bony anatomy and soft tissue matching	50
			Evaluate the images	
20	Be able to carry out corrective actions	Recognize the critical structures on the verification images	Critically evaluate the verification images	50
		Identify the correct imaging protocol	Make corrections in accordance with the protocol	
		Explain the position verification protocols commonly used	Record any corrections	

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
21	Be able to check the dose delivered	Identify the relationship between the prescribed dose, the entrance and exit dose and the dose level of critical organs to the monitor unit or timer setting	Carry out in vivo dosimetry as per protocol	50
			Evaluate results and take corrective action as per protocol	
			Report any inconsistency	
22	Be able to follow and also help implement health and safety procedures	Explain the health and safety issues for patients and staff	Assess the safety features and adhere to the same	50
23	Be able to interpret, apply and disseminate information as a member of the radiotherapy team	Define and explain the data that must be disseminated	Identify the appropriate personnel to whom specific information should be disseminated	50
			Communicate the correct, relevant and appropriate information	
24	Be able to transmit knowledge to new professionals, patients and families	Critique and summaries new information from reputable sources	Critically evaluate new information and distil it down to relevant components for the specific audience	50
25	Be able to demonstrate professional behaviour	Explain the legal and ethical guidelines related to the profession	Practice in accordance with legislation regulations and ethical guidelines	50
		Be aware of your own competency levels	Promote collaborative practice	
		Identify the elements that reflect professional appearance and manner		

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
26	Be able to demonstrate a sensitive and caring attitude to patients	Explain the components of good communication	Self-awareness of their own personality traits	50
		Describe the main personality types	Analyse how the differences in personality influence approach	
		Be aware of the patient' gender, age, cultural background, educational level and social situation		
27	Be able to carry out best practice at all times	Be familiar with current literature and evidence based best practice	Critically evaluate and apply knowledge gained	50
			Apply problem solving techniques in the workplace	
28	Be able to ensure radiation protection legislation is adhered to	Describe the radiation hazards and how they are managed	Routinely inspect the area to ensure that radiation protection measures are in place and functional	50
		Explain the legislation relating to radiation protection		
29	Be able to carry out the daily/weekly Quality Control (QC) checks on patient prescription and treatment data	Explain Quality Management System (QMS), Quality Assurance (QA) and Quality Control (QC	Perform the daily/weekly QC procedures	50
			Analyse and record the results and report any deviations	

Sl no	Learning outcomes	Knowledge/ Comprehension	Applications / Synthesis /Evaluation	Hours
30	Be able to report incidents and near misses	Be familiar with the reporting system and reporting protocols	Report incidents and near misses according to the protocol of the department	50
			Examine any incidents or near incidents and how they can be prevented in the future	
31	Be able to review the literature	Define search terms for specific treatment sites	Identify the appropriate literature in the area of interest	100
32	Be able to suggest implementation of research findings	Identify relevant sources of Research	Evaluate research with respect to current departmental practice	100
33	Be able to suggest/ initiate topics for radiotherapy research.	Identify literature to support research proposal	Review the literature in the area	100
		Define the necessary steps in preparing and carrying out research	Formulate a research question	
34	Ability to teach and communicate to DRTT and BSCRTT students	Understand and identify topics and techniques to be taught	Teach /demonstrate to DRTT and BSCRTT students	100
	TOTAL HOURS			**1490**

RT DIPLOMA, BRTT AND MRTT PROGRAM COMPITENCY LEVELS AS DESIRED IN STANDARD FORMAT CAN BE REPLACED TO PREVIOUS LEVELS OF MODEL 2016.

Performance Criteria	Indicators		
	Knowledge	**Skill**	**Behavior**
Diploma RT Be able to interpret and evaluate a treatment prescription Be able to conduct the simulation and mark-up procedure for all standard treatment Techniques. Understand all planning techniques for the clinical site/s	• Should have in depth knowledge Identify the area for treatment. Quantify the practical problems associated with machine and accessory equipment limitations familiar with the techniques and equipment used • Explains the course of planned treatment	• Recognises and considers patient's specific needs Create and evaluate treatment plans Analyse the information to prepare the patient for treatment according to protocols. Manage the simulation planning & Treatment Delivery equipment safely and accurately for patients. Decide and finalize with other RT team members suitable patient position and appropriate immobilization system. Prepare the patient and perform imaging/ scanning for planning as per protocols.	• Greets and respects all patients and their attendants in a caring, sensitive and appropriate manner • Positive attitude and patience towards patient's requirements • Ensures equal care and treatment is provided to all patients • Respect towards patients regarding their health care decisions
• Ability to manage confidentiality of patient's demographic and medical record data Be able to transfer all relevant information and complete accurate documentation	• Should have adequate knowledge of data protection and how this will impact security, access and confidentiality of the patient's records • Should have essential knowledge to ensure the patient environment will remain safe and user-friendly, in terms of	• Conversant in using various digital devices, access cloud storage platforms and saves electronic medical records on system-based software programs and keeps them safe Recognize the importance of accurate information according to the treatment plan and prescription associated with health and safety issues.	• Restricts self from discussing patient information and condition in any open forum/external communication Know to whom or where the documentation and information should be sent

Be able to prepare the shielding devices Discuss the importance of reproducible treatment delivery Avoid random errors Monitor the patient during each treatment **BRRT- in addition to above competencies following will be added to BR RT program** Recognize the importance of accurate documentation Be able to monitor, manage and record the patient's side effects throughout the course of treatment Advise patient on appropriate nutrition, sexual function, rest, skin care, nausea and other symptoms Be able to acquire the initial verification images Distinguish between systematic and random errors and	access and facilities Know the shielding devices/methods available Identify the co-morbidities that will impact on patient position Recognize the signs and symptoms associated with treatment in different sites Identify and explain the possible side effects to each patient Be aware of the legal issues relating to treatment documentation Identify the side effects associated with the individual treatment Explain the impact of nutritional status on patient tolerance of treatment Explain the different modalities/ methods used to generate verification images Compare and contrast bony anatomy and soft tissue matching Understand and Identify the relationship between the prescribed dose, the entrance and exit dose and the dose level of critical organs to the	Implement correct QC, storage and handling procedures for immobilization devices Evaluate the patient's general condition prior to commencing positioning Assess the daily physical and psychological status of the patient prior to treatment Check and verify all treatment parameters Select the correct settings for imaging Acquire an appropriate image Recognize the critical structures on the verification images	Inform the patient about the procedure Identify the patient in accordance with recognized procedures and consistent with the department protocol Record all side effects and any intervention recommended Be familiar with the follow up procedures Carry out in vivo dosimetry as per the protocol under supervision Be able to demonstrate professional behaviour Identify the elements that reflect professional appearance and manner Promote collaborative practice

understand the geometric errors Be able to check the dose delivered			
Be able to follow health and safety procedures Be able to demonstrate a sensitive and caring attitude to patients Be able to ensure radiation protection legislation is adhered to • Ability to adhere to health and safety policies of the practice Be able to review the literature Be able to follow research findings	Define and explain the data that must be disseminated Be aware of the patient' gender, age, cultural background, educational level and social situation Describe the radiation hazards and how they are managed • Should have vital knowledge about appropriate personal hygiene, cleanliness of the practice, hygiene relating to instrumentation, disposal of clinical waste etc. • Should be aware of policies of the local governing body and professional organizations	• Implements appropriate measures for infection control • Maintains comfortable, hygienic and risk-free environment Evaluate research with respect to current Help in formulating a research question	Analyse how the differences in personality influence approach Routinely inspect the area to ensure that radiation protection measures are in place and functional
• Ability to promote ethical and cordial relationship with other health care professionals	• Should have essential knowledge of how to maintain practice in accordance with other professional health care standards	• Explains the condition that are treatable/correctable beyond your practice standards	• Honesty and understanding of own limitations

• Ability to comply with legal, professional and ethical guidelines, law and codes **MASTERS RT PROGRAME-in addition to above competencies following will be added to MRRT program** Be able to demonstrate a sensitive and caring attitude to patients Be familiar with current literature and evidence based best practice Be able to suggest/ initiate topics for radiotherapy research. Ability to teach and communicate to DRTT and BSCRTT students **Provide leadership in radiation therapy**	• Should have vital knowledge of the law, codes and guidelines set by the regulatory body of profession and is fully aware of the consequences if not followed. • Should have in depth knowledge of ethical practice and standard operating procedures followed in the clinical examination Analyse how the differences in personality influence approach Critically evaluate and apply knowledge gained Apply problem solving techniques in the workplace Understand and identify topics and techniques to be taught *Appreciate the value of mentor- mentee relationship within your specialty* Respond professionally to change implementation Organize delivery of care in a patient-centred manner	• Follows the code of conduct set down by the council/ appropriate authorities Routinely inspect the area to ensure that radiation protection measures are in place and functional Be able to report incidents and near misses *- Be receptive to the provision and acceptance of constructive feedback*	*Foster professional growth of self and peers* Identify risks and barriers to optimal access to radiation therapy

CLINICAL COMPETENCE

Clinical placements provide the student with an opportunity to experience the clinical environment and apply theoretical learning to the workplace. Each clinical placement will build on the student's existing knowledge from previous placements and from the clinical skills tutorials and enhance clinical competence by reinforcing learning continuously.

