सत्यमेव जयते

National Commission for Allied and Healthcare Professions

COMPETENCY BASED CURRICULUM

for

"RADIOTHERAPY TECHNOLOGY"

As per the NCAHP Act -2021

NAGALAND UNIVERSITY
Regulation and Syllabus for
Bachelor of Radiotherapy Technology (BRTT)
(3+1 years) Degree Course

2026

Regulations for the Allied Health Sciences Bachelor Programs of the Nagaland University

The Regulations & syllabus are subject to modifications by the University from time to time

.

1. Eligibility for Admission:

(i) The candidate should have passed the Higher Secondary (10+2) from CBSE or State Education Board or any Govt. recognized Board with at least 50% marks for general candidates (UR) and 45% for SC/ST/OBC/NCL candidates in Physics, Chemistry, and Biology.

(ii) For B.Sc. (Health Information Management) course, candidates with Physics, Chemistry, and Mathematics in 10+2 may also be considered.

(iii) The candidate should have attained the minimum age of 17 years during the admission.

(iv) **Lateral Entry:**
Candidates who have completed a two-year diploma programme in the concerned subject from Boards recognized by Central / State Government(s) / State / Central University with at least 50% marks in aggregate for (UR) candidates and 45% marks in aggregate for SC / ST / OBC / NCL candidates shall be eligible for Lateral Entry to the second year (3rd Semester) of Bachelor Programme in Allied Health Sciences.

2. Duration of the Course:

(i) Group A: 4 years, i.e., 3 years or 6 semesters of academic studies and one year of internship (BHIM, B.Sc. AOTT, BRTT, BSc. MRIT).
Group B: 4 and a half years, i.e., 4 years or 8 semesters of academic studies and six months of internship (BPT, BOT courses).
Group C: 4 years, i.e., 3 and a half year or 7 Semesters of academic studies and six months of internship (BMLS) during the 8th semester.

(ii) The maximum duration of the Bachelor Programme for Group A, B & C above shall be N+2 where N is the normal duration of the programme. No student shall be allowed to continue beyond the maximum duration.

3. Medium of Instruction:

The medium of instruction for all the Allied Health Sciences courses shall be English.

4. Working Days Per Semester:

Each Semester consists of 90 working days, with eight hours of work per day and 40 hours per week, totalling 720 hours per Semester.

5. Internship Hours:

One-year Internship programs will include 1440 hours of practical training and Six Months Internship will include 720 hours of practical training.

6. Attendance:

(i) A candidate must secure a minimum of 80% attendance in theory classes. Students who fail to meet the requirement due to illness may be eligible for a 5% condonation, provided they submit a medical certificate from a registered medical practitioner.

(ii) 100% in skills training (practical/internship) to qualify for the award of degree. In case of insufficient attendance, the candidate's internship period will be extended accordingly. There are no other exceptions to these rules under any circumstances.

7. Submission of Log Books:

a) At the time of practical examination, each candidate shall submit to the examiners his / her Log book duly certified by the Head of the Department as a bonafide record of the work done by the candidate.

b) The practical record shall be evaluated by the concerned Head of the Department (Internal Evaluator) and the practical record marks shall be submitted to the University 15 days prior to the commencement of the theory Examinations.

c) In respect of failed candidates, the marks awarded for record at previous examination will be carried over for the subsequent examination. The candidates shall have the option to improve his performance by submission of fresh records.

8. Revaluation / Scrutiny of Answer Papers:

(i) There is no provision for candidate to request for revaluation of the answer papers of failed candidates in any examination. However, the failed candidates can apply for scrutiny.

(ii) Nagaland University shall constitute a Result Moderation Committee of 3 members.

9. Pattern of Question Paper for University Examination:

Descriptive type Questions	=30%
Descriptive Short Notes	=30%
Short Answer questions	=20%
MCQ Type	=20%

10. Assessment:

(i) Assessment for theory and practical examinations: - Students must attain at least 50% marks in each theory and practical component, both in internal assessments and in the final University examinations to pass the course. The final marks will be 75% from the University examination and 25% will be from the internal assessment.

(ii) The distribution of marks between theory and practical shall be provided in the **Curriculum and Syllabi** of each course.

(iii) Assessment for internship: - During the internship, students gain clinical experience and learn to document patient care effectively. Each student must maintain a logbook and a portfolio.

