

Study Scheme & Syllabus  
of  
Bachelor of Science in  
(Radiotherapy Technology)  
(B.Sc RT)

Batch 2024 onwards

IKG Punjab Technical University

**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 centers.
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 40% in Physics, 50% in Biology, 15% in Chemistry, 10% in English (Language & Comprehension) and 10% in General Awareness about health related methods.
  - b. Successful candidates on the basis of written test will be called for the interview & shall have face an interview board. The interview board should include at least one senior radiation oncologist, one senior medical physicist apart from other nominees, whose recommendations shall be final for the selection of the students.
  - c. During subsequent counseling (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**

The course shall be 4 years/8 Semester (Including 1 year or 2 Semesters of Internship). The Choice based credit system will be applicable to all the semesters.

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.

## Study Scheme and Syllabus

### *First Semester (Foundation Course)*

Course Code	Course type	Course title	Load allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Int.	Ext.		
BSOT101-19	Core Theory	Human Anatomy and Physiology – 1	3	1	0	40	60	100	4
BSRT101-19	Core Theory	Elementary Mathematics and Physics	2	1	0	40	60	100	3
BSOT203-19	Core Theory	Quality Management, Patient safety and Disaster management	3	1	0	40	60	100	4
BSOT103-19	Core Practical	Human Anatomy and Physiology – 1 (Practical)	0	0	4	40	60	100	2
BSRT102-19	Core Practical	Elementary Mathematics and Physics (Practical)	0	0	2	40	60	100	1
BSOT206-19	Core Practical	Quality Management, Patient safety and Disaster management (Practical)	0	0	2	40	60	100	1
BSRT103-19	AECC	Introduction to Healthcare delivery System in India	2	0	0	40	60	100	2
BSOT105-19	AECC	Medical Law and Ethics	2	0	2	50	**	50	3
BSOT106-19	AECC	Medical Terminology, Record keeping and Orientation to Radiotherapy Technology and Management	2	0	0	40	60	100	2
HVPE101-18	AECC	Human Values, De-addiction and Traffic Rules	3	0	0	40	60	100	3
HVPE102-18	AECC	Human Values, De-addiction and Traffic Rules (Lab/ Seminar)	0	0	1	25	--**	25	1
BMPD102-18		Mentoring and Professional Development	0	0	2	25	--**	25	1
<b>Total</b>			<b>16</b>	<b>03</b>	<b>12</b>	<b>420</b>	<b>480</b>	<b>900</b>	<b>25</b>

\*\*The Human Values, De-addiction and Traffic Rules (Lab/ Seminar) and Mentoring and Professional Development course will have internal evaluation only.

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***Second Semester***

Course Code	Course type	Course title	Load allocation			Marks distribution		Total Marks	Credits
			L	T	P	Int.	Ext.		
BSOT201-19	Core Theory	Human Anatomy and Physiology– 2	3	1	0	40	60	100	4
BSRT201-19	Core Theory	Radiographic Anatomy	2	1	0	40	60	100	3
BSRT202-19	Core Theory	Basic Radiation Physics	3	1	0	40	60	100	4
BSOT204-19	Core Practical	Human Anatomy and Physiology–2 (Practical)	0	0	4	40	60	100	2
BSRT203-19	Core Practical	Radiographic Anatomy (Practical)	0	0	4	40	60	100	2
BSRT204-19	Core Practical	Basic Radiation Physics-I (Practical)	0	0	4	40	60	100	2
EVS102-18	AECC	Environmental Sciences	2	0	0	40	60	100	2
BSRT205-19	AECC	Basic computers and Information Science	2	0	2	40	60	100	3
BSRT206-19	AECC	Communication and soft skills	2	0	1	25	50	75	2
BMPD202-18		Mentoring and Professional Development	0	0	2	25	--**	25	1
<b>Total</b>			<b>14</b>	<b>03</b>	<b>17</b>	<b>370</b>	<b>530</b>	<b>900</b>	<b>25</b>

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***Third Semester***

Course Code	Course type	Course title	Load allocation			Marks distribution		Total Marks	Credits
			Lecture	Tutorial	Practical	Internal	External		
BSRT301-19	Core Theory	Oncology Science –I	3	1	0	40	60	100	4
BSRT302-19	Core Theory	Radiotherapy equipment - I	3	1	0	40	60	100	4
BSRT303-19	Core Theory	Basic Radiotherapy Physics	3	1	0	40	60	100	4
BSRT304-19	Core Practical/Laboratory	Oncology Science –I Physics of Radiotherapy (Practical)	0	0	4	40	60	100	2
BSRT305-19	Core Practical/Laboratory	Radiotherapy equipment - I (Practical)	0	0	4	40	60	100	2
BSRT306-19	Core Practical/Laboratory	Basic Radiotherapy Physics (Practical)	0	0	4	40	60	100	2
BSRT307-21	Ability Enhancement Compulsory course	Effects of Radiation to environment and its safety	1	0	0	40	60	100	1
BSRT308-21	Ability Enhancement Compulsory course	Patient care, positioning and immobilization	2	0	2	40	60	100	3
BSRT309-19	Ability Enhancement Compulsory course	Radiation emergencies	2	0	1	25	50	75	2
BSRT310-19		RTT directed Clinical Education-I	0	0	2	25	**	25	1
<b>Total</b>			<b>14</b>	<b>03</b>	<b>17</b>	<b>370</b>	<b>530</b>	<b>900</b>	<b>25</b>

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***Fourth Semester***

Course Code	Course type	Course title	Load allocation			Marks distribution		Total Marks	Credits
			Lecture	Tutorial	Practical	Internal	External		
BSRT401-19	Core Theory	Oncology Science – II	3	1	0	40	60	100	4
BSRT402-19	Core Theory	Principles of radiotherapy planning and Technique	3	1	0	40	60	100	4
BSRT403-19	Core Theory	Radiation quantities & Units and detection/ Measurement	3	1	0	40	60	100	4
BSRT404-19	Core Practical/Laboratory	Oncology Science – II (Practical)	0	0	4	40	60	100	2
BSRT405-19	Core Practical/Laboratory	Principles of radiotherapy planning and Technique (Practical)	0	0	4	40	60	100	2
BSRT406-19	Core Practical/Laboratory	Radiation Quantities & Units and detection/ Measurements (Practical)	0	0	4	40	60	100	2
BSRT407-19	Ability Enhancement Compulsory course	Biological Effects of Radiations	2	0	0	40	60	100	2
BSRT408-19	Ability Enhancement Compulsory course	Radiation safety	1	0	2	40	60	100	2
BSRT409-19	Ability Enhancement Compulsory course	Mold Room / Motion Management techniques	2	0	1	25	50	75	2
BSRT410-19		RTT directed Clinical Education-II	0	0	2	25	**	25	1
<b>Total</b>			<b>14</b>	<b>03</b>	<b>17</b>	<b>370</b>	<b>530</b>	<b>900</b>	<b>25</b>