Learning in the clinical environment should be appropriate to the level of the student and the theory that is being learnt. Each clinical assessment must align to the specific learning outcomes of the level that increase in complexity from standard radiotherapy techniques to more complex treatments.

Clinical placements allow the student to become familiar with:

(1) The purpose/function of the equipment with particular attention to the following:

- Features of a radiotherapy treatment room;
- Safety features including interlocks, cameras and intercom;
- Equipment:
  - major components of linear accelerator (and/or Cobalt-60);
  - radiation types and energies;
  - treatment techniques;
  - shielding;
  - treatment verification;
  - in vivo dosimetry;
  - field size;
  - distance;
  - wedges;
  - bolus.
- Accurate patient positioning;
- Accessory positioning and immobilization aids including:
  - masks;
  - mouth bites;
  - breast board;
  - vacuum forming devices;
  - belly board;
  - foot-fix;
  - knee-fix;
  - lung board; any other in use in the department.

(2) Patient care and management before, during and after treatment with particular attention to the following:

- Communication;
- First treatment information;
- Daily care during treatment;
- Recognition of new signs and symptoms;
- Recognition and care of side effects;
- Appropriate referral.

Learning outcomes specific to clinical placements

The learning outcomes must be relevant to the programme/qualification and to the level of the student. In all programmes there is a progressive development of the student from more general outcomes to highly specific outcomes for complex professional practice. The outcomes listed below are in order of application from Diploma level to Masters level and while all must be achieved, there can be some flexibility in the presentation and assessment of these outcomes. The students in all programmes will also be required to critically evaluate their practice through the process of reflection which in turn will enable them to become critical thinkers and reflective practitioners. The aim of clinical placement at this level is to ensure that the students develop a range of clinical competencies appropriate to a newly qualified RTT.

The assessment forms are examples of possible criteria for the assessment of the learning outcomes.

The learning outcomes are that the student will be able to:

- Understand the general work that is undertaken on the unit or in the area to which students are assigned;
- Describe the overall radiotherapy process;
- Understand the psychosocial issues associated with cancer treatment;
- Explain the technical aspects of the treatment unit;
- Identify and describe the purpose of the features of the treatment room;
- Identify and explain the use and purpose of the safety features;
- Describe the equipment used in routine radiotherapy;
- Identify and explain the use of the various positioning and immobilisation devices;
- Identify, position and immobilise the patient correctly;
- Work as a team member on the unit or in the area to which they are assigned;
- Understand the radiotherapy process;
- Apply knowledge of psychology and sociology to patient care and management;
- Interpret the treatment prescription;
- Understand standard treatment plans;
- Participate in the simulation procedures;
- Explain the available image verification methods commonly used;
- Define patient assessment criteria and appropriate referral.

Students on a 3.5-year degree programme will have additional clinical placements to enable them to participate in all the steps of treatment planning for complex treatment techniques (e.g. 3-D conformal radiotherapy) and to acquire the skills necessary to adapt to future developments in the field of radiotherapy, incorporating best practice and evidence- based medicine. Students at this level will be required to integrate fully in all sections of the Radiotherapy Department. The students will also be required to critically evaluate their practice through the process of reflection which in turn will enable them to become critical thinkers and reflective practitioners.

The assessment forms are examples of possible criteria for the assessment of the learning outcomes in level 5.

The learning outcomes for Masters level that are additional to the learning outcomes already listed are that the student will be able to:

- Participate fully in and demonstrate competence in all aspects of localisation, planning processes, verification, treatment set-up and delivery which enable them to integrate fully as a member of the Radiotherapy team;
- Demonstrate professional attitude appropriate to a newly qualified RTT in terms of effective communication with patients, relatives, staff and the wider multi-disciplinary team;
- Critically evaluate their practice through the process of reflection which they will demonstrate by discussion with clinical staff and document in reflective diaries and case studies as part of their clinical portfolio;
- Evaluate patient conditions and respond appropriately in terms of advice and support relating to the treatment process;
- Analyse treatment techniques in relation to best practice and evidence based medicine.

Table 3 onwards documents are indicative of assessment forms for all the levels.

Table 3 ASSESSMENTS AND ASSIGNMENTS RELEVANT TO THE PROGRAMME LEVELS

Assessment and Assignment forms to be completed	**Diploma**	**Bachelor Degree**	**Masters**
Professional assessment	√	√	√
Clinical assessment	1 and 2	1, 2 and 3	1, 2 and 3
Clinical assignment	1 and 2	1, 2 and 3	1, 2, 3 and 4

Table 4 PROFESSIONAL ASSESSMENT (PROFESSIONALISM)

COMPETENCY					
	PASS AND LEVEL OF COMPETENCE				
	PASS	**EXCEEDS EXPECTATIONS**	**EXAMPLES**	**FAIL**	**REASON**
Professional appearance (Uniform, orderliness, tidiness)					
Attendance					
Punctuality					
Reliability (carrying out tasks as directed)					
Willingness to participate					
Assumes responsibility within appropriate limits					
Courtesy					

	PASS	EXCEEDS EXPECTATIONS	EXAMPLES	FAIL	REASON
Communication with patients. Engages the patient in general conversation Recognises his/her limitations in patient interaction					
Communication with staff Asks questions Transfers information accurately Functions effectively as member of multi-disciplinary team Engages with patients, staff, public in a professional manner					
Professional manner with the patient (As appropriate for the stage the student has reached in the education programme)					
Additional comments:					

Table 5 PROFESSIONAL ASSESSMENT (HEALTH AND SAFETY)

RADIATION PROTECTION AND HEALTH AND SAFETY		
STUDENT IDENTIFIED AND DISCUSSED THE PURPOSE OF:	**PASS**	**FAIL**
Personnel radiation monitoring devices		
Radiation warning signs and warning lights		
Entrance system (e.g. maze, gate) and wall thickness		
Door interlocks		
Emergency buttons		
Last man out button		
Fire-fighting equipment		
Fire alarms and fire exits		
Emergency / crash trolley		
Oxygen and suction equipment		

STUDENT WAS AWARE OF LOCAL INFECTION CONTROL GUIDELINES:	PASS	FAIL
Identified the materials required		
Helped to prepare the room for an infectious patient or outlined the procedure		
Helped with cleaning procedures following treatment of an infectious patient or outlined the procedure		
Helped to correctly dispose of waste material or outlined the procedure		
Additional Comments:		

TITLE PAGE FOR ALL CLINICAL ASSESSMENTS

Name:
Unit/Section:

Department/Hospital: Placement Dates

Attendance record	Detail	Comment
Full attendance		
No. of days and dates absent		
Staff member notified and date of notification		

Signatures following discussion between student and clinical mentor/supervisor:

Student: _____

Clinical mentor/supervisor(s): _____

RTT Educator: _____

Date: _____

CLINICAL ASSESSMENT

Continuous formative clinical assessment

Please comment on the student's core and generic competencies considering the student's ability to:

- Identify the area being treated and discuss related theory;
- Accurately set-up the patient according to the prescription and plan;
- Practice professionally within the team;
- Appropriately communicate with and care for the patient.

Were the aims and objectives, outlined at the beginning of this placement, fulfilled?

Yes No Partially

Name:

Signature: _____ _____ _____

RTT Instructor Student Date

Please comment on the student's progress throughout their time on this clinical placement.

