MAHATMA GANDHI UNIVERSITY
of
MEDICAL SCIENCES & TECHNOLOGY
JAIPUR

Mahatma Gandhi Institute of Allied Health Sciences

Syllabus

Bachelor of Radiation Therapy Technology

4 years
(3 Years + 1 Year Internship)

Program Code:BRTT26

Duration- VIII Semesters (4 Years)

(B.RTT)

Principal
MG Institute of Allied Health Sciences
Jaipur

Dr. Bushra Fiza
Dean, Faculty of Allied and
Healthcare Professions
MGUMST, Jaipur

2026-2027

Recommended by the BOS in Allied Health Sciences at its meeting held on 8th April, 2026, the Faculty of Allied and Healthcare Professions at its meeting held on 28.7.2026 and approved by Academic Council at its meeting held on 03.08.2026

NOTICE

1. The university reserves the right to make changes in the syllabus /books/ guidelines, fee-structure or any other information at any time without prior notice the decision of the university shall be binding on all.

2. The jurisdiction of all court cases shall be Jaipur Bench of Hon'ble Rajasthan High Court only.

3. This syllabus is aligned with the NCAHP Curriculum dated 24.04.2025 and Corrigendum dated 27.05.2026. Any subsequent amendments, revisions or corrigenda issued by the NCAHP shall automatically apply to the Rules, Regulations and Syllabus of MGUMST, Jaipur, and implemented accordingly.

References:
https://ncahp.abdm.gov.in/Curriculum/RADIOTHERAPY%20TECHNOLOGY.pdf
https://ncahp.abdm.gov.in/Curriculum/CurriculumCorrigendum/RT1__27May2026.pdf

List of Abbreviations

Abbreviation	Full Form
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

Rules and Regulations of

Bachelor of Radiation Therapy Technology (B.RTT)

Program Code: **BRTT26**

1. **Title of the Program** - Bachelor of Radiation Therapy Technology
2. **Duration of the Program** – Duration shall be for a period of 4 years (VIII semesters) including one year of internship.
3. **Medium of Instruction** – English
4. **Eligibility for Admissions**-

- The candidate must have passed Senior Secondary (10+2) or equivalent with Physics, Chemistry & Biology (Botany + Zoology) subjects.
- Admission on the basis of merit of Senior secondary (10+2).
- He/she has completed 17 years of age at the time of admission or will complete that age on or before 31 December of the year of his/her admission to the first year of the undergraduate Allied and Healthcare Course.
- Lateral Entry to the candidates in second year (3rd semester) who have passed Diploma of Radiotherapy Technology (D.RT) from recognised university
- Medical fitness certificate is mandatory to submit and it is to be endorsed by Government medical officer.
- Foreign students' admission process in under graduate (UG):
    1) Foreign national students intending to study UG program in India, shall have to take equivalence certificate of eligibility certificate from respective State Allied and Healthcare Council.
    2) For Under Graduate admission of foreign national students, merit list will be based on University Entrance Exam.
    3) Verification of Valid Visa and valid visa duration of foreign national students, to be verified by respective institution & University before enrolling students for program.
        - The admission criteria shall be updated by the Commission from time to time.
        - Admission process shall be conducted by State/Union Territory/ University.

5. **Admission Process** – Selection shall be done by an admission board of the University/Rajasthan State Allied & Healthcare Council strictly on merit/written examination

6. **Reservation Policy** – Reservation policy for admissions shall be as per the state/ Centre Government norms.

7. **Enrolment**[@]

   1. Every candidate who is admitted to the Bachelor of Radiation Therapy Technology program in Mahatma Gandhi Institute of Allied Health Sciences shall be required to get himself/herself enrolled with the Mahatma Gandhi University of Medical Sciences & Technology (MGUMST) after paying the prescribed eligibility and enrolment fees.
   2. A candidate shall deposit enrolment fee along with tuition fees at the time of his/her admission to the program. Such a candidate who fails to submit, to the college principal, duly filled enrolment form along with original documents including migration certificate required for enrolment within prescribed period then after he/she shall pay late fee applicable at that time. No student will be allowed to appear in the End of Semester Examination without his/her enrolment.

8. **Introduction –** 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.

   a) Objectives/ Aim of the Program

   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.

b) **Program Outcomes**

Upon successful completion of the B.RTT program, students will be able to:

POs	Outcome
PO 1	Apply knowledge of physics, radiobiology, and oncology in radiotherapy practice.
PO 2	Demonstrate competency in operating radiotherapy equipment (e.g., linear accelerators, brachytherapy units) and treatment planning systems.
PO 3	Ensure accurate patient positioning, immobilization, and delivery of prescribed radiation doses
PO 4	Implement radiation safety and protection principles for patients, staff, and the public.
PO 5	Collaborate effectively with radiation oncologists, medical physicists, and healthcare teams.
PO 6	Practice ethical, legal, and professional standards in radiotherapy services
PO 7	Apply evidence-based practices and participate in quality assurance and quality control procedures.
PO 8	Communicate effectively with patients and healthcare professionals, ensuring compassionate care.
PO 9	Utilize information and communication technology, including treatment planning and imaging software
PO 10	Engage in lifelong learning, research, and professional development in radiotherapy sciences.

c) Program Specific Outcomes

PSOs	Outcome
PSO-1	Proficiently perform radiotherapy procedures including patient positioning, treatment simulation, treatment delivery, radiation safety practices and operation of radiotherapy equipment such as Linear Accelerators, Teletherapy and Brachytherapy units.
PSO-2	Apply knowledge of radiation physics, radiobiology, treatment planning and imaging techniques for accurate dose delivery, patient care and effective

	management of radiotherapy procedures.
PSO-3	Demonstrate competency in quality assurance, radiation protection, patient communication, professional ethics and multidisciplinary teamwork to ensure safe and effective cancer care services.

d) Graduate Attributes

Upon graduation, student will possess the following attributes:

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.

9. 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.

Program Completion Timeline[@]

- All academic coursework must be completed within a maximum of double the program duration.
- For B.RTT in a 4-year program, all requirements must be fulfilled within 8 years. Failure to do so will result in exit from the program.

10. Minimum Instruction/ Teaching Days – Each Semester would typically last for 5months which would be followed by a short vacation.

11. Programme Structure (Semester I, II, III, IV_____*Distribution of courses semester wise)*

B.RTT First Semester– Foundation Course

Course Title	Course Title	Theory Hours	Practical Hours	Total Hours	Credit
BRTT-001	Introduction to Healthcare Delivery System in India	60	0	60	4
BRTT-002	Basic Computers and Information Science#	10	40	50	2
BRTT-003	Communication and Soft Skills#	20	10	30	1
BRTT-004	Medical Terminology and Record Keeping (Including Anatomical Terms)#	40	0	40	2
BRTT-005	Medical Law and Ethics	40	0	40	2
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	4
BRTT-007	Professionalism and Values#	20	0	20	1
BRTT-008	Biostatistics and Introduction to Research Methodology	40	20	60	3
BRTT-009	Principles of Management#	40	0	40	2
BRTT-010	Community Orientation and Clinical Visit (Including Related Practical to Course 001)	0	100	100	3
	TOTAL	**310**	**230**	**540**	**24**

B.RTT Second Semester

Course code	Course Title	Theory Hours	Practical Hours	Total Hours	Credit
BRTT-011	Elementary Mathematics and Physics	30	10	40	2
BRTT-012	Human Anatomy and Physiology	60	60	120	6
BRTT-013	Radiographic Anatomy	20	40	60	3
BRTT-014	Oncology Science – I	60	20	80	4
BRTT-015	Principles of Radiotherapy and Radiotherapy Techniques	40	20	60	3
BRTT-016	Radiation Quantities, Units and Detection/Measurement	40	20	60	3
	RTT Directed Clinical Education – part (studentship	0	120	120	3
	TOTAL	**250**	**290**	**540**	**24**

B.RTT Third Semester

Course code	Course Title	Theory Hours	Practical Hours	Total Hours	Credit
BRTT-017	Basic Radiation Physics	60	40	100	5
BRTT-018	Oncology Science – II	40	20	60	3
BRTT-019	Radiotherapy Equipment – I	50	50	100	5
BRTT-020	Radiation Safety	40	40	80	4
BRTT-021	Patient Care, Positioning and Immobilization	40	20	60	3
	RTT Directed Clinical Education – part (studentship)	0	140	140	4
	TOTAL	**230**	**310**	**540**	**24**

B.RTT Fourth Semester

Course code	Course Title	Theory Hours	Practical Hours	Total Hours	Credit
BRTT-022	Radiotherapy Equipment – II	40	60	100	5
BRTT-023	Quality Assurance in Radiotherapy – I	30	50	80	4
BRTT-024	Basic Radiotherapy Physics	40	25	65	3
BRTT-025	Biological Effects of Radiation	10	5	15	1
	RTT Directed Clinical Education – Part III (Studentship)	0	280	280	9
	TOTAL	**120**	**420**	**540**	**22**

B.RTT Fifth Semester

Course code	Course Title	Theory Hours	Practical Hours	Total Hours	Credit
BRTT-026	Clinical Radiobiology	40	40	80	4
BRTT-027	Mould Room / Motion Management Techniques	30	60	90	4
BRTT-028	Special RT Techniques and Recent Advances	20	50	70	4
	RTT Directed Clinical Education – Part IV (Studentship)	0	300	300	10
	TOTAL	**90**	**450**	**540**	**22**

B.RTT Sixth Semester

Course code	Course Title	Theory Hours	Practical Hours	Total Hours	Credit
BRTT-029	Radiological / Nuclear Medicine / Other Imaging Techniques in Radiotherapy Planning	20	60	80	4
BRTT-030	Radiotherapy Treatment Delivery	20	60	80	4
BRTT-031	Operational Issues in Radiation Therapy	20	60	80	4
	RTT Directed Clinical Education – Part V (Studentship)	0	300	300	10
	TOTAL	**60**	**480**	**540**	**22**

B.RTT Seventh and Eighth Semester

Course Title	Theory Hours	Practical Hours	Total Hours	Credit
RTT Internship / Externship (Internship – Minimum 720 Hours; Calculation Based on 8 Hours per Day for 90 Working Days in a Semester)	0	1440	1440	20+20
TOTAL	**0**	**1440**	**1440**	**40**

12. Conduct of Continuous Assessment/ Internal Assessment –

- 30% of the total marks is allotted for CIE in each course.
- 50% of CIE shall be based on the average of marks obtained in two notified formative written tests. Absence without prior permission for a formative test shall result in scoring of the test as zero.
- The remaining 50% of CIE will be based on internal assessments in the form of evaluation seminars, CIE will be conducted for theory and practical for each course wherever applicable.
- A Candidate must secure at least 40% of total marks fixed for CIE in the particular subject in order to be eligible to appear for the End Semester Examination (ESE) for that subject.

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.

13. Dissertation/ Internship/ Project/ Clinical Postings

7th and 8th Semester: Internship (Lab posting/ Research dissertation):

A compulsory Internship (Clinical Posting) of 12 months shall be completed by every student after successful completion of the academic programme to be eligible for the award of the Bachelor of Radiation Therapy Technology (B.RTT).

14. Scheme of Examination –The end of semester examination for the program shall be conducted semester wise at the end of every semester.