Activity	Marks %	Assessor
Log book	20	Supervisor
Portfolio*	20	Supervisor
Practical	40	Examiners
Viva voice	20	Examiners

*The portfolio provides one with an opportunity to demonstrate the breadth and depth of your knowledge on certain topics
The portfolio incorporates the follow documents:

- Curriculum vitae
- Progress reports
- "Summary of Competency Achievement" demonstrating the level of competency achieved in each sub-module.
- Samples of work prepared by the intern from at least 5 of the modules of internship training guide.
-

A presentation delivered covering key aspects of the module

The clinical supervisor will examine the portfolio at regular (at least once in three months) intervals and provide feedback to the Intern.

(iv) Mode of Evaluation: -
Evaluation for Theory papers during Odd End Semester Examination shall be internally done by the colleges and Theory papers during Even End Semester Examinations shall be externally evaluated or as notified by the University

11. Internship Project:

As part of the internship, students are required to choose a relevant subject and prepare an in-depth project report, which should include the objective, scope of the project, and a detailed report.

12. Advancement to the Next Semester:

Advancement to the next semester is contingent upon meeting the following conditions and clearing any backlogs as described: -
A student may not fail in more than two papers in the preceding semester to be eligible to advance to the next semester.

13. Repeat examination for failed candidates:

Failed papers in odd semesters can be repeated during the exams of the subsequent odd semester. Similarly, failed papers in even semesters exams can be repeated during the subsequent even semester exams.

14. Vacation:

Maximum of 15 days including Saturdays and Sundays

15. Re-Admission after Break of Study:

Students shall be allowed to continue after break in studies provided the maximum duration as given in Clause- 2 (ii) is not exceeded.

16. Award of the Degree:

a. Candidates who have passed all written examinations and successfully completed the compulsory internship as per the university's requirements will be awarded the degree.
b. Final Consolidated Mark sheet shall be issued by the Nagaland University to the candidate after submission of his/her Internship Completion Certificate by the College.

17. Academic Calendar:

a. Odd semester shall be from July to December, and Even semester shall be from January to June.
b. The odd semester and even semester university (end) examinations shall be conducted in the months of December and June respectively.

XXXXXXX

A LIST OF ESSENTIAL AND RECOMMENDED BOOKS FOR STUDENTS OF RADIATION THERAPY TECHNOLOGY:

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

2. Physiology and Pathology:

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

3. Hospital Administration:

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

4. Radiation Oncology:

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

5. Radiotherapy techniques:

   (i) Treatment Planning in Radiation Oncology by F.M. Khan
   (ii) Washington & Leaver's Principles and Practice of Radiation Therapy
   (iii) Radiation Therapy Planning - Gunilla Bentel
   (iv) The Physics & Technology of Radiation Therapy - McDermott and Orton
   (v)Practical Radiotherapy Planning 3rd and 4th edition by Jane Dobbs
   (vi) Clinical Target Volumes in Conformal and Intensity Modulated Radiation Therapy by Gregoire, Scalliet , Ang by Springer Publications
   (vii) Radiotherapy Treatment Planning – Richard F Mould

6. Imaging in Oncology

   (i) Radiology Fundamentals, Introduction to Imaging and technology by Harjit Singh published by Springer
   (ii) Oncologic Imaging by Bragg, Rubin, Hrisack W.B. Saunders Publication
   (iii) Basics of PET Imaging by Gopal. B. Saha Springer publications

(iv) Essentials of Radiographic Physics and Imaging by James Johnston and Terry Fauber
(v) Bushong, S.C., Radiological Sciences for Technologists, Mosby Elsevier (2009).
(vi) Diagnostic Radiology Physics Handbook for Teachers and Students by IAEA

7. Radiation Physics and Dosimetry

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

8. Radiation Protection:

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

Bachelor of Radiotherapy Technology (BRTT)

Semester Wise Distribution of Subjects
Total Credits= 125; Total Marks=6200

Semester	Code	Subject	Credits				Internal	
			Theory	Practical	Total		Theory	Practical
1st semester	BRTT-001	Introduction to Healthcare Delivery System in India	3	0	3		30	0
	BRTT-002	Basic computers and information Science	1	1	2		30	30
	BRTT-003	Communication and soft skills	1	0	0		30	30
	BRTT-004	Medical Terminology and Record keeping (including anatomical terms)	2	0	2		30	0
	BRTT-005	Medical Law and Ethics	2	0	2		30	0
	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)	2	2	4		30	30
	BRTT-007	Professionalism and values	1	0	1		30	0
	BRTT-008	Biostatistics and introduction to research methodology	2	0.5	2.5		30	30
	BRTT009	Principals of Management	2	0	2		30	0
	BRTT010	Community orientation and clinical visit (including related practical to course 001)	0	3	3		**0**	0
			Total		**21.5**			