1. Overall for this placement, this student is:

Adequate:_____ Reason:

_____

Needs further practice: Reason: _____

_____

2. Indicate what aspects are excellent, very good, good, satisfactory or poor. Provide reasons and recommend areas that the student can work on:

Poor:_____ Reason:

_____

Satisfactory: _____
Reason:

_____

Good: _____

Reason:

_____

Very good _____

Reason:

_____

Excellent _____
Reason:

_____

Name:

Signature: _____

_____ _____

Clinical Supervisor Student

Table 6 CLINICAL ASSESSMENT 1: PATIENT SET-UP

The student	Did not complete	Completed with significant assistance	Completed with minimal assistance	Completed with no assistance	Excellent (no assistance and used initiative at all
Read set-up details and prepared the treatment room appropriately					
Call and identify patient correctly					
Check patient's condition (communicates well with the patient)					
Positioning and immobilization of the patient (communicates well with RT team)					
Confirm parameters					
Additional Comments:					

Table 7 CLINICAL ASSESSMENT 2: PATIENT SET-UP

The student:	Did not complete	Completed with significant assistance	Completed with minimal assistance	Completed with no assistance	Excellent (no assistance and used initiative at all times)
Interpret the treatment prescription correctly and check with the treatment plan for a standard setup					
Read set-up details and prepare the treatment room appropriately (following health and safety procedures)					
Call and identify patient correctly					
Check patient's condition (communicates well with the patient)					
Positioning and immobilization of patient (communicates well with RT team)					
Explain the image verification methods commonly used					
Define patient assessment criteria and appropriate referral					
Confirm parameters					

CLINICAL ASSESSMENT 3 AND 4: PATIENT MANAGEMENT AND TREATMENT

Learning outcomes for this placement

Agreed by:

Student Signature:

RTT Educator Signature:

Date:

Interim Review and discussion (not applicable if short placement) Comments:

RTT:

Student:

Signatures: _____ _____

Date: _____

Table 8 CLINICAL ASSESSMENT OF PATIENT MANAGEMENT

Ability to assist patients in all aspects of patient care					
The student:	**Unable to meet outcome**	**Significant assistance required**	**Minimal assistance required**	**No assistance required**	**Excellent and used initiative at all**
Knew the local practice of patient identification and showed their ability to do this, appropriately and consistently throughout placement					
Communicated effectively with patients and relatives as appropriate					
Communicated effectively with the other members of the RTT and multidisciplinary team					
Appropriately assisted and supported patients throughout the treatment preparation procedures					
Evaluated patients' physical signs and symptoms and was aware of possible psychosocial issues					
Understood the potential patient difficulties with respect to patient condition, contrast, catheters, ink tattoos etc. and responded appropriately					
Followed good hygiene practices and infection control policies					

Table 9 CLINICAL ASSESSMENT OF TECHNICAL KNOWLEDGE AND ABILITY (POSITIONING AND IMMOBILIZATION)

Assessing all aspects of mould room procedures		**Level of assistance required**			
The student:	**Unable to meet outcome**	**Significant assistance required**	**Minimal assistance required**	**No assistance required**	**Excellent and used initiative**
Could interpret mould room request form and prepare equipment accordingly					
Understood the principles of good patient positioning and immobilization and could position and manipulate patients appropriately					
Understood the differences between the immobilization devices used and selected the appropriate device for the patient					
Understood the principles of production of the immobilization devices and could participate in their production					
Displayed knowledge of the principles of use of mouth bites/tongue depressors and other accessories and could participate in their production					

Understood the principles of magnification and beam energy when producing customized shielding (e.g. lead electron cut-outs) and could participate in their production					
Could interpret the information available in order to produce an accurate contour and could participate in the process					
Understood the principles of bolus and build-up and applied this knowledge in the production of customized bolus and build-up e.g. wax.					
Understood the importance of daily quality assurance in the mould room and participated in these procedures					
Understood the importance of accurate and clear documentation to ensure reproducibility of position throughout treatment					

Additional Comments:

General:

Areas for development:

Table 10 CLINICAL ASSESSMENT OF TECHNICAL KNOWLEDGE AND ABILITY (IMAGE ACQUISITION)

Assessing all aspects of patient set up					
The student:	**Unable to meet outcome**	**Significant assistance required**	**Minimal assistance required**	**No assistance required**	**Excellent and used initiative at all times**
Communicated effectively and worked as a team member in positioning the patients and using the correct immobilization devices for the individual patient					
Moving and handling patients in an appropriate and safe manner					
Understood the principles of contrast in imaging and carried out safety procedures correctly					
Understood the functions of radio-opaque markers and fiducial markers in imaging and applied them correctly					
Displayed knowledge of the principles of the techniques used and the reasons for any changes made for individual patients and could participate in the selection of field					
Performed final checks and verbal confirmation of commencing scan					
Accurately completed all steps at the console to the point of 'scan start'					

Recognized the importance of good quality image production					
Understood the importance of accurate and clear documentation to ensure reproducibility of position throughout treatment					
Understood the importance of daily quality assurance and participated in these procedures					
Additional Comments: General: Areas for development:					

CLINICAL ASSIGNMENTS

CLINICAL ASSIGNMENT 1

Clinical Assignment 1 has two components. The aim of the first component of this assignment is to evaluate the student's understanding of the pathway of two patients commonly encountered in a radiotherapy department. These case scenarios are examples and can be changed to reflect the patient population in a specific department. The scenarios can also be adapted to reflect the techniques and modalities of treatment that should be assessed (e.g. external beam radiotherapy, brachytherapy and other modalities such as surgery, chemotherapy and other as relevant).

The second component is designed to encourage the student to reflect on their experience of the radiotherapy department, the role of the various members of the radiotherapy team and how this experience will impact on their working practice.

CLINICAL ASSIGNMENT 2

Clinical Assignment 2 has two components. The aim of the first component of this assignment is to evaluate the student's knowledge and understanding of the management of a patient with a malignancy commonly treated in the radiotherapy department where they are on clinical placement.

The second component is to assess how much the students have understood of the interaction between the radiation therapist and the patient attending for the first visit.

CLINICAL ASSIGNMENT 3

This Assignment has five components and is designed to assess the depth of knowledge and understanding that the student has acquired in the academic and clinical setting and their ability to apply their theoretical knowledge to clinical practice.

CLINICAL ASSIGNMENT 4

This Assignment builds on clinical assignment 3 and aims to evaluate the student's ability to apply their knowledge and understanding to more complex cases and to evaluate the student's ability to make decisions.

CLINICAL ASSIGNMENT 1 (Year 1 of all levels of courses)

Name:

Department/Hospital:

Unit:

Placement Dates:

Date submitted:

Part 1: The patient pathway

While the student is on placement, select two patients: e.g. a young woman with early breast cancer and an older gentleman with more advanced head and neck cancer. The student should read the patient notes carefully and use the information gained together with information from the academic modules to complete the assignment outlined below.

Note: These are examples and can be adjusted to suit the department Case Scenario 1:

The patient with early breast cancer is a 42 year old married woman with three children who works full time. She has been referred for radiotherapy and chemotherapy following surgery.

Case Scenario 2:

The patient with head and neck cancer is a 70 year old male diagnosed with advanced oral cancer and he has been referred for radiotherapy. He has a history of smoking and alcohol abuse. He lives alone.

Assignment

Based on your understanding of the patient pathway, the departments and personnel involved at each stage, and the practical and psychosocial issues relevant to each patient:

Briefly describe how each of the two patients will be managed and the role of the personnel involved at each stage of their care;

Describe in detail the management of the patients in the radiotherapy department.

Word count: Approximately 2000 words per case scenario

Part 2: The reflective report

During the first clinical placements emphasis is placed on professional behaviour and how this impacts on teamwork and the patient experience.

The student should reflect back on their first placement and discuss:

First impressions, taking into consideration how first impressions might affect a patient attending for their first radiotherapy appointment;

How understanding of all aspects of professionalism has evolved giving examples of the impact of professionalism on teamwork and the patient experience;

How the student's experience has influenced his/her attitude to clinical practice in radiation therapy.

CLINICAL ASSIGNMENT 2 (Year 2 of bachelor and above)

This assignment is an example of what can be completed throughout the year covering all clinical placements. The student should be encouraged to select a variety of patients that are representative of those treated in the clinical site. Alternatively a list of required or recommended sites/pathologies can be provided.

Name:
Department
Unit:
Placement Dates:
Date submitted:

Part 1: Patient case study

While the student is on placement he/she is required to complete one patient case study on a patient being treated in one the sites most commonly encountered in the centre.

The student should select one patient he/she has been involved in treating.

The student should read the patient's clinical notes carefully and use the information contained within them as well as the information/knowledge gained in the academic programme to complete the case study.

The case study should include information on the following aspects of patient management/care:

A profile of the patient selected including the student's reasons for selecting this patient.

An overview of the history, investigations and other treatments received.

A detailed description of the radiotherapy technique used.

The acute and late side effects associated with treatment at this site and the advice given to the patient.

Word count: Approximately 3000 words

Part 2: Giving first visit information to patients

The students will be asked to outline the procedure they have observed when an RTT was giving first visit information to a patient. Include in the answer:

The setting in which the information was given;

Who was present;

The information given to the patient;

The opportunity for questions and feedback.

Word count: Approximately 500 words

CLINICAL ASSIGNMENTS 3 (Year 3 of master and above)

This assignment is an example of what can be completed throughout the year covering all clinical placements. The student should be encouraged to select a variety of patients that are representative of those treated in the clinical site. Alternatively a list of required or recommended sites/pathologies can be provided.