MARKS DISTRIBUTION
B.RTT First Semester– Foundation Course

Course/ Paper Code	Course/ Paper Name	Credits Theory	Credits Practical	Theory ESE	Theory CIE	Practical ESE	Practical CIE	Total
BRTT-001	Introduction to Healthcare Delivery System in India	4	0	70	30	–	–	100
BRTT-002	Basic Computers and Information Science#	1	1	40	10	-	-	50
BRTT-003	Communication and Soft Skills#	1	0	40	10	–	–	50
BRTT-004	Medical Terminology and Record Keeping (Including Anatomical Terms)#	2	0	40	10	–	–	50
BRTT-005	Medical Law and Ethics	2	0	70	30	–	–	100
BRTT-006	Introduction to Quality and Patient Safety	2	2	70	30	40	10	150
BRTT-007	Professionalism and Values#	1	0	40	10	–	–	50
BRTT-008	Biostatistics and Introduction to Research Methodology	3	0	70	30			100
BRTT-009	Principles of Management#	2	0	40	10	–	–	50
BRTT-010	Community Orientation and Clinical Visit (Including Related Practical to Course 001)	0	3	–	–	70	30	100
TOTAL		**17**	**7**	**480**	**170**	**110**	**40**	**800**

- **Note- #** indicates the non- university exam

B.RTT Second Semester

Course /Paper Code	Course/ Paper Name	Credits Theory	Credits Practical	Theory ESE	Theory CIE	Practical ESE	Practical CIE	Total
BRTT-011	Elementary Mathematics and Physics	2	0	70	30	–	–	100
BRTT-012	Human Anatomy and Physiology	3	3	70	30	40	10	150
BRTT-013	Radiographic Anatomy	1	2	70	30	40	10	150
BRTT-014	Oncology Science – I	3	1	70	30	40	10	150
BRTT-015	Principles of Radiotherapy and Radiotherapy Techniques	2	1	70	30	40	10	150
BRTT-016	Radiation Quantities, Units and Detection/Measurement	2	1	70	30	40	10	150
	Radiotherapy Clinical Education – Part I (Studentship)	0	3	–	–	70	30	100
TOTAL		**13**	**11**	**420**	**180**	**420**	**180**	**950**

B.RTT Third Semester

Course/ Paper Code	Course/ Paper Name	Credits Theory	Credits Practical	Theory ESE	Theory CIE	Practical ESE	Practical CIE	Total
BRTT-017	Basic Radiation Physics	3	2	70	30	40	10	150
BRTT-018	Oncology Science – II	2	1	70	30	40	10	150
BRTT-019	Radiotherapy Equipment – I	3	2	70	30	40	10	150
BRTT-020	Radiation Safety	2	2	70	30	40	10	150
BRTT-021	Patient Care, Positioning and Immobilization	2	1	70	30	40	10	150
	RTT Directed Clinical Education – Part II (Studentship)	0	4	–	–	70	30	100
TOTAL		**12**	**12**	**350**	**150**	**420**	**180**	**850**

B.RTT Fourth Semester

Course/ Paper Code	Course/ Paper Name	Credits Theory	Credits Practical	Theory ESE	Theory CIE	Practical ESE	Practical CIE	Total
BRTT-022	Radiotherapy Equipment – II	2	3	70	30	40	10	150
BRTT-023	Quality Assurance in Radiotherapy – I	1	3	70	30	40	10	150
BRTT-024	Basic Radiotherapy Physics	2	1	70	30	40	10	150
BRTT-025	Biological Effects of Radiation	1	0	70	30	–	–	150
	RTT Directed Clinical Education – Part III (Studentship)	0	9	–	–	70	30	100
TOTAL		**6**	**16**	**280**	**120**	**350**	**150**	**700**

B.RTT Fifth Semester

Course/ Paper Code	Course/ Paper Name	Credits Theory	Credits Practical	Theory ESE	Theory CIE	Practical ESE	Practical CIE	Total
BRTT-026	Clinical Radiobiology	3	1	70	30	70	30	200
BRTT-027	Mould Room / Motion Management Techniques	2	2	70	30	70	30	200
BRTT-028	Special RT Techniques and Recent Advances	2	2	70	30	70	30	200
	RTT Directed Clinical Education – Part IV (Studentship)	0	10	–	–	70	30	100
TOTAL		**7**	**15**	**210**	**90**	**280**	**120**	**700**

B.RTT Sixth Semester

Course/ Paper Code	Course/ Paper Name	Credits Theory	Credits Practical	Theory ESE	Theory CIE	Practical ESE	Practical CIE	Total
BRTT-029	Radiological / Nuclear Medicine / Other Imaging Techniques in Radiotherapy Planning	2	2	70	30	70	30	200
BRTT-030	Radiotherapy Treatment Delivery	2	2	70	30	70	30	200
BRTT-031	Operational Issues in Radiation Therapy	2	2	70	30	70	30	200
	RTT Directed Clinical Education – Part V (Studentship)	-	10	–	–	70	30	100
TOTAL		**6**	**16**	**210**	**90**	**280**	**120**	**700**

B.RTT Seventh and Eighth Semester

Course/ Paper Name	Credits Theory	Credits Practical	Theory ESE	Theory CIE	Practical ESE	Practical CIE	Total
RTT Internship / Externship (Internship – Minimum 720 Hours; Calculation Based on 8 Hours per Day for 90 Working Days in a Semester)	0	40	–	–	210	90	300
	0	**40**	**0**	**0**	**210**	**90**	**100**

Note: ESE will be conducted immediate after end of 8th semester at the institutional level.

15. Conduct of University Examination/ End of Semester Examination –

a) **Appointment of Examiners and Paper Setters (Qualification of paper Setters and Examiners):**

- All the examiners, paper setters, theory examination answer book evaluators, external and internal examiners for practical examinations shall be appointed by the respective university.
- Professor/Assoc. Professor/ Assistant Professor/Lecturer/Allied Health Professional having PG Qualification and 3 years professional /teaching experience after PG in respective fields or UG Qualification and 5 years professional industry/teaching experience after UG is eligible to act as an internal or external examiner of theory/practical examination.

b) **Eligibility to appear for the Examination:**

A student is required to have minimum 75% attendance in theory and 80% practical's separately of each semester to make him/her eligible to appear in the university semester examination.

c) **Theory Examinations:**

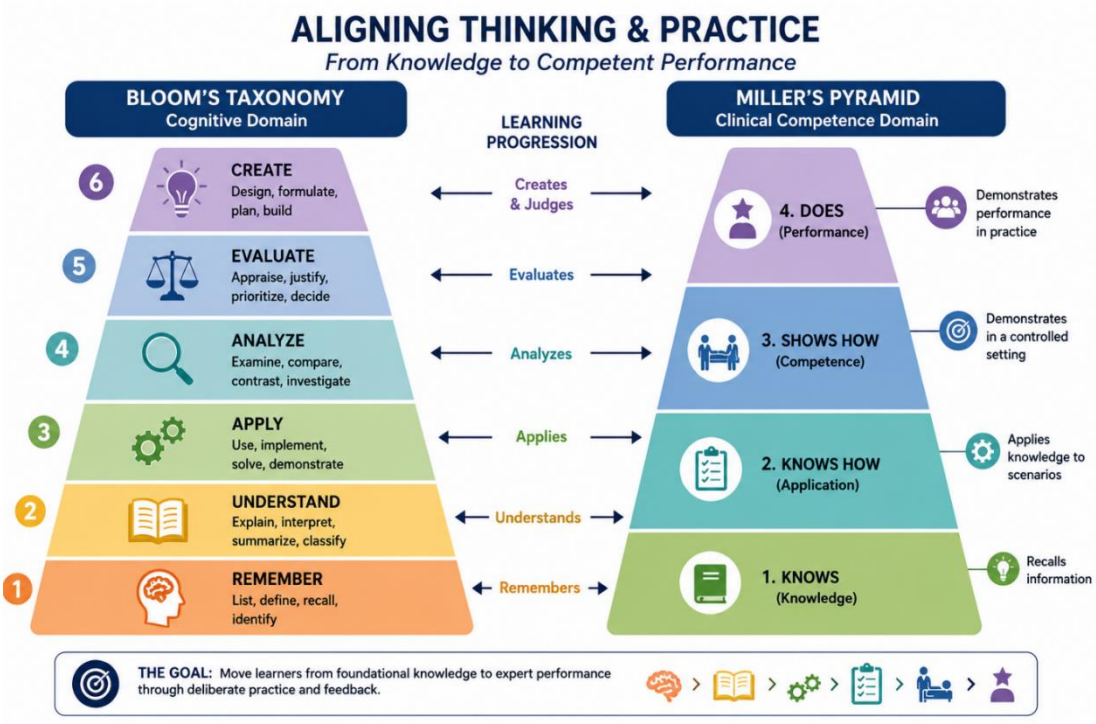
- There shall be Theory papers in each semester of study.
- Each Theory paper examination shall be of 3 hours duration and a maximum of 70 marks.
- Internal assessment (IA) shall be 30 marks for each Theory paper.
- The Paper Setter shall set the questions within the prescribed course of study of the concerned paper. There will be a set pattern of question papers duly approved by the Academic Council.

Proposed Pattern of question papers –

MAXIMUM MARKS = 70		
TYPE OF QUESTION	NUMBER OF QUESTION	MARKS FOR EACH QUESTION
ESSAY TYPE	3 (to answer 2)	10
SHORT ESSAY TYPE	9 (to answer 7)	5
SHORT ANSWER TYPE	7 (to answer 5)	3

Passing Marks: A candidate will have to obtain at least 40% marks in each Theory paper including internal assessment to pass.

Bloom's Level: A blended approach—combining didactic methods, experiential laboratory training, problem-solving, clinical immersion, and research exposure—is essential in Medical Laboratory Sciences. When guided by educational frameworks such as Bloom's Level, these methodologies ensure that learners progress from acquiring foundational knowledge to demonstrating competence and ultimately practicing independently as professionals.
By weaving Bloom's Level (cognitive depth) the curriculum ensures that graduates not only master theoretical knowledge but also translate it into safe, accurate, and independent laboratory practice.



d) **Practical Examinations and Viva Voce**

- At the end of each semester there shall be the practical and viva-voce examination. It shall be conducted after the Theory examination is over. A candidate will have to obtain at least 40% marks in the practical and viva-voce examination.
- The university shall appoint the panel of examiners in such a manner that the complete syllabus of semester is taken care of by the internal/external practical examiner(s).

The practical examinations shall be conducted by one external examine and one internal examiner appointed by the president of the university.@

e) **Results:** A candidate will have to obtain at least 40% marks separately in each Theory paper including internal assessment and a minimum of 40% marks in the practical examination for him to be declared pass.

f) **Supplementary Examination (MGUMST Rules)** @

- Supplementary examination conducted by the University for unsuccessful candidates.
- Lower semester exams conducted along with current semester exams.
- Internal assessment can be improved before supplementary examination.

Grace Marks: The award of grace marks shall be as per the policy governed by the rules of Mahatma Gandhi University of Medical Sciences & Technology (MGUMST)

g) **Revaluation/ Scrutiny**@ - As per as MGUMST Rules

Re- Evaluation of marks is permitted only for theory papers. The University/board, on application within the stipulated time and remittance of a prescribed fee, shall permit a Re- evaluation of marks for the course/s applied. The marks obtained after re- evaluation shall be the final marks awarded.

h) **Promotion to the next 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.

- Minimum **40% CIE** to appear for ESE. Candidate with **not more than 2 backlog subjects** can be promoted to the next semester. Backlogs can also be cleared during internship.