Semester	Code	Subject	Credit			Marks					Total Hours	
			Theory	Practical	Total	Internal		Semester		**Grand Total**	Theory	Practical
						Theory	Practical	Theory	Practical			
2nd semester	BRTT-011	Elementary Mathematics and Physics	2	0	2	30	30	70	70	200	30	10
	BRTT-012	Human Anatomy and Physiology	3	2	5	30	30	70	70	200	60	60
	BRTT-013	Radiographic Anatomy	1	1	2	30	30	70	70	200	20	40
	BRTT-014	Oncology Science- I	3	0.5	3.5	30	30	70	70	200	60	20
	BRTT-015	Principles of radiotherapy and radiotherapy techniques	2	0.5	2.5	30	30	70	70	200	40	20
	BRTT-016	Radiation Quantities, Units and Detection/Measurement	1	0.5	1.5	30	30	70	70	200	20	20
		RTT Directed Clinical Education – part I (studentship)	0	4	4	0	0	0	100	100	-	140
			Total		**20.5**					**1300**	230	310

Semester	Code	Subject	Credit			Marks					Total Hours	
			Theory	Practical	Total	Internal		Semester		**Grand Total**	Theory	Practical
						Theory	Practical	Theory	Practical			
3rd semester	BRTT-017	Basic Radiation Physics	3	1	4	30	30	70	70	200	60	40
	BRTT-018	Oncology Science-II	2	0.5	2.5	30	30	70	70	200	40	20
	BRTT-019	Radiotherapy Equipment –I	2	1	3	30	30	70	70	200	50	50
	BRTT-020	Radiation Safety	2	1	3	30	30	70	70	200	40	40
	BRTT-021	Patient care, positioning and immobilization	2	0.5	2.5	30	30	70	70	200	40	20
		RTT Directed Clinical Education – part II (studentship)	0	4	4	0	0	0	100	100	-	140
			Total		**19**					**1100**	230	310

Semester	Code	Subject	Credit			Marks					Total Hours	
			Theory	Practical	Total	Internal		Semester		**Grand Total**	Theory	Practical
						Theory	Practical	Theory	Practical			
4th semester	BRTT-022	Radiotherapy Equipment –II	2	2	4	30	30	70	70	200	40	60
	BRTT-023	Quality Assurance in Radiotherapy-I	2	1	3	30	30	70	70	200	30	50
	BRTT-024	Basic Radiotherapy Physics	2	1	3	30	30	70	70	200	40	25
	BRTT-025	Biological Effects of Radiation	1	0	1	30	30	70	70	200	10	5
		RTT Directed Clinical Education – part III (studentship)	0	8	8	0	0	0	100	100	-	280
			Total		**19**					**900**	120	420

Semester	Code	Subject	Credit			Marks					Total Hours	
			Theory	Practical	Total	Internal		Semester		Grand Total	Theory	Practical
						Theory	Practical	Theory	Practical			
5th semester	BRTT-026	Clinical Radiobiology	2	1	3	30	30	70	70	200	40	40
	BRTT-027	Mould Room /Motion Management Techniques	2	2	4	30	30	70	70	200	30	60
	BRTT-028	Special RT Techniques and Recent advances	1	1	1	30	30	70	70	200	20	50
		RTT Directed Clinical Education – part IV (studentship)	0	8	8	0	0	0	100	100	-	300
			Total		**16**					**700**	90	450

Semester	Code	Subject	Credit			Marks					Total Hours	
			Theory	Practical	Total	Internal		Semester		Total	Theory	Practical
						Theory	Practical	Theory	Practical			
6th Semester	BRTT-029	Radiological/Nuclear Medicine/Other Imaging Techniques in Radiotherapy Planning	1	2	3	30	30	70	70	200	20	60
	BRTT-030	Radiotherapy treatment delivery	1	2	3	30	30	70	70	200	20	60
	BRTT-031	Operational Issues in Radiation Therapy	1	2	3	30	30	70	70	200	20	60
		RTT Directed Clinical Education – part V (studentship)	0	8	8	0	0	0	100	100	-	300
			Total		**17**					**700**	60	480
4th YEAR	Internship/Externship	12-month compulsory rotational clinical posting Project submission Mid-term assessment Final Practical & Viva			**12**					**100**		**1440**

Except for the 6th semester papers, the rest of the practical Exam could be spotters and viva.