Name:

Department/Hospital:

Unit:

Placement Dates:

Date submitted:

Part 1: Two patient case studies

While they are on placement, students are required to complete two patient case studies of patients they are involved in treating and that represent the sites most commonly encountered in the centre.

This assignment is an example of what can be completed throughout the year covering all clinical placements. The student should be encouraged to select a variety of patient diagnoses or alternatively a list of required sites/pathologies can be provided (e.g. breast, prostate, lung, oesophagus, thorax, and pelvis, dependent on which sites are covered in the academic programme)

The student should read the patient's clinical notes carefully and use the information contained within them as well as the information/knowledge gained in the academic programme to complete the case study.

Each case study must include information on the following aspects of patient management/care:

A profile of the patient selected including the student's reasons for selecting this patient;

An overview of the history, investigations and other treatments received;

A detailed description of the radiotherapy technique used;

The acute and late side effects associated with treatment at this site and the advice given to the patient.

Word count: Approximately 3000 words

Part 2: Treatment verification

For one of the patients the student has selected, describe in detail the verification method used. Discuss the choice of method and evaluate its appropriateness

Word count: Approximately 1000 words

Part 3: Giving first visit information to patients

Outline where you gave the first visit information to the patient. Include in your answer:

The setting in which the information was given;

Who was present?

The information given to the patient; The opportunity for questions and feedback; Applied theory; Include your own reflections on the process in your answer.

Word count: No more than 500 words

Part 4: The reflective report

For each patient selected:

Based on the diagnosis, detail the acute and late side effects that you would expect this patient might experience, giving reasons, and indicate how they can be minimized;

Based on the acute and late side effects, you have identified evaluate the quality and level of information given to the patient prior to their first treatment;

Describe your role as a member of the team and in the management of the patient.

Word count: No more than 1000 word

CLINICAL ASSIGNMENT 4

Name:
Department:
Unit:
Placement Dates:
Date submitted:
To be completed throughout the year covering all clinical placements

Part 1: Patient case studies

While the student is on placement he/she is required to complete five patient case studies on patients being treated for five different sites or techniques. At least 3 of the case studies should be for curative intent and at least 1 should be a palliative case study. The RTT Educator may require 1 of the 5 case studies to reflect more specialized techniques that are not carried out in the centre and is therefore more theoretical.

Instructions to the student:

Select patients you have treated in any of the following regions (adjust according to the centre and programme):

Paediatric patient; TBI; Extremities (e.g. soft tissue sarcoma); 3D conformal radiotherapy; IMRT; Stereotactic radiotherapy; Brachytherapy.

Read the patient's clinical notes carefully and use the information contained within them to complete the case studies. Refer also to the information/knowledge you have gained through your academic programme and include these in your discussion.

Each case study must include information on the following aspects of patient management/care:

- A profile of the patient selected including your reasons for selecting this patient;
- An overview of the history, investigations and other treatments received;
- The treatment prescription and the rationale for its selection;
- A detailed description of the radiotherapy technique used;
- The acute and late side effects associated with treatment at this site and the advice given to the patient.

For the palliative case study provide this in addition to the above:

- A brief overview of the relevant prior treatments;
- The specific care and support required for this patient and their family;
- Your role in the management of this patient.

Word count: No more than 3000 words

Part 2: Decision making

Based on the students' experience in a range of clinical settings and involved in the treatment of a wide range of patients they should discuss the aspects that must be considered in the day-to-day decision making on a treatment unit to ensure that each patient receives optimal care. An example of one aspect to consider is the duration of treatment and the scheduling of the appointments. Students should base their answer on two patients they have treated.

Word count: No more than 1000 words

Part 3: The reflective report

For this assignment students are expected to review their previous reflective reports and describe how their attitudes and beliefs have changed over the four years and the factors that have most influenced or brought about these changes.

Word count: No more than 1000 words

Name of the Institution/ University

DEPARTMENT OF RADIATION ONCOLOGY

LOG BOOK

Bachelor of Radiation Therapy Technology

Submitted By

Student Name

Batch Number/Year

Registration Number

CERTIFICATE

This is to certify that the content of log book is a Bonafede work
of _____Reg. No._____
BRTT student in Department of Radiation Oncology, Name of the Institution/ for the Academic year_____

Head of the Department

Bachelor of Radiation Therapy Technology student appraisal form

Training Evaluation Period _____ to _____
Student Name_____ Registration No: _____

Unit/Machine _____ Department_____

Sr.No	Particulars	Not Satisfactory (1,2,3)	Satisfactory (4,5,6)	More than Satisfactory (7,8,9)	Remarks
1	**Knowledge & Understanding** 1. Prepared for their level of Knowledge 2. Demonstrates continuing development of knowledge 3. Recognising the members of the team				
2	**Critical Thinking & Evaluation** 1. Understands the clinical workflow 2. Able identify the immobilization devices and accessories from the patient chart				
3	**Professional & Ethical Practice** 1. Understands the protocols & standards of practice 2. Provides care for the patient 3. Able to read/check the recorded documentation 4. Actively communicates with the team				

4	**Care & Clinical Management** 1. Demonstrates empathy and care for individuals 2. Is aware of special needs of patient (wheel chair, blankets, etc.,. 3. Actively participates in patient positioning, monitoring and reaction assessment				
5	**Professionalism** 1. Demonstrates appropriate interest & enthusiasm in learning 2. Attentive 3. Punctuality 4. Professional appearance 5. Maintain the patient information confidentiality 6. Follows the radiation safety norms				

Weekly Academic Schedule

Day	Time	Event
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		

Clinical posting Schedule

Month	Department	Machine

List of Seminars/Conference attended

List of Seminars/Conference presented

Patient case file presentation

Sl.No	Patient name	Hospital No.	Radiation Oncologist	Planning physicist
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Checked by

Radiation Therapist/Radiation Oncologist/Medical Physicist

Note: During the clinical/ Machine posting minimum 10 patient cases being treated in that machine should be presented every week and duly signed by the senior Radiation therapist.

Name of the Institution/ University

DEPARTMENT OF RADIATION ONCOLOGY

LOG BOOK

Master of Radiation Therapy Technology

Submitted By

Student Name

Batch Number/Year

Registration Number

CERTIFICATE

This is to certify that the content of log book is a bonafide work
of _____Reg. No._____
MRTT student in Department of Radiation Oncology, Name of the Institution/ for the Academic year_____

Head of the Department

Master of Radiation Therapy Technology student appraisal form

Training Evaluation Period _____ to _____
Student Name_____ Registration No: _____

Unit/Machine _____ Department_____

Sr.No	Particulars	Not Satisfactory (1,2,3)	Satisfactory (4,5,6)	More than Satisfactory (7,8,9)	Remarks
1	**Knowledge & Understanding** 1. Demonstrates knowledge and skills learned at university or on previous placements by actively participating in procedures 2. Is able to adapt knowledge or skills to similar clinical practice procedures 3. Actively participates in learning opportunities 4. Demonstrates that they can apply 'on the job' learning				
2	**Critical Thinking & Evaluation** 5. Seeks resources or information during machine down time or periods when workload is reduced, or as negotiated with their supervisor 6. Carries out administrative/ organisational related activities that contribute to workflow without the need for continual prompting 7. Consults protocols before undertaking unfamiliar treatment or planning techniques				

3	**Professional & Ethical Practice** 8. Understands responsibility for a duty of care to the patient 9. Acknowledges errors and seeks advice regarding the appropriate course of action 10. 10.Sets goals that are achievable in conjunction with supervisors 11. Reflects on level of ability in order to build on and increase competence 12. 12.Completes documentation according to department protocols 13. Follows up missing data and information 14. Communicates with other health professionals where appropriate				
4	**Care & Clinical Management** 15. Demonstrates empathy and care for individuals 16. Is aware of special needs of patient (wheel chair, blankets, etc.,. 17. Performs technical skills to an appropriate level of competence relative to the stage of their academic program in: Treatment , Planning , Simulation/CT 18. Has knowledge of the data they need to obtain and record for treatment quality assurance purposes				

	19. Has an understanding of the principles and protocols of imaging for treatment verification 20. Has an understanding of the record and verify facility				
5	**Professionalism** 21. Demonstrates appropriate interest & enthusiasm in learning 22. Attentive 23. Punctuality 24. Professional appearance 25. Maintain the patient information confidentiality 26. Follows the radiation safety norms 27. Correct manual handling skills 28. Uses infection control procedures 29. Operates machinery and equipment safely				