Letter Grades and Grade Points

Letter Grade	A+	A	B	C	D	E	F/I/DT
Credit value	10	9	8	7	6	5	0

F- Fail, DT - Detained/Attendance shortage, I – Incomplete

Internals Weightage (%)	End semester Exam Weightage (%)
30	70

Calculation of GPA & CGPA: An example is provided

Course code	Course	Credits (a)	Grade obtained by the student	Credit value (b)	Grade Points (a x b)
BRTT1	Course - 1	4	D	6	24
BRTT2	Course - 2	4	B	8	32
BRTT3	Course - 3	3	A+	10	30
BRTT4	Course - 4	4	C	7	28
BRTT5	Course - 5	5	A	9	45
TOTAL		**20**	**-**	**-**	**159**

1st Semester GPA = Total grade points / total credits

159/20 = **7.95**

Suppose in **the 2nd semester, GPA** = **8.35** with respective course credit 20

$$Then,\ 1^{st}YearCGPA = \frac{\sum 7.95x20\sum + \sum 8.35x20\sum}{20 + 20} = 8.15$$

Progression Criteria to Higher Semesters

Minimum **40% CIE** to appear for ESE. Candidate with **not more than 2 backlog subjects** can be promoted to the next semester. Backlogs can also be cleared during internship.

Credit Wweightage Distribution

Item	Weightage (%)
Formative	
Class participation/presentation	5%
Assignment & quizzes	5%
Sessional exams	20%

Summative	
End-of-Semester University exam	70%
Total	100 %

Internals Weightage (%)	**End semester Exam Weightage (%)**
30	70

16. **Award of Degree:** The degree shall be awarded by the university only after receipt of course completion certificate and No Dues from the principal of the college.

17. **Authority to issue transcript:** The Controller of Examination of the University shall be the authority for issuing transcript after receiving the described fee from the candidate.

18. **Logbooks and Clinical Records**:

- A compulsory internship (Lab posting/ Research dissertation) of one year.[@]
- 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
- Upon successful completion, students will receive an Internship Certificate that includes:
  A summary of activities undertaken
  Details of clinical or relevant departmental postings with corresponding hours
- Information on any research project completed during research dissertation
- The certificate must be authenticated by the Dean/Head of Department (HoD)/Coordinator and the Head of the Institution (HoI).

19. **Any specific point/ rule/ regulation related to college/ institute- NA**

20. **Course wise Syllabus with Recommended Text Books**

21. **Model Papers - Attached**

QUESTION PAPER TEMPLATE FOR B.RTT SEMESTER I–IV

INSTRUCTIONS FOR PAPER SETTERS FOR B.RTT SEMESTER I–IV

1. All questions must be framed in alignment with the NCAHP framework. Map each question to the relevant Course Outcome (CO) and Bloom's taxonomy.
2. Every question must carry two mandatory annotations:(a) Course Outcome (CO): e.g., CO2, CO5;(b) Highest Bloom's Level Attained: e.g., L3 – Application. These must be written in brackets after the question text.
3. The Bloom's Taxonomy ceiling for B.RTT Semester I–IV is Level 3 – Application. No question in this paper shall exceed this level. The paper setter must self-audit using the Bloom's reference table provided in this template.
4. Question distribution across Bloom's levels [L1 – Knowledge; L2 – Comprehension; and L3 – Application] must be documented on the master copy. Recommended distribution for Semester I–IV:

   L1–L2: ~70–80%;

   L3: ~20–30%;

   L4–L6: ~0% (not applicable).
5. Avoid repetition of topics across questions. Q1, Q2 and Q3 should collectively cover a minimum of 6–8 different topics/competencies to ensure adequate syllabus sampling.
6. All Long Answer Questions must carry sufficient internal scope. A 10-mark Long Answer Question should have 4–5 expected response components. These expected answers must be included in the model answer key submitted alongside the paper.
7. The paper setter must submit:

   (i) Question Paper with CO + Bloom's Level annotations;

   (ii) Model Answer Key with marking scheme.

   All documents are confidential and must be submitted in a sealed envelope to the Examination Cell.

B.RTT Semester I–IV: Question-Level Mapping Table (70 Marks)

Q. No.	Question Type	Bloom's Range
Q1	Long Answer (Attempt any 2 out of 3)	L1 – L3
Q2	Short Essay (Attempt any 7)	L1 – L3
Q3	Short Answer (Attempt any 5)	L1 – L2 only

Question Paper Structure:

Subject Code **Subject Abb.**

Bachelor of Radiation Therapy Technology (B.RTT)

Semester

Subject Name

Time: 3 Hours

Maximum Marks: 70

Q.1. Essay Questions (Attempt any 2) **2 × 10 = 20 Marks**

a) …… (CO- ,L-)
b)…… (CO- ,L-)
c)…… (CO- ,L-)

Q.2. Short Essay Questions (Attempt any 7) **7 × 5 = 35 Marks**

a) …… (CO- ,L-)
b) …… (CO- ,L-)
c) …… (CO- ,L-)
d) …… (CO- ,L-)
e) …… (CO- ,L-)
f) …… (CO- ,L-)
g) …… (CO- ,L-)
h) …… (CO- ,L-)
i) …… (CO- ,L-)

Q.3. Short Answer Questions (Attempt any 5) **5 × 3 = 15 Marks**

(a) …… (CO- ,L-)
(b) …… (CO- ,L-)
(c) …… (CO- ,L-)
(d) …… (CO- ,L-)
(e) …… (CO- ,L-)
(f) …… (CO- ,L-)
(g) …… (CO- ,L-)

QUESTION PAPER TEMPLATE FOR B.RTT SEMESTER V–VI

INSTRUCTIONS FOR PAPER SETTERS FOR B.RTT SEMESTER V–VI

1. All questions must be framed in alignment with the NCAHP framework. Map each question to the relevant Course Outcome (CO) and NCAHP and Bloom's Taxonomy.
2. Every question must carry two mandatory annotations:(a) Course Outcome (CO): e.g., CO2, CO5;(b) Highest Bloom's Level Attained: e.g., L5.These must be written in brackets after the question text.
3. The Bloom's Taxonomy ceiling for B.RTT Semester V–VI is Level 5 – Evaluation. No question in this paper shall exceed this level. The paper setter must self-audit using the Bloom's reference table provided in this template.
4. Question distribution across Bloom's levels [L2 – Comprehension; L3 – Application; L4 – Analysis; and L5 – Evaluation] must be documented on the master copy. Recommended distribution:
   L2-L3: ~70–80%;
   L4: ~10–15%;
   L5: 5-10%
5. Avoid repetition of topics across questions. Q1, Q2 and Q3 should collectively cover a minimum of 6–8 different topics/competencies to ensure adequate syllabus sampling.
6. All Long Answer Questions must carry sufficient internal scope. A 10-mark Long Answer Question should have 4–5 expected response components. Clinical scenarios or case-based questions should be included wherever appropriate. These expected answers must be included in the model answer key submitted alongside the paper.
7. The paper setter must submit:
   (i) Question Paper with CO + Bloom's Level annotations;
   (ii) Model Answer Key with marking scheme.
   All documents are confidential and must be submitted in a sealed envelope to the Examination Cell.

BRTT Semester V–VI: Question-Level Mapping Table (70 Marks)

Q. No.	Question Type	Bloom's Range
Q1	Long Answer (Attempt any 2 out of 3)	L2 – L4
Q2	Short Essay (Attempt any 7)	L2 – L4
Q3	Short Answer (Attempt any 5)	L2 – L3 only

Question Paper Structure:

Subject Code **Subject Abb.**

Bachelor of Radiation Therapy Technology (B.RTT)

Semester

Subject Name

Time: 3 Hours

Maximum Marks: 70

Q.1. Essay Questions (Attempt any 2) **2 × 10 = 20 Marks**

a) …… (CO- ,L-)
b)…… (CO- ,L-)
c)…… (CO- ,L-)

Q.2. Short Essay Questions (Attempt any 7) **7 × 5 = 35 Marks**

a) …… (CO- ,L-)
b) …… (CO- ,L-)
c) …… (CO- ,L-)
d) …… (CO- ,L-)
e) …… (CO- ,L-)
f) …… (CO- ,L-)
g) …… (CO- ,L-)
h) …… (CO- ,L-)
i) …… (CO- ,L-)

Q.3. Short Answer Questions (Attempt any 5) **5 × 3 = 15 Marks**

(h) …… (CO- ,L-)
(i) …… (CO- ,L-)
(j) …… (CO- ,L-)
(k) …… (CO- ,L-)
(l) …… (CO- ,L-)
(m) …… (CO- ,L-)
(n) …… (CO- ,L-)

SEMESTER-I

Foundation

Introduction to Healthcare Delivery System in India

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Describe the structure and functions of the Indian healthcare delivery system at primary, secondary, and tertiary levels.	L1
CO2	Explain the roles of public and private healthcare sectors, National Health Mission, and National Health Policy in healthcare delivery.	L2
CO3	Discuss the objectives, implementation strategies, and significance of major National Health Programmes in India.	L2
CO4	Explain the basic principles and applications of various AYUSH systems of medicine and their role in healthcare.	L2

Course Content:

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.

Reference Books -

Indian Healthcare: Inside Out" by B.S. Ajaikumar

Healthcare Delivery in India: Critical Perspectives" edited by K.R. Nayar and R. Raman

Basic Computers and Information Science

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall the basic components, functions, and generations of computers.	L1
CO2	Explain the principles of operating systems, networking, and internet applications.	L2
CO3	Describe the functions and applications of common software used in healthcare settings.	L2
CO4	Demonstrate the use of MS Word, Excel, and PowerPoint for professional documentation and presentations.	L3

Course Content:

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

Reference Books -

1. T. M. Srinivasan, Use of Computers and Multimedia in Education. Horton, 2002

Communication and Soft Skills

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Define the principles and types of communication used in healthcare environments.	L1
CO2	Explain barriers to effective communication and methods to overcome them.	L2
CO3	Discuss the importance of interpersonal skills and teamwork in healthcare delivery.	L2

Course Content:

Communication and soft skills

Major topics to be covered under Communication course –

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

Reference books -

1. Tom Koorkkakala, Communicative English for General Nursing Students, K.J. Publications, 2008.
2. King's English, Addone Publishing Group, Thiruvananthapuram.
3. John Ellison Kahn & Others, How to Write and Speak Better.

Medical Terminology and Record Keeping (including anatomical terms)

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's Taxonomy
CO1	Recall commonly used medical terms, abbreviations, prefixes, suffixes, and root words.	L1
CO2	Explain the formation and interpretation of medical terminology related to body systems.	L2
CO3	Describe anatomical positions, planes, movements, and directional terms used in healthcare.	L2

Course Content:

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.

Reference Books -

1. Davies, Juanita. Essentials of Medical Terminology. 3rd edition. New York. Delmar.2008
2. Mogli. JD. Medical Records: Organization & Management 2ndedition New Delhi: Jaypee Brothers
3. The body by Bilbirson Agreed for Occupance

Medical Law and Ethics

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall fundamental concepts of medical law, ethics, and professional responsibilities.	L1
CO2	Explain ethical principles including autonomy, beneficence, non-maleficence, and confidentiality.	L2
CO3	Discuss medico-legal issues related to informed consent, patient rights, and professional conduct.	L2
CO4	Apply ethical and legal principles while handling patient information and clinical situations.	L3
CO5	Demonstrate professional accountability and ethical decision-making in healthcare practice.	L3

Course Content:

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.

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". 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.

Reference Books -

l. Medical Law and Ethics by Bonnie F Fremgen

2. Medical Law and Ethics by Jonathan Herring

Introduction to Quality and Patient safety

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom taxonomy
CO1	Recall the concepts of quality assurance, quality improvement, and patient safety.	L1
CO2	Explain infection control measures, biomedical waste management, and safety protocols.	L2
CO3	Discuss the importance of NABH standards and patient safety initiatives in healthcare.	L2
CO4	Demonstrate basic life support (BLS), CPR, and emergency response procedures.	L3
CO5	Apply infection prevention and patient safety practices in clinical environments.	L3

Course Content:

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) Action 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.