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***Fifth Semester***

Course Code	Course type	Course title	Load allocation			Marks distribution		Total Marks	Credits
			Lecture	Tutorial	Practical	Internal	External		
BSRT501-19	Core Theory	Radiotherapy Equipment-II	3	1	0	40	60	100	4
BSRT502-19	Core Theory	Radiotherapy planning & techniques in brachytherapy -I	3	1	0	40	60	100	4
BSRT503-19	Core Theory	Special Radiotherapy Techniques	3	1	0	40	60	100	4
BSRT504-19	Core Practical/Laboratory	Radiotherapy Equipment - II(Practical)	0	0	4	40	60	100	2
BSRT505-19	Core Practical/Laboratory	Radiotherapy planning & techniques in brachytherapy -I (Practical)	0	0	4	40	60	100	2
BSRT506-19	Core Practical/Laboratory	Special Radiotherapy Techniques (Practical)	0	0	4	40	60	100	2
BSRT507-19	Ability Enhancement Compulsory course	Electron beam therapy	2	0	0	40	60	100	2
BSRT508-19	Ability Enhancement Compulsory course	Radiotherapy Planning & techniques in Brachytherapy-II	3	0	0	40	60	100	3
BSRT509-19	Ability Enhancement Compulsory course	Biostatistics	1	0	0	25	50	75	1
BSRT510-19		RTT directed Clinical Education-III	0	0	2	25	**	25	1
<b>Total</b>			<b>15</b>	<b>03</b>	<b>14</b>	<b>370</b>	<b>530</b>	<b>900</b>	<b>25</b>

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***Sixth Semester***

Course Code	Course type	Course title	Load allocation			Marks distribution		Total Marks	Credits
			Lecture	Tutorial	Practical	Internal	External		
BSRT601-19	Core Theory	Nuclear Medicine and imaging techniques in Radiotherapy planning	3	1	0	40	60	100	4
BSRT602-19	Core Theory	Clinical Radiobiology	3	1	0	40	60	100	4
BSRT603-19	Core Theory	Quality Assurance in Radiotherapy	3	1	0	40	60	100	4
BSRT604-19	Core Practical/Laboratory	Nuclear Medicine and imaging techniques in Radiotherapy planning (Practical)	0	0	4	40	60	100	2
BSRT605-19	Core Practical/Laboratory	Clinical Radiobiology (Practical)	0	0	4	40	60	100	2
BSRT606-19	Core Practical/Laboratory	Quality Assurance in Radiotherapy (Practical)	0	0	4	40	60	100	2
BSRT607-19	Ability Enhancement Compulsory course	Management of Radiotherapy Equipments & shielding of all critical organs including genitals.	1	0	0	40	60	100	1
BSRT608-19	Ability Enhancement Compulsory course	Radiation protection and monitoring	2	0	2	40	60	100	3
BSRT609-19	Ability Enhancement Compulsory course	Radiotherapy treatment delivery	1	0	2	25	50	75	2
BSRT610-19		RTT directed Clinical Education-IV	0	0	2	25	**	25	1
<b>Total</b>			<b>13</b>	<b>03</b>	<b>18</b>	<b>370</b>	<b>530</b>	<b>900</b>	<b>25</b>

# Bachelor of Science (Radiotherapy Technology) Batch 2024 Onwards

## [Semester VII-VIII]

### 7<sup>th</sup> Semester

Course Code	Course Title	Marks Distribution			Credits
		Internal	External	Total	
BSRT-701-21	Semester Internship	200	-	200	8

### 8<sup>th</sup> Semester

Course Code	Course Title	Marks Distribution			Credits
		Internal	External	Total	
BSRT-801-21	Semester Internship	200	-	200	8

# SEMESTER-I

## Human Anatomy and Physiology– I (Theory)

Subject Code: BSOT101-19

**Rationale:** Students will be able to learn the terminology of the subject and basic knowledge of cells, tissues, blood and to understand anatomy and physiology of human body. This subject will develop an understanding of the structure and function of organs and organ systems in normal human body.

### Topics:

1. Introduction to human Anatomy and Physiology
2. Cell and cell organelles
  - 2.1 Structure and classification
  - 2.2 Function
  - 2.3 Cell division (Mitosis and Meiosis)
3. Tissues
  - 3.1 Definition
  - 3.2 Classification with structure and Functions
    - 3.2.1 Epithelial tissues
    - 3.2.2 Connective tissues
    - 3.2.3 Muscular tissues
    - 3.2.4 Nervous tissue
4. Blood
  - 4.1 Composition
  - 4.2 Function of blood
5. Muscular skeletal system
  - 5.1 Introduction
  - 5.2 Classification
  - 5.3 Structure and function of skeletal system, muscles and joints
  - 5.4 Various movements of body
6. Respiratory system
  - 6.1 Introduction
  - 6.2 Structure
  - 6.3 Function
  - 6.4 Mechanism of breathing and respiration
  - 6.5 Various terms involved in respiratory System
    - 6.5.1 Vital capacity
    - 6.5.2 Total Volume
    - 6.5.3 Reserve volume
    - 6.5.4 Total lung capacity
7. Cardiovascular system
  - 7.1 Anatomy and physiology of heart
  - 7.2 Blood circulation
  - 7.3 Arteries and veins
  - 7.4 Conductive system of heart

- 7.5 Cardiac cycle
- 7.6 Introduction to ECG
- 8. Lymphatic system
  - 8.1 Introduction
  - 8.2 Structure and function
    - 8.2.1 Lymph nodes
    - 8.2.2 Spleen
    - 8.2.3 Thymus gland, Tonsils

**Suggested readings:**

1. Anatomy & Physiology- Ross and Wilson
2. Anatomy and Physiology: Understanding the Human Body by Clark
3. Anatomy and Physiology for nurses by Evelyn Pearce
4. Anatomy and Physiology for nurses by Sears
5. Anatomy and Physiology for nurses by Pearson
6. Anatomy and Physiology by N Murgesh

## Elementary Mathematics and Physics (Theory)

Code : BSRT101-19

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

# Quality Management, Patient safety and Disaster management (Theory)

Code : BSOT203-19

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 maneuvers 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 color 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. 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.