Weekly Academic Schedule

Day	Time	Event
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		

Clinical posting Schedule

Month	Department	Machine

List of Seminars/Conference attended

List of Seminars/Conference presented

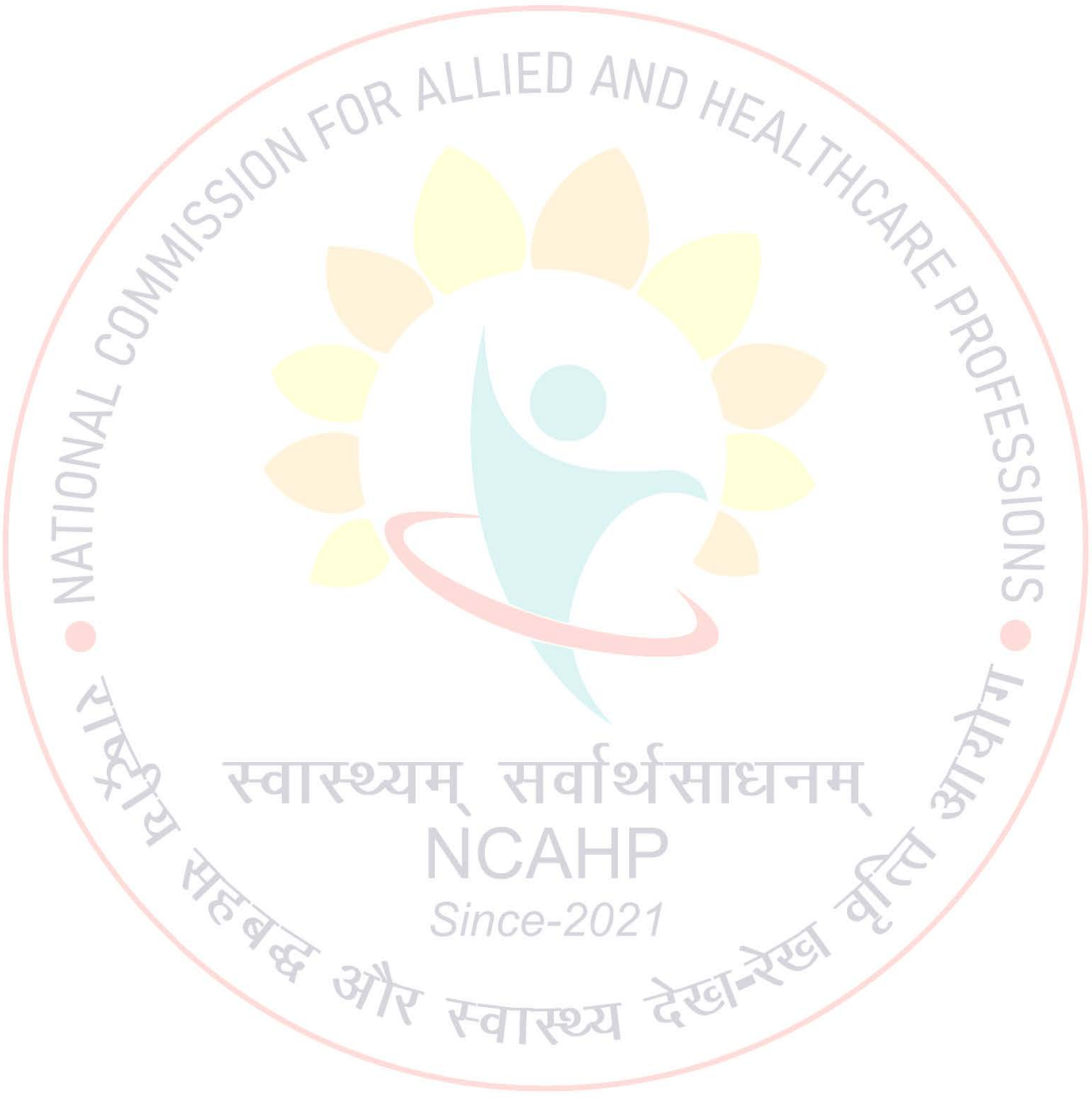
Patient case file presentation

Sl.No	Patient name	Hospital No.	Radiation Oncologist	Planning physicist
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Checked by

Radiation Therapist/Radiation Oncologist/Medical Physicist

Note: During the clinical/ Machine posting minimum 10 patient cases being treated in that machine should be presented every week and duly signed by the senior Radiation therapist.


NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
राष्ट्रीय संबद्ध और स्वास्थ्य देख-रेख पेशा आयोग
स्वास्थ्यम् सर्वार्थसाधनम्
NCAHP
Since-2021

Chapter 5

Job description

Chapter 5: Job Description for all levels (Proposed)

A brief overview of the proposed job description is mentioned below for various levels, however this may be customized based on different work settings.

Level 4 Diploma holder

- Assisting in Patient identification and verification of the patient/ treatment site identification
- Simulation- basic site specific simulation
- Immobilization -simple
- Basic knowledge in radiation safety
- Treatment preparation
- Treatment for Single field, Parallel opposed treatment, 3 field treatment, other simple 3D treatment not involving IMRT or Complex 3D
- Data entry including treatment recording
- General knowledge pertaining to biomedical waste disposal
- Familiarization with equipment
- Knowledge on radiation reaction management
- Brachytherapy treatment under supervision

Level 5 Bachelor holder

- Patient identification and verification of the patient/ treatment site identification
- Simulation- basic site specific simulation
- Immobilization -simple
- Basic knowledge in radiation safety
- Treatment preparation
- Treatment for Single field, Parallel opposed treatment, 3 field treatment, other simple 3D treatment not involving IMRT or Complex 3D
- Data entry including treatment recording
- General knowledge pertaining to biomedical waste disposal
- Familiarization with equipment
- Knowledge on radiation reaction management
- Brachytherapy treatment under supervision
- Machine preparation for the simulation and treatment
- Treatment of Complex 3D including IMRT/VMAT/SRS/SRT/SGRT/Proton therapy
- Treatment image verification including EPID and Cone Beam CT
- Simulation for SRS /SRT/SBRT

- Information management / communication for inter disciplinary
- Use of oncology information systems for recording the treatment delivery
- Brachytherapy treatment

Level 6

In addition the above mentioned responsibilities-

- Supervision of the health and safety features
- Professional responsibility including quality check on treatment delivery, chart verification
- Special procedures treatment including TBI/TSET etc

Level 7

- Professional developmental skill
- Special Brachytherapy treatment skill
- Ability to critically evaluate practice
- Routine QA on brachytherapy machine as per protocol
- Verifies the accuracy of the patient setup before the treatment as per protocol
- Monitors the patients for clinical reaction for all the patients
- Evaluates the field placement based on pre-treatment images

Level 8

- Notifies appropriate health physicians when immediate clinical response is necessary based on emergency
- Weekly and monthly audit of patient set up
- Radiation incidence reporting as per institutional protocol
- Maintenance of the radiation generating RT equipment and log book for the equipment as per institutional protocol.
- Involvement in clinical research and development/clinical trails
- Involvement in teaching/demonstration/practical's
- Standardizing the teaching skills and developing a curriculum for the teaching program.

Level 9

- Be technically competent and able to complete pre-treatment preparation procedures for patients for any of the most observed cancer sites in the radiation therapy department, including problem solving as required.
- Participate in all documentation procedures
- Demonstrate professionalism in appearance and conduct at all times

Level 10

Effective contributor / Technical Expert to the radiation therapy team and developing skills within the wider multidisciplinary team.

Demonstrates a professional attitude at all time.