Reference Books -

1. Handbook of healthcare quality & patient safety- Girdhar J Gyani & Alexander Thomas — 2nd edition- 2017
2. Total quality management in the healthcare industry:An efficient guide for healthcare management- Balasubramanian Mahadevan — 2022
3. Step by step Quality Hospital Care- Farooq Jan- I st edition 2013
4. Patient safety and healthcare improvement Willey Blackwell- 1 st edition - 2014

Professionalism and values

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall professional values, ethics, and responsibilities expected of healthcare professionals.	L1
CO2	Explain the importance of integrity, accountability, empathy, and respect in patient care.	L2
CO3	Discuss the significance of cultural sensitivity and professional behaviour in healthcare settings.	L2

Course Content:

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 professionalism in terms of healthcare system is 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 behavior- professional behavior, 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

Reference Books -

1. Professionalism in Health Care: A Primer for Career Success" by Sherry Makely
2. "Principles of Management for Quality Projects: Smart Strategies" by George Ecke

Bio-Statistics and Introduction to Research Methodology

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall basic concepts and terminology used in research methodology and biostatistics.	L1
CO2	Explain research designs, sampling methods, and ethical considerations in healthcare research.	L2
CO3	Discuss methods of data collection, organization, and presentation.	L2

Course Content:

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

Reference books -

1. Research methodology- CR K othari & Gaurav Garg — 4 th edition — 2019
2. 1ntroduction to research methodology — Bhanwar Lal Garg, Renu Kavdia, Sulochana Agarwal & Umesh kumar Agarwal — 2019
3. Research methodology for health professionals — RC Goyal — 2nd edition — 2023
4. Research Methodlogy and applied statistics —DN Sansanwal - 2020

Principles of Management

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall the basic concepts and functions of management.	L1
CO2	Explain principles of planning, organizing, leadership, and decision-making.	L2
CO3	Discuss the importance of teamwork, innovation, and change management in healthcare organizations.	L2

Course Content:

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

Reference Books -

l.Hospital and patient care management — Dr.Vidhya Srinivasan & Dr.Akshay Ch.Deka-2022

2.Principles of hospital practice and patient care — P Srinivasulu Reddy 1 st edition -2019

3.Principles & Practice of Critical Care — P.K Verma — 3 rd edition- 2019.

SEMESTER-II

Elementary Mathematics and Physics

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall fundamental mathematical concepts including percentages, ratios, logarithms, trigonometry, and graphical representations.	L1
CO2	Explain the principles of mechanics, electrostatics, magnetism, and current electricity relevant to healthcare sciences.	L2
CO3	Describe the working principles of electrical and magnetic systems used in radiation-related applications.	L2
CO4	Apply mathematical methods and graphical techniques to solve problems encountered in radiation physics.	L3
CO5	Apply the principles of electricity, magnetism, and measurement instruments in clinical and radiotherapy environments.	L3

Course Content:

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.

Reference books -

1. The Physics of Radiation Therapy – F.M. Khan
2. The Physics of Radiology – Johns & Cunningham

Human Anatomy and Physiology

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall the structure and organization of cells, tissues, organs, and body systems.	L1
CO2	Explain the anatomy and physiology of the skeletal, muscular, nervous, endocrine, cardiovascular, respiratory, digestive, urinary, and reproductive systems.	L2
CO3	Describe the anatomical relationships of the head and neck, thorax, abdomen, pelvis, and lymphatic system.	L2
CO4	Apply anatomical and physiological knowledge for patient positioning and treatment localization in radiotherapy.	L3
CO5	Correlate normal physiological functions with clinical conditions relevant to radiation therapy practice.	L3

Course Content:

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.

Reference Books:-

1. Handbook of General Anatomy by B.D Chaurasia
2. Human Anatomy by B.D Chaurasia
3. Anatomy and Physiology in Health and Illness by Ross and Wilson
4. Pocket Sectional Anatomy Vol 1 and 2 by Moller and Rief, Thieme Publications
5. A text book of Medical Physiology by Guyton and Hall

Radiographic Anatomy

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall normal anatomical structures visualized through conventional and cross-sectional imaging modalities.	L1
CO2	Explain the principles and clinical applications of CT, MRI, Ultrasound, Mammography, and Nuclear Medicine in oncology.	L2
CO3	Describe the role of imaging in tumour localization, treatment planning, and treatment verification.	L2

Course Content:

(Radiographic Anatomy) 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

Reference books :-

1. The Physics of Radiation Therapy – F.M. Khan
2. The Physics of Radiology – Johns & Cunningham

Oncology Science- I

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall basic concepts of tumour pathology, carcinogenesis, and cancer biology.	L1
CO2	Explain the etiology, epidemiology, genetic factors, and risk factors associated with cancer development.	L2
CO3	Describe tumour growth patterns, spread mechanisms, and staging principles.	L2
CO4	Apply knowledge of cancer prevention, screening, and early detection strategies in healthcare settings.	L3
CO5	Apply tumour staging concepts to understand the clinical management of cancer patients.	L3

Course Content:

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

Reference Books:-

1. Walter and Millers Textbook of Radiotherapy
2. Principles and Practice of Radiation Oncology by Perez and Brady
3. Text book of Radiation Oncology by Philips, Hope and Roach
4. Principles and Practice of Brachytherapy by Joslin, Flynn and Hall
5. Brachytherapy Applications and techniques by Phillip M. Devlin

Principles of Radiotherapy and Radiotherapy Techniques

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall the basic principles and applications of radiotherapy in benign and malignant diseases.	L1
CO2	Explain the biological effects of radiation on normal and malignant tissues.	L2
CO3	Describe various radiotherapy techniques including fixed field, rotational, arc, and skip therapies.	L2
CO4	Apply patient setup, immobilization, and simulation procedures for accurate treatment delivery.	L3
CO5	Apply beam modifying devices and treatment accessories during radiotherapy procedures.	L3

Course Content:

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

Reference Books -

1. Treatment Planning in Radiation Oncology – F.M. Khan
2. Principles and Practice of Radiation Therapy – Washington & Leaver
3. Radiation Therapy Planning – Gunilla Bentel
4. Practical Radiotherapy Planning – Jane Dobbs
5. Radiotherapy Treatment Planning – Richard F. Mould

Radiation Quantities, Units and Detection/Measurement

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall radiation quantities, units, and dose limits used in radiation protection and dosimetry.	L1
CO2	Explain the principles of radiation interaction, detection, and measurement.	L2
CO3	Describe the construction and operation of radiation detectors and dosimeters used in clinical practice.	L2
CO4	Apply appropriate radiation measuring instruments for monitoring and dose assessment.	L3
CO5	Apply detector selection principles based on radiation type and measurement requirements.	L3

Course Content:

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.

Reference Books -

1. The Physics of Radiation Therapy – F.M. Khan
2. Radiation Detection and Measurement – Glenn F. Knoll
3. Radiation Dosimetry – H.E. Johns

RTT Directed Clinical Education – part I (studentship)

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.

SEMESTER-III

Basic Radiation Physics

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall the concepts of atomic structure, radioactivity, isotopes, radioactive decay, and electromagnetic radiation.	L1
CO2	Explain the production, properties, and characteristics of X-rays and their clinical significance.	L2
CO3	Describe the interaction of radiation with matter including photoelectric effect, Compton scattering, pair production, and attenuation processes.	L2
CO4	Apply the principles of radiation attenuation, HVT, TVT, and energy absorption in radiotherapy practice.	L3
CO5	Apply radiation physics concepts to understand radiation behaviour and safety in clinical settings.	L3

Course Content:

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 Xrays, 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.

Reference Books -

1. The Physics of Radiation Therapy – F.M. Khan
2. The Physics of Radiology – Johns & Cunningham
3. Radiation Oncology Physics – E.B. Podgorsak

Oncology Science-II

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall the diagnostic methods used in oncology including clinical examination, biopsy, laboratory investigations, and imaging.	L1
CO2	Explain tumour staging and grading systems including TNM classification and their clinical importance.	L2
CO3	Describe various treatment intents such as radical, adjuvant, neoadjuvant, and palliative therapies.	L2
CO4	Apply staging and grading information in understanding cancer management strategies.	L3
CO5	Apply performance status assessment in evaluating patient suitability for cancer treatment.	L3

Course Content:

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

Reference Books -

1. Walter and Miller's Textbook of Radiotherapy
2. Principles and Practice of Radiation Oncology – Perez & Brady
3. Textbook of Radiation Oncology – Phillips, Hope & Roach

Radiotherapy Equipment –I

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall the basic components and functions of teletherapy and brachytherapy equipment.	L1
CO2	Explain the principles, design features, and operation of HDR, LDR, and PDR brachytherapy systems.	L2
CO3	Describe the structure and functioning of telecobalt units, medical linear accelerators, and tomotherapy systems.	L2
CO4	Apply knowledge of beam directing, beam modifying, and beam defining devices in treatment delivery.	L3
CO5	Apply appropriate radiotherapy accessories and machine properties for safe and accurate treatment procedures.	L3

Course Content:

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.

Reference Books -

1. The Physics & Technology of Radiation Therapy – McDermott & Orton
2. Practical Radiotherapy: Physics and Equipment – Pam Cherry & Angela Duxbury

Radiation Safety

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall the fundamental principles of radiation protection, dose limits, and radiation hazards.	L1
CO2	Explain the concepts of time, distance, shielding, workload calculation, and radiation monitoring.	L2
CO3	Describe regulatory requirements, safety standards, and radiation emergency preparedness procedures.	L2
CO4	Apply radiation protection measures and safe work practices in radiotherapy departments.	L3

Course Content:

(Radiation Safety) 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

Reference Books -

1. Principles of Radiation Protection – Morgan & Turner
2. Physics for Radiation Protection – James E. Martin
3. An Introduction to Radiation Protection – Allen Martin & Samuel Harbison
4. ICRP Report 103

Patient care, Positioning and Immobilization

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Recall the fundamental principles of radiation protection, dose limits, and radiation hazards.	L1
CO2	Explain the concepts of time, distance, shielding, workload calculation, and radiation monitoring.	L2
CO3	Describe regulatory requirements, safety standards, and radiation emergency preparedness procedures.	L2
CO4	Apply radiation protection measures and safe work practices in radiotherapy departments.	L3
CO5	Demonstrate the use of survey meters, dosimeters, and quality assurance tools for radiation safety monitoring.	L3

Course Content:

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.

Reference books -

1. Treatment Planning in Radiation Oncology – F.M. Khan
2. Principles and Practice of Radiation Therapy – Washington & Leaver
3. Practical Radiotherapy Planning – Jane Dobbs
4. Radiotherapy Treatment Planning – Richard F. Mould

RTT Directed Clinical Education – part III (studentship)

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.

SEMESTER-IV

Radiotherapy Equipment –II

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Explain the principles and applications of treatment planning systems used in external beam radiotherapy and brachytherapy.	L2
CO2	Describe the functions and clinical applications of phantoms, dosimeters, and in-vivo dosimetry systems.	L2
CO3	Apply the use of EPID, CT simulators, and on-board imaging systems in treatment verification procedures.	L3
CO4	Apply record and verify systems and oncology information systems for patient data management and treatment delivery.	L3
CO5	Analyze the role of imaging, dosimetry, and information systems in improving treatment accuracy and patient safety.	L4

Course Content:

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

Reference Books-

1. The Physics & Technology of Radiation Therapy – McDermott & Orton
2. Practical Radiotherapy: Physics and Equipment – Pam Cherry & Angela Duxbury

Quality Assurance in Radiotherapy-I

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Explain the principles and objectives of quality assurance in radiotherapy.	L2
CO2	Describe the functions of QA tools used for equipment performance evaluation and treatment accuracy.	L2
CO3	Apply quality assurance procedures for telecobalt units, linear accelerators, brachytherapy units, and simulators.	L3
CO4	Perform routine QA checks related to beam alignment, field congruence, isocentre accuracy, and patient support systems.	L3
CO5	Analyze QA results to identify deviations affecting treatment precision and safety.	L4

Course Content:

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 Basic Radiotherapy Physics 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.