# Human Anatomy and Physiology– I (Practical)

Code : BSOT103-19

1. Demonstration of various parts of body
2. Demonstration of tissues of body
3. Demonstration of parts of digestive system
4. Demonstration of parts of respiratory system
5. Demonstration of parts of skin
6. Demonstration of parts of excretory system
7. Demonstration of various parts of circulatory system (Demonstration from models)
8. Examination of blood film for various blood cells from stained slides
9. Blood pressure estimation
10. Demonstration of various parts of nervous system (brain and spinal cord)(Model)
11. Structure of eye and ear (demonstration from models)
12. Demonstration of reflex action
13. Demonstration of structural differences between skeletal, smooth and cardiac muscles (permanent mounts)
14. Demonstration of various bones and joints
15. Demonstration of various parts of reproductive system (Male and female from models and charts)
16. To study circulatory system from charts and transverse section (TS) of artery and vein from permanent slides.
17. To study digestive system from charts and TS of liver, spleen and pancreas from permanent slides.
18. Study of Urinary system (charts)
19. Study of Genital system (male & female) from charts and TS of testis and ovary from permanent slides.
20. To study nervous system (From models / charts)
21. To study various body fluids.

Note: Demonstrations can be done with the help of models, charts and histological slides

# Elementary Mathematics and Physics (Practical)

Code:BSRT102-19

- 1) Wedge transmission factor for given wedge.
- 2) Measurement of block transmission factor for given block.
- 3) Measurement of tray transmission factor for given tray.
- 4) Blood irradiation in 6MV photon energy.
- 5) To check ODI of linac by using mechanical front pointer.
- 6) To check couch movement of Linac.
- 7) To form orfit cast for patient.
- 8) To check laser accuracy in simulator.

Note: Some practicals may be added as and when required

# Introduction to Healthcare delivery System in India

Code: BSRT103-19

## Rationale

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 Health 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 defense immunizing agents, cold chain, immunization, disease monitoring and surveillance.

# Medical Terminology, Record keeping and Orientation to Radiotherapy Technology and Management

Code: BSOT106-19

## **Rationale**

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. 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.
10. Record keeping in Radiotherapy clinics
11. Introduction to Radiotherapy
12. Induction training and orientation to Radiotherapy

# Medical Law and Ethics

Code: BSOT105-19

## Rationale

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.

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, analyzing, and attempting to resolve the ethical problems that arise in practice". 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.

## **Mentoring Professional Development, Drug De-addiction and Traffic Rules**

The objective of mentoring will be development of:

1. Overall Personality
2. Aptitude (Technical and General)
3. General Awareness (Current Affairs and GK)
4. Communication Skills
5. Presentation Skills
6. The course shall be split in two sections i.e. outdoor activities and class room activities. For achieving the above, suggestive list of activities to be conducted are:

### **Part – A (Class Activities)**

1. Drug De-addiction
  - a. Drugs and their misuse
  - b. Addictive Drugs
  - c. Their harmful effects on human body and society
  - d. Motivational talks of Psychologists and/or Drug De-addiction counsellor.
  - e. Awareness regarding de-addiction
2. Traffic rules
  - a. To learn various traffic rules in India
  - b. Importance of patience while driving
  - c. How traffic rules are beneficial
  - d. To arrange a lecture from traffic police expert on accidents
3. Expert and video lectures
4. Aptitude Test
5. Group Discussion
6. Quiz (General/Technical)
7. Presentations by the students
8. Team building Exercises
9. Basic exercises on Computers are also added as per Annexure-I

### **Part – B (Outdoor Activities)**

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B. Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

## **SEMESTER-II**

### **Anatomy and Physiology– II (Theory)**

Code : BSOT201-19

**Rationale:** Students will be able to learn the terminology of the subject and basic knowledge of cells, tissues, blood and to understand anatomy and physiology of human body. This subject will develop an understanding of the structure and function of organs and organ systems in normal human body.

#### **Module-1**

1. Structure and function of sense organ
  - 1.1 Eye
  - 1.2 Ear
  - 1.3 Nose
  - 1.4 Tongue
2. Body fluids and their significance: Important terms, types of body fluid, total body water, avenues by which water leaves and enters body, general principles for fluid balance, cardinal principle, How body fluids maintain Homeostasis, Electrolytes & ions Function of electrolytes, How electrolyte imbalance leads to fluid imbalance

#### **Module-2**

3. Digestive system: Organization; accessory organs; structure & function (Mouth, Tongue, Teeth, Oesophagus, Pharynx, Stomach, Intestine, Rectum, Anus); Digestive glands; physiology of digestion of carbohydrates, lipids & proteins
4. Liver: structure and function

#### **Module-3**

5. Urinary system: Main parts, Structure & function of kidney, structure of nephron, physiology of excretion & urine formation, urine, additional excretory organs
6. Genital system: Structure of male and female reproductive system, Gametogenesis in male & female, menstrual cycle. Placenta and extra embryonic membranes.

#### **Module-4**

7. Nervous system: Parts, function & structure; brain, spinal cord, spinal & cranial nerves; all & none principle, role of neurotransmitters in transmission of nerve impulse
8. Endocrine system: Endocrine & exocrine glands, their location, structure & functions

Suggested readings:

1. Anatomy & Physiology- Ross and Wilson
2. Anatomy and Physiology: Understanding the Human Body by Clark
3. Anatomy and Physiology for nurses by Evelyn Pearce
4. Anatomy and Physiology for nurses by Sears
5. Anatomy and Physiology for nurses by Pearson
6. Anatomy and Physiology by N Murgesh

# Radiographic Anatomy (Theory)

## Code: BSRT201-19

**Rationale:** Emphasis on plain and cross-sectional radiographic anatomy

### Topics:

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

# Basic Radiation Physics (Theory)

## Code: BSRT202-19

Module – I	SI Units, Force, mass, momentum, work, energy, power, density, pressure, heat, sound, wave and oscillations.
Module-II	Atomic structure: Atom, nucleus, Bohr theory of hydrogen atom, atomic mass and energy units, distribution of orbital electrons atomic energy levels, nuclear forces, nuclear energy levels, particle radiations, electromagnetic radiations, electricity and magnetism.
Module-III	Nuclear Transformations : Radioactivity, decay constant, activity half life, mean life, radioactive series, radioactive equilibrium, modes of decay : $\alpha$ -decay, $\beta$ -decay, electron capture, internal conversion, isomeric transition.  Nuclear reactions : ( $\alpha,p$ ) reaction, ( $\alpha, n$ ) reaction, proton bombardment, deuteron bombardment, neutron bombardment, photodisintegration, fission, fusion, activation of nucleides, nuclear reactors.
Module-IV	Interaction of radiation with matter : ionization and excitation, various types of interaction processes (photoelectric effect, Compton scattering, pair production etc.) Interaction of charged particles and neutrons with matter. Comparative beam characteristics.
Module-V	Production of X-rays : X-ray tube, anode, cathode construction and working principles of transformers and autotransformers used in x-ray circuits, voltage rectification and measurements in x-ray circuits. Physics of x-ray production (Bremsstrahlums and Characteristic x-rays).