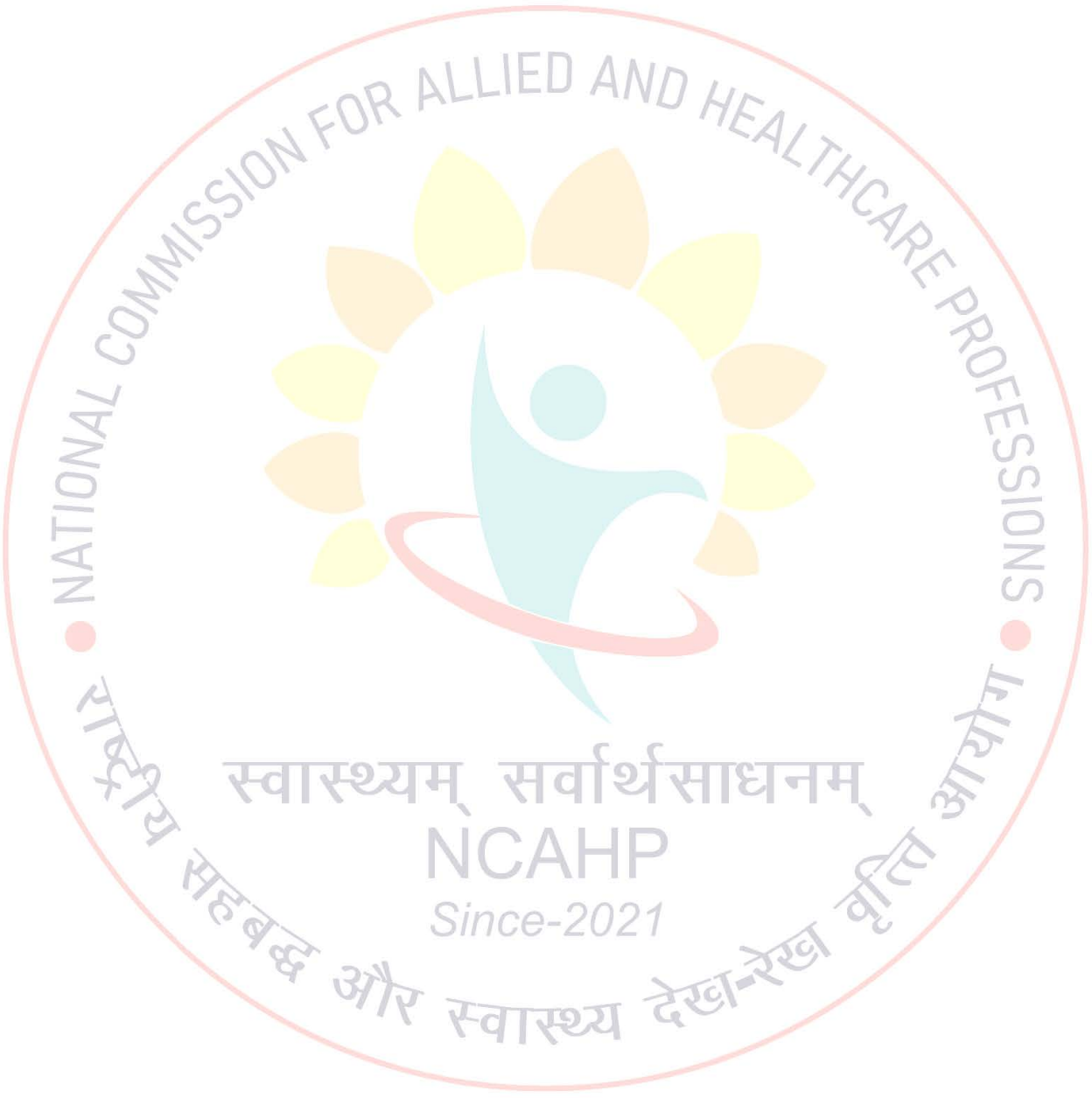
Contributes as educators (practice tutors/lecturers/ professor) mapped to university structure and training requirements

Critically reflect on current practice and consider innovative solutions to drive continuous practice change

Participate as a full team member

Always adhere to departmental health and safety procedures, including radiation protection and infection control guidelines

Can communicate effectively with patients, carers, and all staff.


NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
राष्ट्रीय संबद्ध और स्वास्थ्य देख-रेख पेशा आयोग
स्वास्थ्यम् सर्वार्थसाधनम्
NCAHP
Since-2021

Annex- 1

Radiation facilities covered under AERB jurisdiction

The Jurisdiction of AERB covers the following radiation facilities –

- Diagnostic Medical X- ray installations
- Radiation Therapy Installations
    - Teletherapy
    - Brachytherapy
- Nuclear Medicine Laboratories
    - Diagnostic and low dose therapy
    - High dose therapy
- Radio Immuno Assay (RIA)
- Research
- Industrial Radiography Installations
    - Radiography cameras
    - X –Ray units
    - Accelerators
- Gamma Irradiation Plants
    - ISOMED, Board of Radiation and Isotope Technology, Mumbai
    - SARC, Sriram Institute for Industrial Research, Delhi
    - RASHMI, Kidwai Memorial Institute of Oncology, Bangalore
    - RAVI, Defence Lab, Jodhpur
    - RVNRL, Rubber Board, Kottayam
    - PANBIT, SCTIMST, Trivandrum
    - Radiation Processing Facility, BRIT, Vashi
    - VIKIRAN, Organic Green Foods Ltd, Kolkata
    - STERICO, Mumbai
    - Universal ISO- MED, Universal Medicap Ltd, Vadodara
    - Vardaan Agrotech Pvt. Ltd, Haryana
    - Microtrol Sterilisation Services Pvt Ltd, Hyderabad
    - KRUSHAK, BRIT-BARC Facility, Lasalgaon, Nasik
- Nucleonic Gauges
- Consumer Products

Annex-2

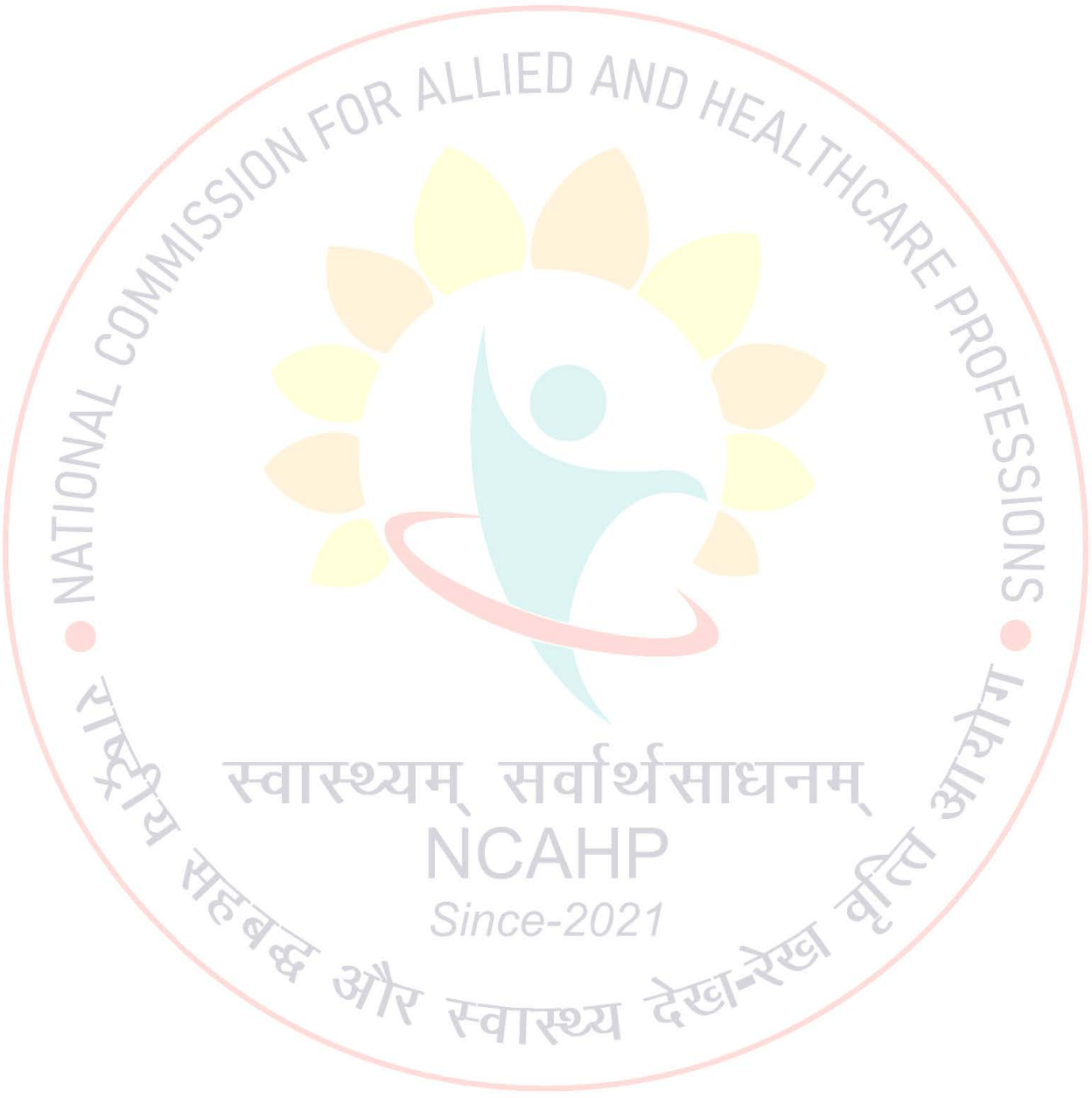
Details of Institutes approved by AERB for Radiotherapy courses