INTERNSHIP – Minimum 1440 hours (calculated based on 8 hours per day, if 180 working days in one-year span)

BRTT-001: Introduction to Healthcare Delivery System in India

BRTT-002: Basic Computers and Information Science

BRTT-003: Communication and Soft Skills

BRTT-004 Medical Terminology and Record keeping (including anatomical terms)

BRTT-005 Medical Law and Ethics

BRTT-006 Introduction to Quality and Patient safety

BRTT-007 Professionalism and values

BRTT-008 Biostatistics and introduction to research methodology

BRTT-009 Principals of Management

BRTT-010 Community orientation and clinical visit

BRTT -011 Elementary Mathematics and Physics

BRTT -012 Human Anatomy and Physiology

BRTT -013 Radiographic Anatomy

BRTT -014 Oncology Science

BRTT -015 Principles of radiotherapy and radiotherapy techniques

BRTT -016 Radiation Quantities, Units and Detection/Measurement

BRTT -017 Basic Radiation Physics

BRTT -018 Oncology Science-II

BRTT -019 Radiotherapy Equipment –I

BRTT -020 Radiation Safety

BRTT -021 Patient care, positioning and immobilization

BRTT -022 Radiotherapy Equipment –II

BRTT -023 Quality Assurance in Radiotherapy-I

BRTT -024 Basic Radiotherapy Physics

BRTT -025 Biological Effects of Radiation

BRTT -026 Clinical Radiobiology

BRTT -027 Mould Room /Motion Management Techniques

BRTT -028 Special RT Techniques and Recent advances

BRTT -029 Radiological/Nuclear Medicine/Other Imaging Techniques in Radiotherapy Planning

BRTT -030 Radiotherapy treatment delivery

BRTT -031 Operational Issues in Radiation Therapy

DETAIL SYLLABUS FOR
BACHELOR OF RADIOTHERAPY TECHNOLOGY (BRTT) COURSE

SEMESTER-1: 21.5 CREDITS

BRTT-001: Introduction to Healthcare Delivery System in India

SUBJECT DESCRIPTION: 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:

UNIT I: INTRODUCTION TO HEALTHCARE DELIVERY SYSTEM
Healthcare delivery system in India at primary, secondary and tertiary care, Community participation in healthcare delivery system, Health system in developed countries, Private Sector, National Health Mission, National Health Policy, Issues in Health Care Delivery System in India.

UNIT 2: NATIONAL HEALTH PROGRAMME
Background objectives, action plan, targets, operations, achievements and constraints in various National Heath Programme.

UNIT 3: **INTRODUCTION TO AYUSH SYSTEM OF MEDICINE**
Introduction to Ayurveda, Yoga and Naturopathy, Unani, Siddha, Homeopathy, Need for integration of various system of medicine.

UNIT 4: HEALTH SCENARIO OF INDIA-
Past, Present and Future

UNIT 5: DEMOGRAPHY & VITAL STATISTICS
Demography – its concept, Vital events of life & its impact on demography, Significance and recording of vital statistics, Census & its impact on health policy.

UNIT 6: EPIDEMIOLOGY
Principles of Epidemiology**,** Natural History of disease**,** Methods of Epidemiological studies**,** Epidemiology of communicable & non-communicable diseases, disease transmission, host defence immunizing agents, cold chain, immunization, disease monitoring and surveillance.

BRTT-002: Basic Computers and Information Science

SUBJECT DESCRIPTION: 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:

UNIT 1: INTRODUCTION TO COMPUTER

Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.

UNIT 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).

UNIT 3: PROCESSOR AND MEMORY

The Central Processing Unit (CPU), main memory.

UNIT 4: STORAGE DEVICES

Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.

UNIT 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.).

UNIT 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.

UNIT 7: INTRODUCTION TO EXCEL

Introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.

UNIT 8: INTRODUCTION TO POWER-POINT

Introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.

UNIT 9: INTRODUCTION OF OPERATING SYSTEM

Introduction, operating system concepts, types of operating system.

UNIT 10: COMPUTER NETWORKS

Introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.

UNIT 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.