# Human Anatomy and Physiology – II (Practical)

Code : BSOT204-19

## Human Anatomy & Physiology – Practical

1. Demonstration of parts of digestive system
2. Demonstration of parts of skin
3. Demonstration of parts of excretory system
4. Demonstration of various parts of nervous system (brain and spinal cord)
5. Structure of eye and ear
6. Demonstration of reflex action
7. Demonstration of various parts of human reproductive system
8. To study digestive system from charts and TS of liver, spleen and pancreas from permanent slides.
9. Study of Urinary system
10. Study of Genital system (male & female) from charts and TS of testis and ovaries
11. To study nervous system
12. To study various body fluids.

**Note: Demonstrations can be done with the help of models, charts and histological slides**

# Radiographic Anatomy (Practical)

## Code: BSRT203-19

1. Physical demonstration of surface anatomy.
2. Physical demonstration of Plain films.
3. Demonstration of Mammography Machine and working
4. Demonstration of CT Machine and working
5. Demonstration of MRI Machine and working
6. Demonstration of Ultrasound Machine and working
7. Demonstration of PET-CT Machine and working
8. Physical demonstration of DRR.
9. Physical demonstration of Portal Imaging and procedures.

NOTE: Some Practicals may be added as and when required.

# Basic Radiation Physics-I (Practical)

## Code: BSRT204-19

1. To find the half life for different radioactive sources .
2. Physical demonstration of X- Ray tube
3. To find the HVL for given X-ray energies.
4. To demonstrate the production of high energy x-rays in LINAC.

Note: some practicals may be added as and when required.

# Environment Studies

Subject code: EVS102-18

## Course Outcomes:

1. Students will enable to understand environmental problems at local and national level through literature and general awareness.
2. The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.
3. The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.
4. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world

### UNIT-1: Introduction to Environmental Studies

Multidisciplinary nature of Environmental Studies: Scope & Importance

Need for Public Awareness

### UNIT-2: Ecosystems

Concept of an Ecosystem: Structure & functions of an ecosystem (Producers, Consumers & Decomposers)

Energy Flow in an ecosystem: Food Chain, Food web and Ecological Pyramids

Characteristic features, structure & functions of following Ecosystems:

- Forest Ecosystem
- Aquatic Ecosystem (Ponds, Lakes, River & Ocean)

### UNIT-3: Natural Resources

Renewable & Non-renewable resources

Forest Resources: Their uses, functions & values (Biodiversity conservation, role in climate change, medicines) & threats (Overexploitation, Deforestation, Timber extraction, Agriculture Pressure), Forest Conservation Act

Water Resources: Their uses (Agriculture, Domestic & Industrial), functions & values, Overexploitation and Pollution of Ground & Surface water resources (Case study of Punjab), Water Conservation, Rainwater Harvesting,

Land Resources: Land as a resource; Land degradation, soil erosion and desertification

Energy Resources: Renewable & non-renewable energy resources, use of alternate energy resources (Solar, Wind, Biomass, Thermal), Urban problems related to Energy

### UNIT-4: Biodiversity & its conservation

Types of Biodiversity: Species, Genetic & Ecosystem

India as a mega biodiversity nation, Biodiversity hot spots and biogeographic regions of India

Examples of Endangered & Endemic species of India, Red data book

**UNIT-5: Environmental Pollution & Social Issues**

Types, Causes, Effects & Control of Air, Water, Soil & Noise Pollution

Nuclear hazards and accidents & Health risks

Global Climate Change: Global warming, Ozone depletion, Acid rain, Melting of Glaciers & Ice caps, Rising sea levels

Environmental disasters: Earthquakes, Floods, Cyclones, Landslides

**UNIT-6: Field Work**

Visit to a National Park, Biosphere Reserve, Wildlife Sanctuary

Documentation & preparation of a Biodiversity (flora & fauna) register of campus/river/forest

Visit to a local polluted site : Urban/Rural/Industrial/Agricultural

Identification & Photography of resident or migratory birds, insects (butterflies)

Public hearing on environmental issues in a village

**Suggested Readings:**

1. Bharucha, E. Text Book for Environmental Studies. University Grants Commission, New Delhi.
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down to Earth, Centre for Science and Environment (R)
9. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
10. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
11. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
12. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.

**IK Gujral Punjab Technical University**  
**B.Sc (Radiotherapy Technology) Batch 2024 Onwards**

13. Mckinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
14. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
15. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
16. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
17. Rao M N. & Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
18. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut
19. Survey of the Environment, The Hindu (M)
20. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
21. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)
22. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

# Basic Computers and Information Science

Code : BSRT205-19

## **Rationale:**

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:**

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 -

MODEL CURRICULUM HANDBOOK OF RADIOTHERAPY TECHNOLOGY

(Intellectual property of Ministry of Health and Family Welfare)

Learning to use MS office: MS word, MS PowerPoint, MS Excel.

2. To install different software.
3. Data entry efficiency

# Communication and soft skills

Code : BSRT206-19

## Rationale:

The students shall be able to communicate with others in an effective manner.

### Module-1

1. Basic Language Skills: Grammar and Usage.
2. Business Communication Skills with focus on speaking - Conversations, discussions, dialogues, short presentations, pronunciation.