Sl. no.	Name of the Institution	Course Name	Affiliated by
1	Basavatarakam Indo-American Cancer Hospital & Research Institute Hyderabad - 500034.Andhra Pradesh	Diploma in Radiotherapy Technician (DRTT)	Andhra Pradesh Para Medical Board, Hyderabad, Andhra Pradesh
2	GSL Trust Cancer Hospital & Research Centre, Rajahmundry - 533105,Andhra Pradesh	Diploma in Radiotherapy Technician(DRTT)	Andhra Pradesh Para Medical Board, Hyderabad, Andhra Pradesh
3	M.N.J. Institute of Oncology, Hyderabad - 500004,Andhra Pradesh	Diploma in Radiotherapy Technician (DRTT)	Andhra Pradesh Para Medical Board, Hyderabad, Andhra Pradesh
4	Medwin Institute of Medical Sciences, Hyderabad - 500001,Andhra Pradesh	Diploma in Radiotherapy Technician	Andhra Pradesh Para Medical Board, Hyderabad, Andhra Pradesh
5	Nizam's Institute of Medical Sciences(NIMS),Hyderabad - 500082,Andhra Pradesh	Post Graduate Diploma in Radiation Therapy Technology(PGDRTT)	NIMS, Hyderabad (Deemed University)
6	Sri Venkateswara Institute of Medical Sciences, University(SVIMS),Tirupati - 517507,Andhra Pradesh	Diploma in Radiotherapy Technology (DRTT)	SVIMS, Tirupati (Deemed University)
7	Yashoda Super Speciality Hospital Hyderabad - 500082,Andhra Pradesh	Diploma in Radiotherapy Technician (DRTT)	Andhra Pradesh Para Medical Board, Hyderabad, Andhra Pradesh
8	Dr. B. Borooah Cancer Institute, Gopinath Nagar, Guwahati - 781016,Assam	Two Years Diploma in Radiotherapy Technology (DRTT)	Srimanta Sankardeva University of Health Sciences, Guwahati, Assam
9	Dr. B. Borooah Cancer Institute, Gopinath Nagar, Guwahati - 781016,Assam	Post Graduate Programme in Radiotherapy Technology (PGDRTT)	Gauhati University, Guwahati, Assam
10	Indira Gandhi Institute of Medical Sciences (IGIMS), Regional Cancer Centre, Patna - 800014,Bihar	Diploma in Medical Radiotherapy Technology (DMRTT)	IGIMS, Patna (Deemed University)
11	Mahavir Cancer Sansthan, Patna - 801505,Bihar	Diploma in Medical Radiotherapy Technology (DMRTT)	Aryabhatta Knowledge University, Patna, Bihar
12	Postgraduate Institute of Medical Education and Research (PGIMER),Chandigarh - 160012,Chandigarh	B.Sc Medical Technology (Radiotherapy)B.Sc. (MRTT)	PGIMER, Chandigarh (Deemed University)
13	Pt. J. N. M. Medical College & Dr.B.R. Ambedkar Memorial Hospital,Raipur - 492001,Chattisgarh	M.Sc. (Radiotherapy Technology)M.Sc. (RTT)	Ayush and Health Sciences University of Chattisgarh
14	Rajiv Gandhi Cancer Institute & Res. Centre, New Delhi - 110085	B.Sc. Medical Technology (Radiotherapy) (BMRT)	Guru Gobind Singh Indraprastha University, New

Sl. no.	Name of the Institution	Course Name	Affiliated by
15	Gujarat Cancer & Research Institute, Ahmedabad - 380016,Gujarat	Course for Medical Radiotherapy Technology,(CMRT)	Gujarat University, Ahmedabad, Gujarat
16	Nursing College, Muni Seva Ashram Goraj, Vadodara - 391760,Gujarat	Post Graduate Diploma In Radiotherapy Technology (PGDRTT)	Gujarat University, Ahmedabad
17	Smt. L. P. Patel Institute of Medical Laboratory Technology, Shri Krishna Hospital & Research Centre, Karamsad - 388325, Gujarat	B.Sc. Medical Technology(Radiotherapy)[B.S c.-MT(RTT)]	Sardar Patel University, Vallabh Vidyanagar, Gujarat
18	Pt. B.D. Sharma P G Institute of Medical Sciences, Rohtak – 124001, Haryana	Three Year Diploma in Radiography & Radiotherapy Technology	Pt. B.D. Sharma University of Health Sciences, Rohtak, Haryana
19	Sher-i-Kashmir Institute of Medical Sciences(SKIMS), Srinagar – 190011, Jammu & Kashmir	B.Sc Radiation Technology B.Sc (RTT)	SKIMS, Srinagar (Deemed University)
20	Bangalore Institute of Oncology, Bangalore – 560027, Karnataka	B.Sc. Radiotherapy[B.Sc.(RT)]	Rajiv Gandhi University of Health Sciences, Bangalore, Karnataka
21	Father Muller Medical College & Hospital, Mangalore – 575002, Karnataka	B.Sc. Radiotherapy[B.Sc.(RT)]	Rajiv Gandhi University of Health Sciences, Bangalore, Karnataka
22	Kasturba Hospital, Mangalore – 575001, Karnataka	Bachelor of Science in Medical Radiotherapy Technology [B.Sc. MRT]	Manipal University, Manipal, Karnataka
23	Kasturba Hospital, Manipal – 576104, Karnataka	B.Sc in Medical Radiotherapy Technology [B.Sc. MRT]	Manipal University, Manipal, Karnataka
24	Kidwai Memorial Institute of Oncology, Bangalore - 560029, Karnataka	B.Sc. Radiotherapy [B.Sc.(RT)]	Rajiv Gandhi University of Health Sciences, Bangalore, Karnataka
25	Manipal Hospital, Bangalore – 560017, Karnataka	Bachelor of Science in Medical Radiotherapy Technology [B.Sc. MRT]	Manipal University, Manipal, Karnataka
26	Narayana Institute of Advanced Research Pvt. Ltd., Bangalore – 560099, Karnataka	B.Sc. Radiotherapy [B.Sc.(RT)]	Rajiv Gandhi University of Health Sciences, Bangalore, Karnataka
27	Amrita Institute of Medical Sciences & Research Centre, Kochi – 682041, Kerala	Bachelor of Science- Medical Radiologic Technology(B.Sc-MRT)	Amrita Vishwa Vidyapeetham Amrita Nagar, Coimbatore, Tamilnadu
28	Mahatma Gandhi University, Kottayam – 686008, Kerala	B.Sc in Medical Radiological Technology B.Sc (MRT)	Mahatma Gandhi University, Kottayam (Deemed University)
29	Malabar cancer Centre, Kannur – 670103, Kerala	Bachelor of Science in Medical Radiological Technology [B.Sc(M.R.T)]	Kannur University, Kannur Kerala

Sl. no.	Name of the Institution	Course Name	Affiliated by
30	Malabar cancer Centre [From Session (2013-2017) onwards], Kannur – 670103, Kerala	Bachelor of Science in Medical Radiological Technology [B.Sc(M.R.T)]	Kerala University of Health Sciences, Thrissur
31	Rashtra Sant Tukdoji Cancer Hospital & Research Centre, Nagpur – 440027, Maharashtra	Advance Diploma in Radiotherapy Technology (ADRTT)	Maharashtra State Board of Technical Education, Mumbai, Maharashtra
32	School of Medical Assistant, INHS Asvini, Mumbai – 400005, Maharashtra	Diploma in Radiotherapy Technician	Maharashtra University of Health Sciences, Nashik, Maharashtra
33	Tata Memorial Hospital, Mumbai – 400012, Maharashtra	Advance Diploma in Radiotherapy Technology(ADRTT)	Maharashtra State Board of Technical Education, Mumbai, Maharashtra
34	Jawaharlal Institute of Postgraduate Medical Education & Research (JIPMER), Pondicherry – 605006, Pondicherry	B.Sc. (Medical Technology Radiotherapy) B.Sc (MRT)	JIPMER, Pondicherry (Deemed University)
35	Christian Medical College, Ludhiana – 141008, Punjab	B.Sc. in Radiotherapy Technology [B.Sc.(RT)]	Baba Farid University of Health Sciences, Faridkot, Punjab
36	Guru Gobind Singh Medical College, Faridkot – 151203, Punjab	B.Sc. in Radiotherapy Technology[B.Sc.(RT)]	Baba Farid University of Health Sciences ,Faridkot, Punjab
37	S. M. S. Medical College and Assoc. Group of Hospital, Ramsingh Road, Jaipur – 302004, Rajasthan	B.Sc Radiotherapy Technology B.Sc. (RT)	Rajasthan University of Health Sciences, Rajasthan
38	Apollo Specialty Hospital, Chennai – 600035, Tamil Nadu	Post Graduate Diploma in Radiotherapy Technology (PGDRT)	Alagappa University, Karaikudi, Tamil Nadu
39	Barnard Institute of Radiology & Oncology, Chennai – 600003, Tamil Nadu	Diploma in Radiotherapy Technology (DRTT)	The Director of Medical Education, Chennai, Tamil Nadu
40	Cancer Institute, Adyar, Chennai – 600020, Tamil Nadu	B.Sc. in Radiotherapy Technology [B.Sc.(RT)]	The Tamil Nadu Dr. M.G.R. Medical University, Chennai, Tamil Nadu
41	Christian Medical & Hospital, Vellore – 632004, Tamil Nadu	B.Sc. in Radiotherapy Technology[B.Sc.(RT)]	The Tamil Nadu Dr. M.G.R. Medical University, Chennai, Tamil Nadu
42	Dr. Kamakshi Memorial Hospital, Chennai – 600100, Tamil Nadu	B.Sc. in Radiotherapy Technology[B.Sc.(RT)]	The Tamil Nadu Dr.M.G.R. Medical University Chennai, Tamil Nadu
43	Govt. M.K. Medical College Hospital, Salem – 636001, Tamil Nadu	Diploma in Radiotherapy Technology,(DRTT)	The Director of Medical Education, Chennai, Tamil Nadu