UNIT 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

References:

- Computer Fundamentals: Pearl Software
- Fundamentals of Computers: E. Balagurusamy
- Basic of Compuer and information technology

BRTT-003: Communication and Soft Skills

The following topics to be covered under communication and soft skills are as follows:

UNIT 1: **BASIC LANGUAGE SKILLS**
Grammar and Usage.

UNIT 2: BUSINESS COMMUNICATION SKILLS.
With focus on speaking - Conversations, discussions, dialogues, short presentations, pronunciation.

UNIT 3: TEACHING THE DIFFERENT METHODS OF WRITING
Letters, E-mails, report, case study, collecting the patient data etc. Basic compositions, journals, with a focus on paragraph form and organization.

UNIT 4: BASIC CONCEPTS & PRINCIPLES OF GOOD COMMUNICATION
Definition and meaning of communication, Objectives and importance of communication. Elements/components of communication (sender, message, channel, receiver, feedback, noise). Characteristics of effective communication. Principles of good communication (clarity, conciseness, correctness, completeness, consideration, courtesy, concreteness). Verbal and non-verbal communication basics. Role of listening in communication. Importance of feedback in effective communication.

UNIT 5: SPECIAL CHARACTERISTICS OF HEALTH COMMUNICATION
Meaning and purpose of health communication, Importance of communication in health education and promotion, Unique features of health communication (credibility, cultural sensitivity, simplicity, accuracy, relevance), Role of media and technology in health communication, Target audience and message design in health programs.

Ethical and social considerations in health communication. Community participation and behavioural change communication (BCC). Examples of successful health communication campaigns.

UNIT 6: TYPES & PROCESS OF COMMUNICATION

Types of communication: Based on direction (one-way, two-way), Based on channel (verbal, non-verbal, written, visual), Based on organizational structure (formal, informal), Based on purpose (internal, external).
The communication process (steps/stages),
Communication models (Shannon-Weaver, Berlo's SMCR, Schramm's model, etc.)
Role of encoding, decoding, and feedback, Factors influencing the communication process, Importance of the communication environment.

UNIT 7: BARRIERS OF COMMUNICATION & HOW TO OVERCOME

Meaning of communication barriers, Types of barriers: Physical barriers, Psychological barriers, Language barriers, Cultural barriers, Organizational barriers, Physiological barriers. Effects of communication barriers, Strategies to overcome barriers: Active listening, Clarity and simplicity in language, Empathy and cultural awareness, Use of feedback, Improving organizational communication channels, Role of technology in overcoming communication barriers.

References:

a. Manipal Academy of higher education; English book for Nurse by Selva Rose, 3rd Edition
b. Selva Rose. 1997, Career English for Nurses. Published by: Orient Blackswan Ltd
c. Quirk Randolph and Greenbaum Sidney, 1987. A University Grammar of English, Hong Kong: Longman group (FE) Ltd/ Pearson.
d. Thomson A.J. and Maituiet A.V. 1987, A Practical English Grammar, Delhi: Oxford University Press.
e. Gimson A.C.1989, An Introduction to pronunciation of English. Hodder Arnold; 4th Revised edition (1 May 1989).
f. O'Connor J.D, 1986. Better English pronunciation
g. Quirk Randolph and Greenbaum Sidney, 1987. A University Grammar of English, Hong Kong: Longman group (FE) Ltd/ Pearson.

BRTT-004 Medical Terminology and Record Keeping (including anatomical terms)

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

UNIT 1: DERIVATION OF MEDICAL TERMS

Introduction to medical terminology, Historical background of medical terms (Greek and Latin origins), Importance of word derivation in healthcare communication, Common Greek and Latin roots used in medical terms.

UNIT 2: DEFINE WORD ROOTS, PREFIXES, AND SUFFIXES

Definition and function of word roots, Common medical word roots and their meanings (e.g., *cardi*, *derm*, *neur*), Definition and role of prefixes, Common prefixes and their meanings (e.g., *hyper-*, *hypo-*, *brady-*, *tachy-*), Definition and role of suffixes, Common suffixes and their meanings (e.g., *-itis*, *-ology*, *-ectomy*, *-algia*).

UNIT 3: CONVENTIONS FOR COMBINED MORPHEMES AND THE FORMATION OF PLURALS

Definition of morphemes and combining forms, Rules for combining multiple roots, Guidelines for spelling and pronunciation in medical terms, Formation of plurals in medical terminology (e.g., *bacterium → bacteria*, *diagnosis → diagnoses*), Common irregular plural forms in medical terms, Practice exercises for combining forms and pluralization.