### Module-2

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

### Module-3

5. Special characteristics of health communication
6. Types & process of communication
7. Barriers of communication & how to overcome

### Module-4

8. Soft Skills - with important sub-elements:
  - a. Communication Styles
  - b. Team work
  - c. Leadership Skills
  - d. Effective & Excellent Customer Service
  - e. Decision Making & Problem Solving
  - f. Managing Time and Pressures
  - g. Self-Management & Attitude

## Suggested readings:

1. Effective Communication and Soft Skills by Nitin Bhatnagar Pearson Education India, 2011
2. Communication N Soft Skills Paperback – 2014 by Niraj Kumar, Chetan Srivastava

## **Mentoring Professional Development, Drug De-addiction and Traffic Rules**

The objective of mentoring will be development of:

1. Overall Personality
2. Aptitude (Technical and General)
3. General Awareness (Current Affairs and GK)
4. Communication Skills
5. Presentation Skills
6. The course shall be split in two sections i.e. outdoor activities and class room activities. For achieving the above, suggestive list of activities to be conducted are:

### **Part – A (Class Activities)**

1. Drug De-addiction
  - a. Drugs and their misuse
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  - c. Their harmful effects on human body and society
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  - e. Awareness regarding de-addiction
2. Traffic rules
  - a. To learn various traffic rules in India
  - b. Importance of patience while driving
  - c. How traffic rules are beneficial
  - d. To arrange a lecture from traffic police expert on accidents
3. Expert and video lectures
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6. Quiz (General/Technical)
7. Presentations by the students
8. Team building Exercises
9. Basic exercises on Computers are also added as per Annexure-I

### **Part – B (Outdoor Activities)**

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B. Mentors/Faculty in-charges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

## **SEMESTER-III**

### **Oncology Science- I** Subject Code: BSRT301-19

**Rationale:** This subject put cancer, its 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 analyze 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.

### **Contents**

#### **Module-1**

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

#### **Module-2**

4. Co-morbidities
5. Etiology and epidemiology
6. Genetics

#### **Module-3**

7. Prevention
8. Early detection
9. Signs and symptoms

#### **Module-4**

10. Public awareness on early signs and symptoms
11. High risk groups
12. Staging of tumors

## **Radiotherapy Equipment -I**

### **Subject Code: BSRT302-19**

**Rationale:** 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.

### **Contents**

#### **Module-1&2**

1. Brachytherapy- Design features, Radiation sources, Technique, High dose-rate (HDR), Low dose-rate (LDR), Pulsed dose-rate (PDR).

#### **Module-3&4**

2. Teletherapy Machines & Accessories:
  - a. Telecobalt Machines
  - b. Medical linear accelerators.
  - c. Difference between Telecobalt and medical LINAC
  - d. Beam directing,
  - e. modifying and defining devices.
  - f. Imaging accessories

## **Basic Radiotherapy Physics**

### **Subject Code: BSRT303-19**

**Rationale:** In this paper, the students acquire knowledge about historical developments and basic knowledge about Radiotherapy Physics

### **Contents**

#### **Module-1**

1. Historical developments in Radiotherapy
2. Super voltage, Orthovoltage, Megavoltage.

## **Module-2**

3. Various types of sources used in Radiotherapy and their properties,
4. Physics of Photons, electrons, protons and neutrons in radiotherapy

## **Module-3**

5. Physical parameters of dosimetry such as Percentage Depth Dose, factors affecting PDD Tissue-Air Ratio, Tissue Maximum Ratio.

## **Module-4**

6. Dose calculation parameters, Sc, Sp for SSD and SAD techniques, relationship between TMR & PDD, Backscatter factor.

# **ONCOLOGY SCIENCE-I (PRACTICAL)**

Subject Code: BSRT304-19

1. Differentiation of normal and cancer cells .
2. Orientation towards clinical examination of head and neck cancers.
3. Demonstration of pre-cancerous lesions.
4. Various instruments used in clinical examination.

# **RADIOTHERAPY EQUIPMENT-I (PRACTICAL)**

Subject Code: BSRT305-19

1. Study of operational safety mechanism of Medical Linear Accelerator.
2. Study of operational safety mechanism of Brachytherapy.
3. Study of operational safety mechanism of Tomotherapy.
4. Study of operational safety mechanism of Simulator.
5. Study of operational safety mechanism of Telecobalt.
6. Handling of emergencies in Teletherapy .
7. Handling of emergencies in Brachytherapy.

## **BASIC RADIOTHERAPY PHYSICS (PRACTICAL)**

Subject Code: BSRT306-19

1. Study of difference between SSD and SAD technique.
2. Preparation of patient setup in SAD technique.
3. Study of mold room equipment in radiotherapy.
4. Patient positioning during treatment for LINAC and brachytherapy.

## **Effects of radiation to environment and its safety**

Subject Code: BSRT307-19

**Rationale:** In this paper, the students acquire knowledge about effects of radiations on our environment. They will also come to know about history of radiation accidents. It will also impart a knowledge about types of Radioactive waste and its management

### **Contents**

#### **Module-1**

1. Sources of environmental radiation,
2. Types of sources: Natural and artificial sources of radiation

#### **Module-2**

3. Background radiations
4. Average annual effective dose to adults from natural sources of ionizing radiations

#### **Module-3**

5. History of Radiation accidents
6. Causes of nuclear disaster,

#### **Module-4**

7. Different types of radioactive waste
8. Guidelines for management of solid radioactive waste.

## **Patient care, positioning and immobilization**

### **Subject Code: BSRT308-19**

**Rationale:** 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.

## **Contents**

### **Module-1**

1. Hospital procedure: Hospital staffing and organization
2. Records relating to patients and departmental statistics,
3. Professional attitude of the technologist to patients and other members to the staff
4. Medico-legal aspects accidents in the departments
5. Appointment organization; minimizing waiting time, out –patient and follow-up clinics; stock-taking and stock keeping.

### **Module-2**

6. Care of the patient: First contact with patients in the department
7. Management of chair and stretcher patients and aids for this
8. Management of the unconscious patient,
9. Elementary hygiene, personal cleanliness, hygiene in relation to patients (for example clean linen and receptacles,
10. Nursing care, temperature pulse and respiration,
11. Essential care of the patient who has a tracheotomy, colostomy, bedpans and urinals, simple application of a sterile dressing.
12. First aid,

### **Module-3**

13. Infection Vs Colonization
14. Microbes: Bacteria, viruses and fungi
15. Brief knowledge about Nosocomial infections
16. Spread of infections, Exogenous and Endogenous infections.
17. Inventory control of drugs used in Radiotherapy: Storage: Classification; labeling and checking, regulations regarding dangerous and other drugs, unit of measurement, special drugs, anti-depressive, anti-hypertensive etc.