Reference Books-

1. Radiation Oncology Physics – E.B. Podgorsak
2. The Physics of Radiation Therapy – F.M. Khan

Basic Radiotherapy Physics

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Explain the historical development and physical principles of radiotherapy equipment and radiation sources.	L2
CO2	Describe the characteristics of photons, electrons, protons, neutrons, and their applications in radiotherapy.	L2
CO3	Apply dosimetric concepts such as PDD, TAR, and TMR in radiotherapy dose calculations and treatment planning.	L3
CO4	Apply the principles of beam modifiers, immobilization devices, and advanced radiotherapy techniques in clinical practice.	L3
CO5	Analyze the selection of radiotherapy techniques and accessories for achieving optimal treatment outcomes.	L4

Course Content:

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.

Reference Books-

1. The Physics of Radiation Therapy – F.M. Khan
2. The Physics of Radiology – Johns & Cunningham

Biological Effects of Radiation

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Explain the biological effects of ionizing radiation on cells, tissues, and organ systems.	L2
CO2	Describe chromosomal aberrations, biological dosimetry, and mechanisms of radiation-induced damage.	L2
CO3	Apply concepts of deterministic, stochastic, somatic, and hereditary effects in radiation protection practices.	L3
CO4	Apply knowledge of acute and chronic radiation exposure in patient care and radiation safety.	L3
CO5	Analyze radiation-induced biological responses and their implications for clinical radiotherapy.	L4

Course Content:

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.

Reference Books-

Radiobiology for the Radiologist – Hall & Giaccia

RTT Directed Clinical Education – part III (studentship)

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.

SEMESTER-V
Clinical Radiobiology

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Explain the principles of cell kinetics, tumour biology, and radiation response mechanisms.	L2
CO2	Describe the five R's of radiobiology, tissue responses, and radiation-induced effects.	L2
CO3	Apply radiobiological models such as LQ, TCP, and NTCP in understanding treatment outcomes.	L3
CO4	Apply principles of fractionation, treatment scheduling, and radiosensitizers in radiotherapy practice.	L3
CO5	Analyze radiobiological factors influencing tumour control and normal tissue complications.	L4

Course Content:

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

Reference Books-

1. Walter and Miller's Textbook of Radiotherapy
2. Principles and Practice of Radiation Oncology – Perez & Brady
3. Textbook of Radiation Oncology – Phillips, Hope & Roach

Mould Room /Motion Management Techniques

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Explain the evolution, properties, and applications of mould materials used in radiotherapy.	L2
CO2	Describe various immobilization devices and their role in treatment accuracy.	L2
CO3	Apply thermoplastic mould preparation techniques for patient immobilization.	L3
CO4	Apply motion management techniques such as breath-hold, gating, tracking, and motion reduction during treatment delivery.	L3
CO5	Analyze the impact of immobilization and motion management strategies on treatment precision and reproducibility.	L4

Course Content:

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

Reference books-

Practical Radiotherapy Planning – Jane Dobbs

Special RT Techniques and Recent Advances

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Apply the principles of special radiotherapy techniques including stereotactic and conformal radiotherapy.	L3
CO2	Apply advanced treatment techniques such as IMRT, IGRT, VMAT, SRS, and SBRT in clinical scenarios.	L3
CO3	Analyze the technical and clinical differences among conventional and advanced radiotherapy techniques.	L4
CO4	Analyze the role of image guidance, treatment verification, and emerging technologies in precision radiotherapy.	L4
CO5	Evaluate recent advances such as proton therapy, carbon ion therapy, and artificial intelligence for their impact on cancer treatment outcomes.	L5

Course Content:

Special RT Techniques and Recent advances

1. 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

Reference books -

1. Treatment Planning in Radiation Oncology – F.M. Khan
2. Radiation Therapy Planning – Gunilla Bentel
3. Radiotherapy Treatment Planning – Richard F. Mould
4. Clinical Target Volumes in Conformal and IMRT – Grégoire, Scalliet & Ang

RTT Directed Clinical Education – part IV (studentship)

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.

SEMESTER-VI

Radiological/Nuclear Medicine/Other Imaging Techniques in Radiotherapy Planning

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Apply the principles of simulation, target volume delineation, and treatment planning in external beam radiotherapy.	L3
CO2	Apply dosimetric concepts and treatment planning parameters for generating optimal treatment plans.	L3
CO3	Analyze dose distributions, DVHs, isodose curves, and treatment planning data for various treatment sites.	L4
CO4	Analyze factors affecting treatment plan quality, dose conformity, and organ-at-risk sparing.	L4
CO5	Evaluate treatment plans based on clinical objectives, radiobiological considerations, and patient-specific requirements.	L5

Course Content:

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.

Reference books -

1. Radiology Fundamentals – Harjit Singh
2. Essentials of Radiographic Physics and Imaging – Johnston & Fauber
3. Radiologic Science for Technologists – Bushong

Radiotherapy Treatment Delivery

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Apply the principles of CT, MRI, PET, SPECT, Ultrasound, and hybrid imaging modalities in radiotherapy planning.	L3
CO2	Apply imaging data for target volume delineation, organ-at-risk identification, and treatment localization.	L3
CO3	Analyze anatomical, functional, and molecular imaging findings for treatment planning and verification.	L4
CO4	Analyze the role of image fusion, image registration, and multimodality imaging in improving treatment accuracy.	L4
CO5	Evaluate the suitability and clinical applications of different imaging modalities for site-specific radiotherapy planning.	L5

Course Content:

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.

Reference books -

1. Treatment Planning in Radiation Oncology – F.M. Khan
2. Principles and Practice of Radiation Therapy – Washington & Leaver

3. Radiation Therapy Planning – Gunilla Bentel
4. Practical Radiotherapy Planning – Jane Dobbs
5. Radiotherapy Treatment Planning – Richard F. Mould

Operational Issues in Radiation Therapy

Course Outcomes

Course Learning Outcomes: The student will be able to		Bloom's taxonomy
CO1	Apply patient positioning, immobilization, and treatment setup procedures for accurate radiation delivery.	L3
CO2	Apply treatment parameters and verification procedures during external beam radiotherapy and brachytherapy treatments.	L3
CO3	Analyze treatment delivery techniques and factors affecting treatment precision and reproducibility.	L4
CO4	Analyze treatment verification data, imaging findings, and setup deviations to ensure accurate dose delivery.	L4
CO5	Evaluate treatment delivery procedures and implement corrective measures to optimize treatment outcomes and patient safety.	L5

Course Content:

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.

Reference books -

1. Treatment Planning in Radiation Oncology – F.M. Khan
2. Principles and Practice of Radiation Therapy – Washington & Leaver
3. Radiation Therapy Planning – Gunilla Bentel
4. Practical Radiotherapy Planning – Jane Dobbs
5. Radiotherapy Treatment Planning – Richard F. Mould

RTT Directed Clinical Education – part V (studentship)

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.

SEMESTER-VII, SEMESTER-VIII

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 1 year (2 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

Model Paper

B.RTT Semester-I

Code: BRTT-001

Bachelor of Radiation Therapy Technology (B.RTT)

Semester I

Introduction to Healthcare Delivery System in India

Time: 3 Hours | Maximum Marks: 70

Q.1. Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the structure of the healthcare delivery system in India at primary, secondary and tertiary levels with suitable examples. (CO1, L2)

B. Discuss the National Health Mission and National Health Policy. Explain their role in improving healthcare services in India. (CO2, L2)

C. Describe the major National Health Programmes in India and explain their importance. (CO3, L2)

Q.2.Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Differentiate between public and private healthcare sectors in India. (CO2, L2)

b) Explain community participation in healthcare delivery. (CO1, L1)

c) Write a short note on the healthcare system of developed countries. (CO2, L2)

d) Discuss the role of Ayurveda in healthcare services. (CO4, L2)

e) Explain the concept and importance of demography. (CO3, L2)

f) Describe the significance of vital statistics in healthcare planning. (CO3, L2)

g) What is census? Explain its impact on health policy. (CO3, L2)

h) Explain the principles of epidemiology. (CO3, L2)

i) Write a note on disease surveillance and monitoring. (CO3, L2)

Q.3.Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define primary healthcare. (CO1, L1)

b. What is National Health Mission (NHM)? (CO2, L2)

c. List objectives of National Health Programmes. (CO3, L2)

d. Define AYUSH. Name its components. (CO4, L2)

e. What are vital events? Give suitable examples. (CO3, L2)

f. Define epidemiology. (CO3, L2)

g. What is immunization? (CO3, L2)

h. Write any three issues in the Indian healthcare delivery system. (CO2, L2)

Model Paper

B.RTT Semester-I

Code: BRTT-005

Bachelor of Radiation Therapy Technology (B.RTT)

Semester I

Medical Law and Ethics

Time: 3 Hours | Maximum Marks: 70

Q.1 ESSAY QUESTIONS (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the basic principles of medical ethics and discuss their importance in healthcare practice. (CO2, L2)

B. Discuss informed consent and patient rights with suitable examples from clinical practice. (CO3, L2)

C. Explain medico-legal aspects of medical records, confidentiality and release of medical information. (CO4, L3)

Q.2 SHORT ESSAY QUESTIONS (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Define medical ethics and explain its goals and scope. (CO1, L1)

b) Write a note on code of conduct for healthcare professionals. (CO1, L1)

c) Explain the principle of confidentiality in healthcare. (CO2, L2)

d) Discuss malpractice and negligence in medical practice. (CO3, L2)

e) Explain rational and irrational drug therapy. (CO2, L2)

f) Write a short note on euthanasia. (CO3, L2)

g) Discuss ethical issues in organ transplantation. (CO3, L2)

h) Explain professional indemnity insurance policy. (CO4, L3)

i) Describe the development of standardized protocols to avoid sentinel events. (CO5, L3)

Q.3 SHORT ANSWER QUESTIONS (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define medical ethics. (CO1, L1)

b. What is autonomy? (CO2, L2)

c. Define informed consent. (CO3, L2)

d. What is negligence? (CO3, L2)

e. Define confidentiality. (CO2, L2)

f. What is medico-legal case (MLC)? (CO4, L3)

g. Define organ transplantation. (CO3, L2)

h. What is professional accountability? (CO5, L3)

Model Paper

B.RTT Semester-I

Code: BRTT-006

Bachelor of Radiation Therapy Technology (B.RTT)

Semester I

Introduction to Quality and Patient Safety

Time: 3 Hours | Maximum Marks: 70

Q.1 ESSAY QUESTIONS (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain quality assurance, quality improvement approaches and NABH guidelines in healthcare. (CO1, CO3, L2)

B. Describe Basic Life Support (BLS), CPR and the use of AED during emergencies. (CO4, L3)

C. Explain biomedical waste management, segregation, colour coding and disposal methods. (CO2, L2)

Q.2 SHORT ESSAY QUESTIONS (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Define quality of care and explain its importance. (CO1, L1)

b) Discuss quality improvement tools used in hospitals. (CO1, L2)

c) Explain vital signs and primary assessment. (CO4, L3)

d) Write a note on first aid and triage. (CO4, L3)

e) Explain infection prevention and control measures. (CO2, L2)

f) Discuss sterilization and disinfection methods. (CO2, L2)

g) Explain the use of personal protective equipment (PPE). (CO5, L3)

h) Write a note on antibiotic resistance and its consequences. (CO3, L2)

i) Explain disaster preparedness and emergency management. (CO3, L2)