UNIT 4: BASIC MEDICAL TERMS

Introduction to commonly used medical terms, Terms related to body systems (skeletal, muscular, circulatory, respiratory, digestive, etc.), Terms for body directions and positions (anterior, posterior, medial, lateral, etc.), Terms for body planes and cavities, Basic clinical terms (symptom, diagnosis, therapy, prognosis, etc.), Common prefixes and suffixes used in body system terminology, Practical examples of medical terms used in documentation.

UNIT 5: FORM MEDICAL TERMS UTILIZING ROOTS, SUFFIXES, PREFIXES, AND COMBINING ROOTS

Rules for constructing medical terms, combining forms in word building, Examples of word construction (e.g., *cardiology = cardi + o + logy*), Understanding compound medical terms, Practical applications in clinical documentation.

UNIT 6: INTERPRET BASIC MEDICAL ABBREVIATIONS/SYMBOLS

Introduction to medical abbreviations and symbols, Importance of standard abbreviations in healthcare communication, Common abbreviations for: Vital signs (BP, HR, RR, T), Diagnostic tests (CBC, ECG, MRI), Treatment and medication (IV, IM, PO, qid, bid), Common symbols used in medical practice, Dangers of misinterpreting abbreviations, Guidelines for correct and safe use of abbreviations, Review of standard abbreviations from approved lists (e.g., WHO, Joint Commission).

UNIT 7: UTILIZE DIAGNOSTIC, SURGICAL, AND PROCEDURAL TERMS AND ABBREVIATIONS

Terms and abbreviation related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.

UNIT 8: INTERPRET MEDICAL ORDERS/REPORTS

Definition and importance of medical orders and reports, Types of medical orders: Physician's orders, Nursing orders, Laboratory and diagnostic test orders, Medication orders. Components of a medical order (patient details, date/time, medication, dosage, route, frequency, signature). Understanding and interpreting common medical abbreviations and symbols used in orders, Reading and interpreting laboratory and diagnostic reports, Legal and ethical aspects of handling medical orders and reports, Verbal vs. written orders — procedures and precautions, Documentation and record-keeping standards, Role of accuracy and clarity in interpreting medical documents, Case examples and practice exercises for interpreting reports.

UNIT 9: DATA ENTRY AND MANAGEMENT ON ELECTRONIC HEALTH RECORD SYSTEM

Introduction to Electronic Health Records (EHR), Difference between paper-based and electronic records, Components and structure of an EHR system, Types of data entered in EHR (demographics, medical history, diagnostics, treatment plans, etc.), Steps and guidelines for accurate data entry, Data validation, editing, and updating processes, Confidentiality, privacy, and data security in EHR systems (HIPAA compliance, access control), Common software used in healthcare data management, Advantages and challenges of using HER, Role of healthcare professionals in maintaining data accuracy and integrity, Backup and recovery procedures for EHR data, Future trends in electronic health record management.

BRTT-005 Medical Law and Ethics

SUBJECT DESCRIPTION: 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:

UNIT 1: MEDICAL ETHICS

Introduction to Medical Ethics, Principles of Medical Ethics (The Four Pillars of ethics), Code of Conduct and Professionalism, Patient Rights and Responsibilities, Ethical Issues in Clinical Practice, Confidentiality and Informed Consent, Research Ethics, Ethical Decision-Making and Dilemmas, Legal and Cultural Dimensions of Medical Ethics.

UNIT 2: INTRODUCTION TO CODE OF CONDUCT

Definition and purpose of a professional code of conduct, Importance of ethical behavior in healthcare settings, Key principles of the healthcare code of conduct (honesty, integrity, respect, accountability), Role of professional bodies in establishing codes of conduct (e.g., WHO, medical councils), Rights and responsibilities of healthcare professionals, Confidentiality and privacy in patient care, Professional boundaries and interpersonal relationships, Consequences of breaching the code of conduct.

UNIT 3: BASIC PRINCIPLES OF MEDICAL ETHICS

Definition and importance of medical ethics, Historical background and evolution of medical ethics (e.g., Hippocratic Oath), The four basic principles of medical ethics: Autonomy (respect for patient's decision), Beneficence (acting in the patient's best interest), non-maleficence (do no harm), Justice (fairness and equality in treatment).
Confidentiality and informed consent, Ethical decision-making in clinical practice, Patient rights and professional duties, Handling ethical dilemmas in healthcare settings, Role of ethics committees in hospitals.