### **Module-4**

18. 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. Treatment couch
- e. Image acquisition for planning (and/or verification)
- f. Modalities for image acquisition for planning
- g. Simulation- Conventional Simulation, CT Simulation, Virtual Simulation
- h. Treatment verification
- i. Protocols- Imaging protocols: development and implementation, On-line/off-line corrections, Matching/co-registration procedures, Documentation.

## **Radiation Emergencies**

Subject Code: BSRT309-19

**Rationale:** In this subject the students will come to know about history of radiation emergencies and will learn to deal with various types of radiations used for treatment / wellbeing of cancer patients.

### **Contents**

#### **Module-1**

1. Historical Radiation emergencies
2. Types of Radiation emergencies

#### **Module-2**

3. Radiation emergencies and to deal with those in LINAC

#### **Module-3**

4. Radiation emergencies and to deal with those in Telecobalt

#### **Module-4**

5. Radiation emergencies and to deal with those in Brachytherapy.

# **RTT directed Clinical Education-I**

Subject Code: BSRT310-19

**Rationale:** During this clinical education the students will visit various Radiotherapy units and will observe operations of the radiation oncology clinic and will understand very basic aspects of dealing with patients and radiotherapy techniques used for treatment / wellbeing of cancer patients.

## **Contents**

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.

## **SEMESTER-IV**

### **Oncology Science-II Subject Code: BSRT401-19**

The 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 analyze 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.

#### **MODULE-1**

1. Clinical examination
2. Biopsy
3. Laboratory tests

#### **MODULE -2**

4. Imaging methods
5. Staging and grading
6. Tumor Nodes Metastasis (TNM) staging system, other commonly used systems

#### **MODULE-3**

7. Treatment intent- radical, adjuvant, palliative
8. Non-malignant diseases

#### **MODULE-4**

9. Primary management of malignancy
10. Performance status

## **Principles of Radiotherapy Planning & Techniques**

### **Subject Code: BSRT402-19**

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 student study about the various treatment accessories such as Mid Line Block (MLB), customized blocks, wedges, etc., for various sites of interest.

#### **MODULE-1**

1. Tissue lateral effects, Integral dose. ICRU 50 definitions of PTV, CTV, GTV Cold spot, Hot spot, ITV
2. Application of radiotherapy in benign conditions
3. Application of radiotherapy in malignant condition.
4. Palliative therapy and radical therapy.

#### **MODULE 2**

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. Evaluation of patient setup for simple techniques.

#### **MODULE 3**

7. Use of Beam Modifying devices, such as wedges, Tissue compensators, Mid Line Block (MLB) in the treatment of respective sites.
8. Customized shielding blocks and its properties.
9. Asymmetric jaws

#### **MODULE-4**

10. Motorized wedges
11. Simulation procedures including CT simulation- for various techniques as 3DCRT , Conventional and IMRT.

**Radiation Quantities, Units and Detection/Measurement**  
**Subject Code: BSRT403-19**

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

**MODULE-1**

1. Radioactivity, Flux, Fluence, Kerma, Roentgen, Exposure, Absorbed Dose, relation between absorbed dose and exposure & kerma, Equivalent Dose,

**MODULE-2**

Weighting Factors, Effective Dose, Natural Background Radiation, Occupational Exposure Limits, Dose limits to Public. Dose limit for adults and children.

**MODULE-3**

Detection and measurement of radiation - Ionisation of gases, Fluorescence and Phosphorescence, Ionisation chambers, Proportional Counters, G.M. Counters, and their applications.

**MODULE-4**

- 1 Scintillation Detector- Types of scintillator used and its Principle , working.
- 2 Liquid scintillator counter its principle construction and working,
- 3 Advantages and disadvantages of various detectors.
- 4 Applications of these detectors.

**Oncology science -II (Practical)**  
**Subject Code: BSRT404-19**

1. Procedure of clinical examination.
  2. Pathological, diagnostic tests for various cancers.
  3. Different methodology adopted for conformation of diagnosis.
  4. Importance of self-examination.
- 

**Principles of radiotherapy planning and techniques (Practical)**  
**Subject Code: BSRT405-19**

1. Comparison between two field and four field technique for Ca Cervix.
  2. Draw isodose curves for Ca Oesophagus .
  3. Preparation of rectangular shielding blocks.
  4. Preparation of shielding blocks for lung.
- 

**Radiation Quantities, Units and detection/ measurement (Practical)**  
**Subject Code: BSRT-406-19**

1. Radiation survey using ionization chamber.
  2. Output measurement of 6 MV photon beam.
  3. Output measurement of different electron energies.
  4. Background radiation measurement.
- 

**Biological Effects of Radiation**  
**Subject Code: BSRT-407-19**

**MODULE-1**

The Cell and its components

Effect of ionising radiation on Cell, Chemical reaction of radiation with cell, free radical formation.

**MODULE-2**

Chromosomal aberration and chromatid aberrations.

Types of various structures formed

its application for the biological dosimetry.

**MODULE-3**

Somatic effects and hereditary effects,

stochastic and deterministic effects, Acute exposure and Chronic exposure, Examples of different effects

**MODULE-4**

LD<sub>50/60</sub>.

Role of RTT in managing the acute effects of radiation.

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**Radiation safety**  
**Subject Code: BSRT408-19**

The radiation therapy needs to be carried out carefully with adequate measuring system for the radiation

workers, such as technologists, which helps in knowing the dose level he/she has received while working in the radiation area.

### **MODULE-1**

Radiation Hazard evaluation and control ,Philosophy of radiation protection.

### **MODULE-2**

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), effect of different shielding material.

### **MODULE-3**

Radiation Emergency Preparedness

Safety and security of radiation sources, tools including role of Gamma Zone Monitor, pocket dosimeter, REM counter,

### **MODULE-4**

Role of RTT in handling radiation emergencies. responsibilities of RTT.

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## **Mould Room /Motion Management Techniques**

### **Subject Code: BSRT409-19**

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

### **MODULE-1**

Mould room procedures, Styrofoam cutters and working,

### **MODULE-2**

shielding blocks materials and their properties, different shielding blocks for different sites.

### **MODULE-3**

Thermoplastic mould - material used and its composition, properties and procedure for mould of various sites

### **MODULE-4**

Breath hold, motion reduction Techniques  
4DCT, Fluoroscopy based tracking  
Real time tumor tracking  
Advantages of motion reduction.