Q.3 SHORT ANSWER QUESTIONS (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define quality assurance. (CO1, L1)

b. Expand NABH. (CO3, L2)

c. What is CPR? (CO4, L3)

d. Define biomedical waste. (CO2, L2)

e. What is segregation of waste? (CO2, L2)

f. Define infection control. (CO5, L3)

g. What is antibiotic resistance? (CO3, L2)

h. What is triage? (CO4, L3)

Model Paper

B.RTT Semester-I

Code: BRTT-008

Bachelor of Radiation Therapy Technology (B.RTT)

Semester I

Biostatistics and Introduction to Research Methodology

Time: 3 Hours | Maximum Marks: 70

Q.1 ESSAY QUESTIONS (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the steps involved in conducting a research study and identifying a research problem. (CO2, L2)

B. Discuss research design and sampling methods used in healthcare research. (CO2, L2)

C. Explain methods of data collection, organization and presentation. (CO3, L2)

Q.2 SHORT ESSAY QUESTIONS (Attempt Any Seven) (7 × 5 = 35 Marks)

a. Define research and explain its importance in healthcare. (CO1, L1)
b. Discuss ethical issues in research. (CO2, L2)
c. Explain different types of research designs. (CO2, L2)
d. Write a note on biostatistics and its applications. (CO1, L1)
e. Explain different types of data. (CO3, L2)
f. Discuss research tools used for data collection. (CO3, L2)
g. Explain probability and non-probability sampling methods. (CO2, L2)
h. Write a short note on research proposal writing. (CO3, L2)
i. Explain data tabulation and graphical presentation. (CO3, L2)

Q.3 SHORT ANSWER QUESTIONS (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define research methodology. (CO1, L1)
b. What is a hypothesis? (CO2, L2)
c. Define sampling. (CO2, L2)
d. What is primary data? (CO3, L2)
e. Define questionnaire. (CO3, L2)
f. What is biostatistics? (CO1, L1)
g. Define research proposal. (CO3, L2)
h. What is informed consent in research? (CO2, L2)

Model Paper

B.RTT Semester-II

Code: BRTT-011

Bachelor of Radiation Therapy Technology (B.RTT)

Semester II

Elementary Mathematics and Physics

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain logarithms, indices and trigonometric applications in solving radiation physics problems. (CO1, CO4, L3)

B. Discuss Newton's laws of motion, force, momentum and their applications in physics. (CO2, L2)

C. Explain electromagnetic induction, transformers, alternating current and power factor. (CO3, L2)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain ratio and proportion with suitable examples. (CO1, L1)

b) Discuss simple interest and compound interest. (CO1, L1)

c) Explain inverse square law and its significance. (CO4, L3)

d) Describe properties of triangles and similar triangles. (CO1, L1)

e) Explain Coulomb's law and electric field. (CO2, L2)

f) Write a note on capacitance and electric potential. (CO2, L2)

g) Discuss Ohm's law and heating effect of current. (CO2, L2)

h) Explain electromagnets and magnetic flux. (CO3, L2)

i) Describe galvanometer, ammeter and voltmeter. (CO5, L3)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define logarithm. (CO1, L1)

b. State Newton's First Law. (CO2, L2)

c. Define momentum. (CO2, L2)

d. What is electric current? (CO2, L2)

e. Define Tesla. (CO3, L2)

f. What is transformer? (CO3, L2)

g. Define RMS value of AC. (CO3, L2)

h. What is voltmeter? (CO5, L3)

Model Paper

B.RTT Semester-II

Code: BRTT-012

Bachelor of Radiation Therapy Technology (B.RTT)

Semester II

Human Anatomy and Physiology

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the structure and functions of the circulatory system with neat labeled diagrams. (CO2, L2)

B. Describe the anatomy and physiology of the respiratory system and explain gas exchange. (CO2, CO5, L3)

C. Discuss the anatomy of the head and neck region and explain its clinical importance in radiotherapy. (CO3, CO4, L3)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the structure and functions of a cell. (CO1, L1)

b) Describe classification of tissues. (CO1, L1)

c) Explain different types of joints and their movements. (CO2, L2)

d) Write a note on muscles and their classification. (CO2, L2)

e) Discuss the structure of the brain and spinal cord. (CO2, L2)

f) Explain lymphatic drainage and functions of lymph nodes. (CO3, L2)

g) Describe the anatomy of the liver and pancreas. (CO3, L2)

h) Explain the endocrine glands and their functions. (CO2, L2)

i) Discuss male and female reproductive systems. (CO2, L2)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define tissue. (CO1, L1)

b. What is a neuron? (CO2, L2)

c. Define reflex arc. (CO2, L2)

d. What is cerebrospinal fluid? (CO2, L2)

e. Name any three endocrine glands. (CO2, L2)

f. Define nephron. (CO2, L2)

g. What is lymph? (CO3, L2)

h. Define fertilization. (CO2, L2)

Model Paper

B.RTT Semester-II

Code: BRTT-013

Bachelor of Radiation Therapy Technology (B.RTT)

Semester II

Radiographic Anatomy

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain Computed Tomography (CT) and discuss its role in oncology imaging. (CO2, L2)

B. Describe Magnetic Resonance Imaging (MRI) and compare it with CT in tumour evaluation. (CO2, L2)

C. Explain the role of imaging in tumour localization, treatment planning and treatment verification. (CO3, L2)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Discuss the importance of surface anatomy in radiotherapy. (CO1, L1)

b) Explain conventional radiography and its applications. (CO1, L1)

c) Write a short note on mammography. (CO2, L2)

d) Explain principles of ultrasound imaging. (CO2, L2)

e) Discuss nuclear medicine imaging. (CO2, L2)

f) Explain Digitally Reconstructed Radiographs (DRR). (CO3, L2)

g) Describe portal imaging and its significance. (CO3, L2)

h) Explain cross-sectional imaging anatomy. (CO1, L1)

i) Discuss imaging modalities used in oncology. (CO2, L2)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a) Define anatomical landmark. (CO1, L1)

b) What is simulation in radiotherapy? (CO3, L2)

c) Define contrast media. (CO2, L1)

d) What is image-guided radiotherapy (IGRT)? (CO3, L2)

e) Define target volume. (CO3, L1)

f) What is multiplanar reconstruction (MPR)? (CO2, L1)

g) Define cross-sectional imaging. (CO1, L1)

h) Explain the role of EPID (CO2, L1)

Model Paper

B.RTT Semester-II

Code: BRTT-014

Bachelor of Radiation Therapy Technology (B.RTT)

Semester II

Oncology Science – I

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the process of carcinogenesis and discuss the biological basis of cancer development. (CO1, CO2, L2)

B. Describe the etiology, epidemiology and genetic factors responsible for cancer. (CO2, L2)

C. Discuss tumour staging and explain its importance in clinical management of cancer patients. (CO3, CO5, L3)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the general pathology of tumours. (CO1, L1)

b) Discuss local and systemic effects of malignant tumours. (CO3, L2)

c) Write a note on cancer epidemiology. (CO2, L2)

d) Explain the role of genetics in cancer development. (CO2, L2)

e) Discuss co-morbidities associated with cancer patients. (CO2, L2)

f) Explain prevention strategies for cancer. (CO4, L3)

g) Describe methods of early detection and screening of cancer. (CO4, L3)

h) Discuss warning signs and symptoms of cancer. (CO4, L3)

i) Explain the significance of identifying high-risk groups for cancer. (CO4, L3)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define neoplasm. (CO1, L1)

b. What is carcinogenesis? (CO1, L1)

c. Define epidemiology. (CO2, L2)

d. What is metastasis? (CO3, L2)

e. Define tumour staging. (CO5, L3)

f. What is cancer screening? (CO4, L3)

g. Define risk factor. (CO2, L2)

h. What is biopsy? (CO3, L2)

Model Paper

B.RTT Semester-II

Code: BRTT-015

Bachelor of Radiation Therapy Technology (B.RTT)

Semester II

Principles of Radiotherapy and Radiotherapy Techniques

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the early and late effects of radiation on normal tissues and malignant tumours. (CO2,L2)

B. Discuss various radiotherapy techniques including Fixed Field, Rotation, Arc and Skip Therapy. (CO3, L2)

C. Explain patient setup, immobilization devices and CT simulation procedures used in radiotherapy. (CO4, L3)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the application of radiotherapy in benign diseases. (CO1, L1)

b) Discuss the role of radiotherapy in malignant conditions. (CO1, L1)

c) Explain single field and multiple field treatment techniques. (CO3, L2)

d) Write a note on ORFIT and Body Frame immobilization devices. (CO4, L3)

e) Discuss evaluation of patient setup in simple treatment techniques. (CO4, L3)

f) Explain the use of wedges in radiotherapy. (CO5, L3)

g) Describe tissue compensators and Midline Blocks (MLB). (CO5, L3)

h) Explain customized shielding blocks and their properties. (CO5, L3)

i) Discuss asymmetric jaws and motorized wedges. (CO5, L3)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define radiotherapy. (CO1, L1)

b. What is Arc Therapy? (CO3, L2)

c. Define Skip Therapy. (CO3, L2)

d. What is CT Simulation? (CO4, L3)

e. Define immobilization. (CO4, L3)

f. What is a wedge filter? (CO5, L3)

g. Define tissue compensator. (CO5, L3)

h. What is Midline Block (MLB)? (CO5, L3)

Model Paper

B.RTT Semester-II

Code: BRTT-016

Bachelor of Radiation Therapy Technology (B.RTT)

Semester II

Radiation Quantities, Units and Detection/Measurement

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain radiation quantities and units used in radiation dosimetry and protection. (CO1, L1)

B. Discuss the principles of radiation detection and measurement with suitable examples. (CO2, L2)

C. Explain the construction, working and applications of ionization chambers, GM counters and scintillation detectors. (CO3, L2)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain radioactivity, flux and fluence. (CO1, L1)

b) Discuss absorbed dose, equivalent dose and effective dose. (CO1, L1)

c) Explain occupational dose limits and public dose limits. (CO1, L1)

d) Describe ionization of gases used in radiation detection. (CO2, L2)

e) Explain fluorescence and phosphorescence. (CO2, L2)

f) Discuss proportional counters and their applications. (CO3, L2)

g) Explain pocket dosimeters and personnel monitoring badges. (CO4, L3)

h) Write a note on Thermoluminescent Dosimeters (TLD). (CO4, L3)

i) Compare different radiation detectors with their advantages and disadvantages. (CO5, L3)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define radioactivity. (CO1, L1)

b. What is kerma? (CO1, L1)

c. Define absorbed dose. (CO1, L1)

d. What is exposure? (CO1, L1)

e. Define GM counter. (CO3, L2)

f. What is scintillation detector? (CO3, L2)

g. Define TLD. (CO4, L3)

h. What is personnel monitoring? (CO4, L3)

Model Paper

B.RTT Semester-III

Code: BRTT-017

Bachelor of Radiation Therapy Technology (B.RTT)

Semester III

Basic Radiation Physics

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain atomic structure, isotopes, isobars and radioactive decay with suitable examples. (CO1, L1)