Sl. no.	Name of the Institution	Course Name	Affiliated by
44	Govt. Rajaji Hospital & Madurai Medical College, Maduri - 625020,Tamil Nadu	Diploma in Radiotherapy Technology (DRTT)	The Director of Medical Education, Chennai, Tamil Nadu
45	Tirunelveli Medical College, Tirunelveli – 627011, Tamil Nadu	Diploma in Radiotherapy Technology,(DRTT)	The Director of Medical Education, Chennai, Tamil Nadu
46	Tripura Institute of Paramedical Sciences, Tripura – 799014, Tripura	B.Sc in Medical Radiotherapy Technology (BMRT)	Tripura Central University, Tripura
47	Institute of Medical Sciences BHU, Varanasi – 221005, Uttar Pradesh	PG Diploma in Medical Technology (Radiotherapy)	Banaras Hindu University, Varanasi
48	J.N. Medical College & Hospital, Aligarh Muslim University, Aligarh – 202002, Uttar Pradesh	Bachelor in Radiation Therapy Technology (BRTT)	Aligarh Muslim University, Aligarh, Uttar Pradesh
49	Sushila Tiwari Memorial Cancer Research Institute, Himalayan Institute Hospital Trust (HIHT), Dehradun – 248140, Uttarakhand	B.Sc Medical Technology (Radiotherapy) B.Sc. (RT)	HIHT, Dehradun (Deemed University)
50	Apollo Gleneagles Hospitals,58, Canal Circular Road, Kolkata – 70005, West Bengal	Diploma in Radio therapeutic Technology(DRT)	State Medical Faculty of West Bengal, Kolkata, West Bengal
51	Bankura Sammilani Medical College, P.O.-Kenduadihi, Bankura – 722102, West Bengal	Diploma in Radio therapeutic Technology(DRT)	State Medical Faculty of West Bengal, Kolkata, West Bengal
52	Burdwan Medical College, P.O. – Rajbari, Baburbag, Burdwan – 713104, West Bengal	Diploma in Radio therapeutic Technology(DRT)	State Medical Faculty of West Bengal, Kolkata, West Bengal
53	Cancer Centre Welfare Home & Research Institute, MG Road, Thakurpukur, Kolkata - 700063,West Bengal	Diploma in Radio therapeutic Technology(DRT)	State Medical Faculty of West Bengal, Kolkata, West Bengal
54	Chittaranjan National Cancer Institute, 37, S.P. Mukherjee Road, Kolkata – 700026, West Bengal	Diploma in Radio therapeutic Technology(DRT)	State Medical Faculty of West Bengal, Kolkata, West Bengal
55	Institute of Post Graduate Medical Education & Research, 244, AJC Bose Road, Kolkata – 700020, West Bengal	Diploma in Radio therapeutic Technology(DRT)	State Medical Faculty of West Bengal, Kolkata, West Bengal
56	Medical College, 88 College Street, Kolkata – 700073, West Bengal	Diploma in Radio therapeutic Technology(DRT)	State Medical Faculty of West Bengal, Kolkata, West Bengal
57	NRS Medical College, 138 AJC Bose Road, Kolkata - 700014,West Bengal	Diploma in Radio therapeutic Technology(DRT)	State Medical Faculty of West Bengal, Kolkata, West Bengal


NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
राष्ट्रीय संबद्ध और स्वास्थ्य देख-रेख पेशा आयोग
स्वास्थ्यम् सर्वार्थसाधनम्
NCAHP
Since-2021

Reference

[1] Introduction to clerkship 1999. Available from: https://umanitoba.ca/faculties/medicine/media/missiion_goals_object_class_2011.pdf.

[2] Standards of practice for ACT Allied Health Professionals 2005. Available from: http://health.act.gov.au/c/health?a=dlpubpoldoc&document=863.

[3] Pamela Mitchell et al. Core principles and values of effective team based healthcare2012. Available from: https://www.nationalahec.org/pdfs/VSRT-Team-Based-Care-Principles-values.pdf.

[4] Professionalism in nursing, midwifery and the allied health professions in Scotland. Scottish Government, 2012 978-1-78045-925-7.

[5] Nursing & Midwifery Council .Standards for competence for registered nurses. Available from: http://www.nmc-uk.org/Documents/Standards/Standards%20for%20competence.pdf.

[6] Social Accountability- A vision for Canadian medical schools Available from: https://www.afmc.ca/fmec/pdf/sa_vision_canadian_medical_schools_en.pdf.

[7] University of Manitoba. Faculty of medicine teaching handbook2004. Available from: umanitoba.ca/faculties/medicine/media/teaching_handbook04.doc.

[8] Medical Council of India. Vision 2015. Published March 2011. Available from: http://www.mciindia.org/tools/announcement/MCI_booklet.pdf.

[9] Sherwin J. Competency-Based Medical Education Takes Shape2011. Available from: https://www.aamc.org/newsroom/reporter/april11/184286/competency-based_medical_education.html.

[10] Bushway D, Everhart D. Investing in Quality Competency-Based Education2014. Available from: http://www.educause.edu/ero/article/investing-quality-competency-based-education.

[11] Brookfield, S. D. Self-Directed Learning In: YMCA George Williams College ICE301 Lifelong learning Unit 1 Approaching lifelong learning. London: YMCA George Williams College; 1994.

[12] Ramnarayan K, Hande S. Thoughts on Self-Directed Learning in Medical Schools: Making Students More Responsible 2005. Available from: http://education.jhu.edu/PD/newhorizons/lifelonglearning/higher-education/medical-schools/.

[13] Harvey, B. J., Rothman, A. I., Frecker, R.C. Effect of an undergraduate medical curriculum on students' self-directed learning. Academic Medicine. 2003; 78(12): 1259-65.

[14] Vertical Integration2015. Available from: http://www.mcw.edu/Medical-School/Curriculum/Traditional-Curriculum/Vertical-Integration.htm.

[15] Srinivas, D.K. Adkoli, B.V. Faculty Development in Medical Education in India: The Need of the Day. Al Ameen J Med Sci (2009)2 (1):6-13. Available at: http://www.alameenmedical.org/ajms/ArticlePDFs/AJMS3.6-13.pdf

[16] TNN. Oral, cervix cancer preventable: Experts. The Times of India 2014 15 Sep 2014.

[17] Sinha K. 7 lakh Indians died of cancer last year: WHO. The Times of India 2013 14 Dec 2014

[18] IANS. Cancer incidence to rise five-fold in India by 2025? The Times of India 2014 3 Feb 2014;Sect. Health & Fitness

[19] American Cancer Society. The Science behind Radiation Therapy, 2014. Available from: http://www.cancer.org/acs/groups/cid/documents/webcontent/003019-pdf.pdf.

[20] Marcus K J. Radiation Therapy 2014. Available from: http://www.britannica.com/EBchecked/topic/488627/radiation-therapy.

[21] Radiation Therapy. Mammography Review for Technologists. Las Vegas Xraycert.com; 2014. p. 133.

[22] AERB. Facilities under the purview of AERB regulation2013. Available from: http://www.aerb.gov.in/AERBPortal/pages/English/Constitution/facilities_jsp.action.

[23] Enhancing youth employability: the importance of core work skills. Skills for employment: policy brief [Internet]. 2013. Available from: http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_234467.pdf.

[24] Fremgen B, Frucht S. Medical Terminology: A Living Language: Pearson Education, Inc. Available from: http://www.ogeecheetech.edu/docs/d_Programs/AlliedHealth/Syllabi/ALHS1090.pdf.

[25] Kong-lung H. Law and ethics in medical practice: An Overview. 2003; 8. Available from: www.fmshk.org/article/746.pdf.

[26] Texas Intensive English Program2014. Available from: https://www.tiep.edu/intensive-programs/.

[27] Mittal R, Mahajan R, Mittal N. Foundation programme: A student's perspective. International Journal of Applied and Basic Medical Research. 2013; 3(1):52-4. Epub 10.4103/2229-516X.112241.