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## **RTT directed Clinical Education-II**

### **Subject Code: BSRT410-19**

**Rationale:** During this clinical education the students will visit Elekta linear accelerator unit in Radiotherapy department and will observe operations of the radiation oncology clinic and will understand very basic aspects of dealing with patients and radiotherapy techniques used for treatment / wellbeing of cancer patients.

### **Contents**

Students will observe the basic operations of the Elekta linear accelerator and 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.

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# SEMESTER-V

## Radiotherapy Equipment -II Subject Code: BSRT501-19

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.

### MODULE-1

Various types of phantoms - the solid water-phantoms, mini water phantom, RFA , Slabs, Materials used for phantoms and their properties.

### MODULE-2

Various types of dosimeters - in-vivo dosimeters.

Ionization chambers for photon dosimetry and electron dosimetry:- PPC chambers, Cylindrical chambers , electrometers , reference conditions for dosimetry, desirable chamber characteristics.

### MODULE-3

3D-CT Simulator, Simulator, 4DCT Simulator, principle, working and Image formation.

### MODULE-4

On-board imaging systems - EPID ,Port film, KVCBCT, MVCT

## Radiotherapy Planning & Techniques- Brachytherapy-1 Subject Code: BSRT502-19

### MODULE-1

Brachytherapy sources and their decay schemes

Properties of ideal brachytherapy sources,

Construction of Ra<sup>226</sup>, Cs<sup>137</sup> & Co<sup>60</sup> tubes and needles and Ir<sup>192</sup> wires.

Physical forms of radioactive sources.

### MODULE-2

To decay processes of brachytherapy sources,

Calibration of brachytherapy (mgRa),

Air-Kerma Strength, Reference-Air-Kerma,

Radium mass equivalent (Ramg Eq.), apparent Activity, milligram-hours, Exposure rate constant.

### MODULE-3 Surface mould and interstitial implants.

Surface mould dosimetry system: construction and distribution rules of circular, square, rectangular, sandwich, concave and convex moulds. Use of surface moulds in the treatment of various anatomical sites.

### MODULE-4

Systems of implant dosimetry :-

Paterson-Parker system : Distribution rules, dose specification and implant optimization criteria for planar and volume implants

Quimby system and memorial system : Distribution rules, dose specification and implant optimization criteria.

Paris system:-Distribution rules, dose specification and implant optimization criteria. Definitions of implant plane, basal dose points, reference dose/dose rate, implant length, width, height and safety margin in single and double plane implants.

Computer system.

## **Special Radiotherapy Techniques**

### **Subject Code: BSRT503-19**

#### **MODULE-1**

Conformal Radiotherapy:3DCRT, Introduction, steps in treatment planning.

IMRT :- Introduction, IMRT Planning, multisegmented static field delivery, dynamic delivery and Intensity modulated Arc Therapy(IMAT).

Tomotherapy:- MIMic based IMRT, Helical tomotherapy.

#### **MODULE-2**

Gamma Knife, principle, construction, and working.

X-Knife, principle, construction, and working.

#### **MODULE-3**

Principle and working of asymmetric jaws in radiotherapy. Techniques in which asymmetric jaws are used. Use of asymmetric jaw movement to get virtual wedge, central shielding, beam divergence matching in Ca. breast and Ca. Medulloblastoma.

Total body irradiation (TBI):- Technique and equipment used

#### **MODULE-4**

SRT, SRS, Design and working of MLC and MMLC. Use of MLC and MMLC in Conformal Radiotherapy and intensity modulated Radiotherapy (IMRT). Use of MMLC in stereotactic radiotherapy and IMRT

## **Radiotherapy Equipment -II (Practical)**

### **Subject Code: BSRT504-19**

1. To explain various types of phantoms used in radiotherapy.
2. Explain different types of ionisation chambers used for dosimetry of photons and electrons.
3. Explain simulation process on CT/Simulator for different sites.
4. Explain different imaging systems in Radiotherapy.
5. Explain handling of emergency in LINAC.

## **Radiotherapy Planning & Techniques in Brachytherapy-1(Practical)**

### **Subject Code: BSRT505-19**

1. Explain different types of radioactive sources and their properties used in Brachytherapy.
2. Explain different applicators used in Ca cervix intracavitary Brachytherapy.
3. To explain the procedure and Imaging in interstitial brachytherapy.
4. Explain steps involved in intracavitary Brachytherapy.
5. To explain handling of emergency in Brachytherapy.

## **Special RT Techniques (Practical)**

### **Subject Code: BSRT506-19**

1. Explain different steps in radiotherapy treatment planning.
2. To verify the optical and radiation field size for Linear Accelerator
3. Explain various steps for treatment for Total Body Irradiation.
4. Explain steps involved for treatment of medulloblastoma.
5. Explain recent advancement in RT Techniques.

**Electron Beam Therapy**  
**Subject Code: BSRT507-19**

**MODULE-1**

Electron beam therapy : Electron interactions, rate of energy loss, collisional losses (ionization and excitation) radiation losses (bremsstrahlung), polarization, stopping power.

**MODULE-2**

Absorbed dose, electron scattering, most probable energy, mean energy, energy at depth. Determination of absorbed dose, output calibration, phantom, reference depth and field size, absorbed dose calculation,

**MODULE-3**

Depth dose distribution, central axis depth dose curves, isodose curves for different electron energies.

**MODULE-4**

Field flatness and symmetry, beam collimation, field size dependence, electron source, x-ray contamination.

**Radiotherapy Planning & Techniques in Brachytherapy-II**  
**Subject Code: BSRT508-19**

**MODULE-1**

Intra-cavitary brachytherapy(Ca.Cx.) dosimetry systems :-  
Stockholm system : Source placement and dose prescription rules.  
Paris system : Source placement and dose prescription roles.

**MODULE-2**

Manchester system : Definition of points. A, B, bladder and rectum point. Manchester applicators, radium loading as per Manchester and MIR criteria. Dose/dose-rate to points Z & B for different tandem and ovoid loadings. Tolerance doses of rectum and bladder

**MODULE-3**

Applicators of Ca Cx : Pre-loaded applicators (Stockholm, Paris etc.), Fletcher suit applicators. Henschke applicators, ring applicators, vaginal applicators. Different tools, catheters and other necessary items required for interstitial implant.

**MODULE-4**

Different applicators used in brachytherapy, rectal templates prostate implant templates. Esophageal applicators, bronchial applicators, intravascular applicators.