B. Describe the production of X-rays and discuss the factors affecting X-ray quality and intensity. (CO2, L2)

C. Explain the interaction of radiation with matter, including photoelectric effect, Compton scattering and pair production. (CO3, L2)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Discuss the structure of an atom and nucleus. (CO1, L1)

b) Explain electromagnetic radiation and particle radiation. (CO1, L1)

c) Write a note on half-life and radioactivity. (CO1, L1)

d) Explain Bremsstrahlung radiation and characteristic X-rays. (CO2, L2)

e) Discuss the role of filters in X-ray production. (CO2, L2)

f) Explain linear and mass attenuation coefficients. (CO4, L3)

g) Discuss Half Value Thickness (HVT) and Tenth Value Thickness (TVT). (CO4, L3)

h) Explain ionization of matter and energy absorption from X-rays. (CO3, L2)

i) Describe the interaction of charged particles and neutrons with matter. (CO5, L3)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define isotope. (CO1, L1)

b. What is radioactivity? (CO1, L1)

c. Define half-life. (CO1, L1)

d. What is Bremsstrahlung radiation? (CO2, L2)

e. Define Compton effect. (CO3, L2)

f. What is pair production? (CO3, L2)

g. Define HVT. (CO4, L3)

h. What is attenuation? (CO4, L3)

Model Paper

B.RTT Semester-III

Code: BRTT-018

Bachelor of Radiation Therapy Technology (B.RTT)

Semester III

Oncology Science – II

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain various diagnostic methods used in oncology. (CO1, L1)

B. Discuss tumour staging and grading according to TNM classification system. (CO2, L2)

C. Explain the role of surgery, radiotherapy, and chemotherapy in cancer treatment. (CO4, L3)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the importance of clinical examination in cancer diagnosis. (CO1, L1)

b) Discuss different types of biopsy procedures. (CO1, L1)

c) Write a note on laboratory investigations used in oncology. (CO1, L1)

d) Explain imaging methods used in cancer diagnosis. (CO1, L1)

e) Explain the importance of follow-up and surveillance after cancer treatment. (CO2, L2)

f) Write a note on tumour markers used in cancer diagnosis. (CO2, L2)

g) Write a note on management of non-malignant diseases. (CO3, L2)

h) Explain primary management of malignancy. (CO4, L3)

i) Discuss performance status assessment in cancer patients. (CO5, L3)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. What is a screening test?. (CO1, L1)

b. Prognostic and predictive factors in oncology (CO2, L2)

c. Role of multidisciplinary tumour boards in cancer care. (CO2, L2)

d. Define palliative treatment. (CO3, L2)

e. What is adjuvant therapy? (CO3, L2)

f. Define neoadjuvant therapy. (CO5, L3)

g. What is metastasis? (CO4, L3)

h. What is radical treatment? (CO3, L2)

Model Paper

B.RTT Semester-III

Code: BRTT-019

Bachelor of Radiation Therapy Technology (B.RTT)

Semester III

Radiotherapy Equipment – I

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the principles, design features and applications of brachytherapy systems. (CO2, L2)

B. Describe the structure and working of a medical linear accelerator with neat labelled diagram. (CO3, L2)

C. Discuss telecobalt machines and different source movement mechanisms. (CO4, L3)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the functions of a radiotherapy simulator. (CO1, L1)

b) Discuss radiation sources used in brachytherapy. (CO2, L2)

c) Write a note on brachytherapy applicators. (CO2, L2)

d) Write a note on beam flattening filters. (CO3, L2)

e) Explain the purpose and applications of wedges in radiotherapy. (CO3, L2)

f) Explain tomotherapy and its applications. (CO3, L2)

g) Describe beam modifying devices used in radiotherapy. (CO4, L3)

h) Explain multileaf collimators (MLC) and their advantages. (CO2, L2)

i) Discuss radiotherapy accessories used during treatment delivery. (CO5, L3)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Expand HDR, LDR, PDR. (CO2, L2)

b. Define penumbra. (CO2, L1)

c. Define Source-to-Axis Distance (SAD). (CO1, L1)

d. Quality assurance in radiotherapy. (CO3, L3)

e. Radiotherapy simulator. (CO1, L2)

f. Define beam modifier. (CO4, L3)

g. Role of compensators. (CO2, L3)

h. Function of Bolus. (CO3, L3)

Model Paper

B.RTT Semester-III

Code: BRTT-020

Bachelor of Radiation Therapy Technology (B.RTT)

Semester III

Radiation Safety

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the philosophy of radiation protection and discuss the role of time, distance and shielding in reducing radiation exposure. (CO2, L2)

B. Describe radiation hazards, their evaluation and control measures in radiotherapy departments. (CO1, CO4, L3)

C. Discuss radiation emergency preparedness, regulatory requirements and the role of Radiation Therapy Technologists during radiation emergencies. (CO3, CO4, L3)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the principles of radiation protection. (CO1, L1)

b) Discuss occupational dose limits and radiation hazards. (CO1, L1)

c) Explain workload calculation in radiotherapy installations. (CO2, L2)

d) Write a note on use factor and occupancy factor. (CO2, L2)

e) Discuss the effects of different shielding materials. (CO2, L2)

f) Explain radiation monitoring and personnel monitoring devices. (CO4, L3)

g) Describe the functions of Gamma Zone Monitor. (CO3, L2)

h) Discuss safety culture and preventive maintenance in radiotherapy departments. (CO3, L2)

i) Explain the responsibilities of licensees, registrants and employers under radiation safety regulations. (CO3, L2)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define radiation protection. (CO1, L1)

b. What is workload? (CO2, L2)

c. Define occupancy factor. (CO2, L2)

d. What is shielding? (CO2, L2)

e. Define radiation emergency. (CO3, L2)

f. What is a survey meter? (CO4, L3)

g. Define HVT. (CO4, L3)

h. What is safety culture? (CO3, L2)

Model Paper

B.RTT Semester-III

Code: BRTT-021

Bachelor of Radiation Therapy Technology (B.RTT)

Semester III

Patient Care, Positioning and Immobilization

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the principles of patient care in a radiotherapy department. (CO1, L1)

B. Describe various positioning and immobilization devices used in radiotherapy and explain their clinical importance. (CO4, L3)

C. Discuss simulation procedures and techniques used in radiotherapy planning. (CO5, L3)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain hospital organization and departmental records management. (CO1, L1)

b) Discuss professional attitude towards patients and healthcare staff. (CO1, L1)

c) Explain the care of unconscious patients and stretcher patients. (CO2, L2)

d) Write a note on infection control and hygiene practices. (CO2, L2)

e) Discuss storage, labeling and handling of drugs in the department. (CO3, L2)

f) Explain breast boards, lung boards and belly boards. (CO4, L3)

g) Discuss vacuum cushions and stereotactic immobilization systems. (CO4, L3)

h) Explain treatment verification and image acquisition. (CO5, L3)

i) Describe image processing, archiving and information management in radiotherapy. (CO5, L3)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define role of fuidicial markers. (CO4, L3)

b. What is first aid? (CO2, L2)

c. Define infection control. (CO2, L2)

d. What is CT simulation? (CO5, L3)

e. Movement treatment couch. (CO4, L3)

f. Define isocentre. (CO4, L3)

g. Define image verification. (CO5, L3)

h. What is a vacuum bag immobilization device? (CO4, L3)

Model Paper

B.RTT Semester-IV

Code: BRTT-022

Bachelor of Radiation Therapy Technology (B.RTT)

Semester IV

Radiotherapy Equipment – II

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the principles and applications of Treatment Planning Systems (TPS) used in external beam radiotherapy and brachytherapy. (CO1, L2)

B. Describe various phantoms and dosimeters used in radiotherapy and discuss their clinical applications. (CO2, L2)

C. Describe the construction, working principle, and applications of Image Guided Radiation Therapy (IGRT) systems. (CO3, L2)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the principle and advantages of Volumetric Modulated Arc Therapy (VMAT). (CO2, L2)

b) Discuss external beam treatment planning procedures. (CO1, L2)

c) Explain brachytherapy treatment planning. (CO1, L2)

d) Describe water phantom and its applications. (CO2, L2)

e) Explain Radiation field analyzer (RFA) phantom and its uses. (CO2, L2)

f) Discuss various in-vivo dosimeters used in radiotherapy. (CO2, L2)

g) Explain the working principle of EPID. (CO3, L3)

h) Discuss Record and Verify Systems in radiotherapy. (CO4, L3)

i) Explain Oncology Information Systems and patient data archiving. (CO4, L3)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define multichannel applicator. (CO1, L1)

b. What is adaptive radiotherapy? (CO2, L1)

c. What is motion management? (CO2, L1)

d. Role of fiducial marker. (CO3, L1)

e. What is a treatment console? (CO4, L1)

f. Define respiratory gating techniques. (CO4, L3)

g. Define image archiving. (CO5, L2)

h. Define source calibration. (CO1, L1)

Model Paper

B.RTT Semester-IV

Code: BRTT-023

Bachelor of Radiation Therapy Technology (B.RTT)

Semester IV

Quality Assurance in Radiotherapy – I

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the principles, objectives and importance of Quality Assurance (QA) in radiotherapy. (CO1, L2)

B. Describe various QA tools used in radiotherapy and discuss their role in treatment accuracy. (CO2, L2)

C. Explain QA procedures for Telecobalt in detail. (CO3, L3)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Discuss the concept of quality assurance in radiotherapy. (CO1, L2)

b) Write a note on beam output constancy verification. (CO3, L3)

c) Describe laser alignment procedures. (CO2, L2)

d) Explain optical and radiation field congruence. (CO4, L3)

e) Discuss beam shaping blocks and beam shaping jaws. (CO4, L3)

f) Explain delineator/diaphragm movements and their importance. (CO4, L3)

g) Discuss isocentre alignment tests. (CO4, L3)

h) Explain QA checks for patient support systems. (CO4, L3)

i) Discuss the role of documentation and record maintenance in quality assurance programmes. (CO4, L2)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Different type of Quality Assurance. (CO1, L2)

b. What is laser alignment? (CO2, L2)

c. Define field congruence. (CO4, L3)

d. What is commissioning? (CO3, L1)

e. Define beam shaping block. (CO2, L2)

f. Define tolerance limit. (CO4, L1)

g. Define patient support system. (CO4, L3)

h. What is preventive QA? (CO5, L4)

Model Paper

B.RTT Semester-IV

Code: BRTT-024

Bachelor of Radiation Therapy Technology (B.RTT)

Semester IV

Basic Radiotherapy Physics

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the historical development of radiotherapy and describe the physical components of Telecobalt Unit. (CO1, L2)

B. Discuss the physics of photons, electrons, protons and neutrons and explain their applications in radiotherapy. (CO2, L2)

C. Explain dosimetric parameters Percentage Depth Dose (PDD), Tissue-Air Ratio (TAR) and derive relationship between them. (CO3, L3)

Q.2 Short Essay Questions(Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the interaction of photon radiation with matter. (CO2, L2)

b) Explain the production of X-rays in an X-ray tube. (CO1, L2)

c) Explain the construction and components of a Linear Accelerator. (CO1, L2)

d) Describe various radiation sources used in radiotherapy and their properties. (CO2, L2)

e) Explain the characteristics of photon beams in radiotherapy. (CO2, L2)

f) Discuss the characteristics of Bremsstrahlung and characteristic radiation. (CO1, L2)

g) Explain the role of bolus and phantom materials in radiotherapy. (CO4, L3)

h) Describe wedges, compensators and shielding blocks. (CO4, L3)

i) Explain special radiotherapy techniques such as IMRT, IGRT and Tomotherapy. (CO5, L4)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. What is a free-air ionization chamber? (CO3, L1)

b. What is a build-up region? (CO2, L1)

c. Define linear attenuation coefficient. (CO2, L1)

d. Define clarkson method (CO3, L3)

e. Role of scatter radiation in radiotherapy. (CO3, L3)

f. What is LET, RBE & OER? (CO4, L3)

g. Define stopping paper. (CO5, L4)

h. Define exposure. (CO4, L1)

Model Paper

B.RTT Semester-IV

Code: BRTT-025

Bachelor of Radiation Therapy Technology (B.RTT)

Semester IV

Biological Effects of Radiation

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the biological effects of ionizing radiation on cells and tissues. (CO1, L2)

B. Describe chromosomal aberrations and explain their different types. (CO2, L2)

C. Discuss deterministic and stochastic effects of radiation and explain their significance in radiation protection. (CO3, CO4, L3)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the structure and functions of a cell. (CO1, L2)

b) Discuss the effects of ionizing radiation on cellular components. (CO1, L2)

c) Explain DNA damage and repair mechanisms. (CO1, L2)

d) Discuss the mechanisms of radiation-induced cell damage. (CO1, L2)

e) Explain biological dosimetry and its importance. (CO2, L2)

f) Discuss somatic effects and hereditary effects of radiation. (CO3, L3)

g) Explain acute radiation exposure and chronic radiation exposure. (CO4, L3)

h) Discuss LD50/60 and its significance. (CO4, L3)

i) Explain the role of Radiation Therapy Technologist (RTT) in managing acute radiation effects. (CO5, L4)

Q.3 Short Answer Questions(Attempt Any Five) (5 × 3 = 15 Marks)

a. Effects of radiation on the hematopoietic system. (CO3, L2)

b. Define mutation. (CO4, L1)

c. What is biological dosimetry? (CO2, L2)

d. Define radiolysis of water. (CO1, L1)

e. What is apoptosis? (CO2, L1)

f. Define mutation. (CO4, L1)

g. Biological effects of prenatal irradiation. (CO4, L2)

h. Describe radiation effects on the reproductive organs. (CO3, L2)

Model Paper

B.RTT Semester-V

Code: BRTT-026

Bachelor of Radiation Therapy Technology (B.RTT)

Semester V

Clinical Radiobiology

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain cell kinetics, cell cycle control mechanisms and tumour biology with reference to radiotherapy. (CO1, L2)

B. Discuss the Five R's of Radiobiology and explain their importance in radiotherapy treatment outcomes. (CO2, L2)

C. Explain the Linear Quadratic (LQ) Model in detail. (CO3, CO5, L4)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the phases of the cell cycle. (CO1, L2)

b) Discuss cell survival and radiation response mechanisms. (CO1, L2)

c) Explain tumour growth kinetics. (CO1, L2)

d) Describe tissue structure and radiation effects. (CO2, L2)

e) Discuss acute and late radiation side effects. (CO2, L2)

f) Explain radiosensitizers and radioprotectors. (CO4, L3)

g) Discuss fractionation and its advantages. (CO4, L3)

h) Explain treatment scheduling in radiotherapy. (CO4, L3)

i) Describe combined modality treatment approaches in cancer therapy. (CO4, L3)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define cell kinetics. (CO1, L2)

b. What is tumour biology? (CO1, L2)

c. Define reoxygenation. (CO2, L2)

d. What is redistribution? (CO2, L2)

e. Define fractionation. (CO4, L3)

f. What is TCP? (CO3, L3)

g. Define NTCP. (CO3, L3)

h. Explain TDF model? (CO4, L3)

Model Paper

B.RTT Semester-V

Code: BRTT-027

Bachelor of Radiation Therapy Technology (B.RTT)

Semester V

Mould Room / Motion Management Technique

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the historical evolution of mould materials and discuss their applications in radiotherapy. (CO1, L2)

B. Describe various immobilization devices used in radiotherapy and explain their role in treatment accuracy. (CO2, L2)

C. Discuss motion management techniques including breath hold, gating, tracking and motion reduction methods. (CO4, CO5, L4)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the importance of mould room procedures in radiotherapy. (CO1, L2)

b) Discuss properties of thermoplastic mould materials. (CO1, L2)

c) Explain the preparation of thermoplastic moulds. (CO3, L3)

d) Describe head and neck immobilization techniques. (CO2, L2)

e) Discuss immobilization methods used for thoracic and pelvic cancers. (CO2, L2)

f) Explain breath-hold techniques in radiotherapy. (CO4, L3)

g) Discuss respiratory gating and its clinical applications. (CO4, L3)

h) Explain tumour tracking techniques. (CO4, L3)

i) Discuss the importance of reproducibility in patient positioning. (CO5, L4)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define internal target volume (ITV). (CO2, L1)

b. Describe shielding blocks and their clinical significance. (CO3, L3)

c. What is a stereotactic frame? (CO1, L1)

d. Quality assurance procedures for immobilization. (CO4, L3)

e. Discuss abdominal compression techniques. (CO4, L3)

f. Explain the principle and applications of deep inspiration breath hold (DIBH). (CO2, L3)

g. Define motion management. (CO4, L3)

h. What is reproducibility? (CO5, L4)

Model Paper

B.RTT Semester-V

Code: BRTT-028

Bachelor of Radiation Therapy Technology (B.RTT)

Semester V

Special RT Techniques and Recent Advances

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain Volumetric Modulated Arc Therapy (VMAT) and its advantages over conventional techniques. (CO1, L3)

B. Discuss Stereotactic Radiosurgery (SRS), Stereotactic Radiotherapy (SRT) and their clinical applications. (CO2, L3)

C. Explain recent advances in radiotherapy including proton therapy, carbon ion therapy. (CO5, L4)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the role of wedges and compensators in treatment delivery. (CO1, L3)

b) Discuss irregular field and oblique field techniques. (CO1, L3)

c) Explain arc rotational and moving field techniques. (CO1, L3)

d) Describe mantle field and hemi-body irradiation. (CO2, L3)

e) Discuss total body irradiation and total skin irradiation. (CO2, L3)

f) Explain BRW and CRW stereotactic frames. (CO2, L3)

g) Discuss principles of 3D conformal radiotherapy. (CO3, L4)

h) Explain image guidance and treatment verification in advanced radiotherapy. (CO4, L4)

i) Discuss the role of artificial intelligence in radiotherapy planning and delivery. (CO5, L3)

Q.3 Short Answer Questions(Attempt Any Five) (5 × 3 = 15 Marks)

a. Explain Total Skin Electron Therapy (TSET). (CO1, L3)

b. Applications of Intraoperative Radiotherapy (IORT). (CO3, L2)

c. Explain working of CyberKnife. (CO2, L3)

d. Define image registration. (CO1, L1)

e. What is a Bragg Peak? (CO3, L1)

f. Define radiomics. (CO4, L1)

g. Define hypofractionation. (CO1, L1)

h. Define artificial intelligence in radiotherapy. (CO5, L2)

Model Paper

B.RTT Semester-VI

Code: BRTT-029

Bachelor of Radiation Therapy Technology (B.RTT)

Semester VI

Radiological / Nuclear Medicine /

Other Imaging Techniques in Radiotherapy Planning

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain the role of 2D, 3D and functional imaging modalities in radiotherapy planning. (CO1, L3)

B. Discuss ICRU 50 delineation with suitable examples. (CO2, L3)

C. Explain image fusion, bony matching and soft tissue matching techniques used in modern radiotherapy planning. (CO3, CO4, L4)

Q.2 Short Essay Questions (Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain the applications of radiography and fluoroscopy in radiotherapy planning. (CO1, L3)

b) Discuss the role of CT imaging in treatment planning. (CO1, L3)

c) Explain MRI and its advantages in tumour delineation. (CO1, L3)

d) Describe PET and SPECT imaging in oncology. (CO1, L3)

e) Explain Gross Tumour Volume (GTV) and Clinical Target Volume (CTV). (CO2, L3)

f) Discuss Planning Target Volume (PTV) and Organs at Risk (OAR). (CO2, L3)

g) Explain image fusion procedures at treatment consoles. (CO4, L4)

h) Discuss 4D treatment planning and its significance. (CO5, L5)

i) Explain IMRT and IGRT planning concepts. (CO5, L5)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Discuss the role of imaging biomarkers in treatment assessment. (CO3, L3)

b. Define CT simulation. (CO1, L1)

c. Define standardized uptake value (SUV). (CO3, L1)

d. Explain clinical applications of Mammography in oncology. (CO2, L2)

e. Explain the role of Ultrasound in cancer diagnosis. (CO2, L2)

f. Expand the applications of functional imaging in oncology. (CO3, L2)

g. What is significance of contrast-enhanced imaging in tumour visualization. (CO1, L2)

h. Define standardized uptake value (SUV). (CO3, L1)

Model Paper

B.RTT Semester-VI

Code: BRTT-030

Bachelor of Radiation Therapy Technology (B.RTT)

Semester VI

Radiotherapy Treatment Delivery

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain Orthovoltage, Superficial and Megavoltage radiotherapy techniques with their clinical applications. (CO1, L3)

B. Discuss brachytherapy and stereotactic radiotherapy techniques used in modern cancer treatment. (CO2, CO3, L4)

C. Explain Total Body Irradiation (TBI), Total Skin Electron Irradiation (TSEI), proton therapy and heavy ion therapy. (CO5, L5)

Q.2 Short Essay Questions(Attempt Any Seven) (7 × 5 = 35 Marks)

a) Explain principles of superficial radiotherapy. (CO1, L3)

b) Discuss orthovoltage radiotherapy and its indications. (CO1, L3)

c) Explain megavoltage treatment techniques. (CO1, L3)

d) Describe HDR brachytherapy treatment delivery. (CO2, L3)

e) Discuss Stereotactic Radiosurgery (SRS). (CO2, L3)

f) Explain Stereotactic Body Radiotherapy (SBRT). (CO2, L3)

g) Discuss cranial and extracranial stereotactic treatments. (CO3, L4)

h) Explain neutron therapy and proton therapy. (CO4, L4)

i) Discuss advantages and limitations of heavy ion therapy. (CO5, L2)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define orthovoltage therapy. (CO1, L3)

b. What is megavoltage therapy? (CO1, L3)

c. Define brachytherapy. (CO2, L3)

d. Expand SRS. (CO2, L3)

e. Expand SBRT. (CO2, L3)

f. What is TBI? (CO5, L1)

g. Define TSEI. (CO5, L2)

h. What is proton therapy? (CO4, L3)

Model Paper

B.RTT Semester-VI

Code: BRTT-031

Bachelor of Radiation Therapy Technology (B.RTT)

Semester VI

Operational Issues in Radiation Therapy

Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Attempt Any Two) (2 × 10 = 20 Marks)

A. Explain patient positioning, immobilization and treatment setup procedures used in radiation therapy. (CO1, L3)

B. Discuss treatment verification procedures and quality control measures used during radiotherapy delivery. (CO2, CO4, L4)

C. Explain operational issues in radiotherapy departments including accreditation, CQI and network information systems. (CO5, L3)

Q.2 Short Essay Questions(Attempt Any Seven) (7 × 5 = 35 Marks)

a) Discuss patient setup verification procedures. (CO1, L3)

b) Explain immobilization techniques used during treatment delivery. (CO1, L3)

c) Describe treatment parameters used in external beam radiotherapy. (CO2, L3)

d) Explain treatment verification in brachytherapy. (CO2, L3)

e) Discuss factors affecting treatment reproducibility. (CO3, L2)

f) Explain analysis of setup deviations and corrective actions. (CO4, L3)

g) Discuss Continuous Quality Improvement (CQI) in radiation oncology. (CO5, L2)

h) Explain accreditation standards in radiotherapy departments. (CO5, L5)

i) Describe the role of network information systems in radiation oncology. (CO5, L3)

Q.3 Short Answer Questions (Attempt Any Five) (5 × 3 = 15 Marks)

a. Define immobilization. (CO1, L3)

b. What is treatment verification? (CO2, L3)

c. Define setup error. (CO3, L4)

d. What is reproducibility? (CO3, L4)

e. Expand CQI. (CO5, L3)

f. What is accreditation? (CO5, L3)

g. Define quality control. (CO4, L4)

h. What is a network information system? (CO5, L2)

Principal
MG Institute of Allied Health Sciences
Jaipur