**Biostatistics**  
**Subject Code: BSRT509-19**

**Module -1**

Logarithms and Antilogarithms (Basic Concepts), Definition- Biostatistics and its importance- Collection and Classification of data- Sample Methods of sampling Classification of data

**Module -2**

Representation of data : Frequency distribution Histogram- Frequency Polygon- Frequency Curve- Normal Frequency Curve Relative Frequency Curve- Cumulative Frequency Curve or Ogive

**Module -3**

Measures of Central Tendency : Objectives- Arithmetic Mean- Geometric Mean Harmonic Mean- Mode- Median, Quartiles, Deciles, Percentiles, Measures of Dispersion : Range- Quartile Deviation- Mean Deviation- Standard Deviation Coefficient of Variation

**Module - 4**

Probability : Measure of Probability- Terminology- Permutations and Combinations- Laws of Probability and Set Theory- Bayes' Theorem. Theoretical Distribution Introduction- Binomial Distribution- Poisson Distribution- Normal Distribution- Standard Normal Distribution

**RTT directed Clinical Education-III**  
**Subject Code: BSRT510-19**

**Rationale:** During this clinical education the students will visit various Radiotherapy units and will observe operation of the radiation oncology clinic and will understand very basic aspects of dealing with patients and radiotherapy equipment used for treatment/ well being of cancer patients.

**Contents**

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

## SEMESTER-VI

### **Nuclear Medicine, Imaging Techniques in Radiotherapy Planning** Subject Code: BSRT601-19

#### **MODULE-1**

2D Imaging Radiography, Fluoroscopic, USG, EPID, Port Film, 3D Imaging - CT, MRI  
Applications of Imaging in Radiotherapy

#### **MODULE-2**

Radionuclides used in nuclear medicine and properties of Radionuclides.  
Biological and Physical Half Life  
Applications of radionuclides for imaging and treatment procedures.

#### **MODULE-3**

ALI, DAC, relation between ALI and DAC  
SPECT Principle, construction and working.

#### **MODULE-4**

PET Principle, construction and working.  
Radionuclides used for functional imaging for various applications  
Application of functional imaging in radiotherapy planning.

### **Clinical Radiobiology** Subject Code: BSRT602-19

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.

#### **MODULE-1**

1. Cell kinetics
2. Cell cycle control mechanisms

#### **MODULE-2**

3. Tumour biology
4. The five 'R's of radiobiology

#### **MODULE-3**

5. Tissue structure and radiation effect
6. The Linear Quadratic (LQ) model

#### **MODULE-4**

7. Acute and late side effects
8. Sensitizers/protectors

**Quality Assurance in Radiotherapy  
Subject Code: BSRT603-19**

**MODULE-1**

Accessories and tools used for QA tests in Radiotherapy such as Front pointer, Back pointer, Laser Alignment, Slabs etc.

**MODULE-2**

Optical and radiation field congruence, Beam shaping blocks, Beam shaping jaws, Output consistency of photon.

**MODULE-3**

Mechanical and radiation Isocentre alignment of gantry, couch and collimator. Output consistency of electron.

**MODULE-4**

Beam on and off mechanisms, Technician's role in QA tests on telecobalt, Linear Accelerator and Brachytherapy.

**Nuclear Medicine and Imaging Techniques in Radiotherapy Planning (Practical)  
Subject Code: BSRT604-19**

1. To explain the various instruments used in Nuclear Medicine.
2. To explain the various steps in the 2D imaging radiography.
3. Explain the procedure and precautions during MRI.
4. Mention various radionuclides used in Nuclear Medicine and their properties.

**Clinical Radiobiology (Practical)  
Subject Code: BSRT605-19**

1. Make list of different types of carcinomas
2. Explain the radiation sensitivity of cell cycle.
3. Explain the linear quadratic model.
4. To make the list of various sensitizers and protectors used in radiotherapy.

**Quality Assurance in Radiotherapy (Practical)  
Subject Code: BSRT606-19**

1. To demonstrate the procedure of making orfit cast for Head & Neck.
2. To perform Laser alignment QA in LINAC.
3. To check radiation iso-center with respect to gantry, collimator and couch.
4. To check the mechanical gantry angle.

**Management of Radiotherapy Equipments & shielding of all critical organs  
including genitals  
Subject Code: BSRT607-19**

Security plans for LINAC.  
Security plan for Telecobalt.  
Security plan for Brachytherapy.  
Importance of shielding of critical organs.  
Different types of protective shielding- gonard shield, thyroid shield, Eye shield, Lung shield.  
Other site-specific shielding.

**Radiation Protection and Monitoring  
Subject Code: BSRT608-19**

**MODULE-1**

Effects on tissues and organs : Stochastic and non-stochastic (deterministic) effects, acute effects, late effects, Late (delayed) effects : cataract formation, organ function, cancer induction.

**MODULE-2**

Effects of radiation on Embryo & foetus : lethal effects, organ malformation, growth impairment, mental retardation, cancer induction, genetic effects.

**MODULE-3**

Personal dosimetry devices: Film badges, TLD badges, pocket ion chambers.  
Principle, composition, properties  
Advantages and disadvantages of PD devices.

**MODULE-4**

shielding principle : ALARA, X-ray shielding, particle shielding and neutron shielding.

**Radiotherapy treatment delivery  
Subject Code: BSRT609-19**

**MODULE-1**

1. Orthovoltage and superficial machines and applicators
2. Treatment Techniques used in superficial and orthovoltage treatments.

**MODULE-2**

3. Super voltage and Megavoltage machines

**MODULE-3**

4. Brachytherapy machines- LDR, MDR, HDR principle, construction and working.

**MODULE-4**

4. Electron Irradiation (TSEI), Proton therapy.

**RTT directed Clinical Education-IV  
Subject Code: BSRT610-19**

**Rationale:** During this clinical education the students will visit nuclear medicine department and Radiotherapy units and will observe operation of the nuclear medicine and quality assurance in radiotherapy and will understand very basic aspects of dealing with patients and radiotherapy equipment used for treatment/ wellbeing of cancer patients.

**Contents**

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

# Bachelor of Science (Radiotherapy Technology)

## [Semester VII-VIII]

### 7<sup>th</sup> Semester

Course Code	Course Title	Marks Distribution			Credits
		Internal	External	Total	
BSRT-701-21	Semester Internship	200	-	200	8

### 8<sup>th</sup> Semester

Course Code	Course Title	Marks Distribution			Credits
		Internal	External	Total	
BSRT-801-21	Semester Internship	200	-	200	8