UNIT 4: MALPRACTICE AND NEGLIGENCE

Definition of malpractice and negligence, Difference between negligence, malpractice, and misconduct, Essential elements of medical negligence (duty, breach, causation, damage), Common examples of medical negligence, Legal implications and professional accountability. Patient rights in cases of malpractice. Role of documentation in preventing negligence claims. Defensive medicine and its ethical implications, Reporting and managing medical errors. Case studies on medical negligence.

UNIT 5: AUTONOMY AND INFORMED CONSENT

Definition and importance of autonomy in medical ethics, Respect for patient autonomy and decision-making rights, Definition and components of informed consent, Conditions for valid consent (voluntariness, information, competence, understanding), Types of consent (written, verbal, implied, proxy), Informed refusal and patient's right to decline treatment, Ethical and legal issues in consent, Consent in special situations (minors, unconscious patients, mentally incapacitated individuals), Role of communication in ensuring informed consent.

UNIT 6: CARE OF THE TERMINALLY ILL

Definition of terminal illness, Ethical principles in end-of-life care, Palliative care: meaning, goals, and importance. Pain and symptom management in terminally ill patients, Do Not Resuscitate (DNR) orders and advance directives, Hospice care and patient dignity, Role of healthcare professionals in emotional and spiritual support, Ethical dilemmas in life-sustaining treatment, Euthansia, Communication with terminally ill patients and families.

UNIT 7: ORGAN TRANSPLANTATION

Introduction to organ transplantation, Types of organ donation (living, deceased, cadaveric), Ethical principles in organ donation and transplantation, Criteria for brain death and organ retrieval, Consent for organ donation — opt-in vs. opt-out systems, Role of transplant coordinators and ethics committees, Legal regulations governing organ transplantation, Ethical issues: commercialization, coercion, and black-market concerns.

UNIT 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 and other various aspects.

UNIT 9: PROFESSIONAL INDEMNITY INSURANCE POLICY

Definition and meaning of professional indemnity insurance, Importance and purpose of indemnity insurance in healthcare, Scope of coverage — what it protects against, Key features and clauses of a professional indemnity policy, Legal background and regulatory requirements.

UNIT 10: DEVELOPMENT OF STANDARDIZED PROTOCOL TO AVOID NEAR MISS OR SENTINEL EVENTS

Definition of near miss and sentinel events, Importance of standardized protocols in patient safety, Components of an effective patient safety protocol, Role of reporting systems and incident analysis, Root cause analysis (RCA) and failure mode effect analysis (FMEA), Development and implementation of safety checklists (e.g., surgical safety checklist), Team communication and coordination to prevent errors, Continuous monitoring, evaluation, and staff training for safety improvement.

UNIT 11: OBTAINING AN INFORMED CONSENT

Definition and purpose of informed consent, Ethical and legal basis of consent in medical practice, Essential elements of informed consent, Types of consent (written, verbal, implied, proxy, blanket), Process of obtaining informed consent — step-by-step procedure, Special considerations: minors, mentally incapacitated, unconscious patients, Documentation and record-keeping of consent, Consequences of failure to obtain valid consent, Cultural and language barriers in informed consent, Role of healthcare professionals in ensuring ethical, clear, and compassionate communication.

References:

a) Principles of Bioethics: Tom Beauchamp & Childress

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)

SUBJECT DESCRIPTION: The objective of the course is to help students understand the basic concepts of quality in healthcare and develop skills to implement sustainable quality assurance program in the health system. The students are also expected to learn about basic emergency care including first aid and triage. 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. The aim of the bio medical waste management and environment safety section is to prevent harm to workers, property, the environment and the general public. And also understand 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 and finally understand the principles of on-site disaster management. Topics to be covered under the subject are as follows:

UNIT 1: QUALITY ASSURANCE AND MANAGEMENT

Concepts of Quality of Care, Quality Improvement Approaches, Standards and Norms, Quality Improvement Tools, Introduction to NABH guidelines.

UNIT 2: BASICS OF EMERGENCY CARE AND LIFE SUPPORT SKILLS –

Basic life support (BLS); sudden cardiac arrest (SCA)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.

Vital signs and primary assessment, basic emergency care – first aid and triage, ventilations including use of bag-valve-masks (BVMs), choking, rescue breathing methods, one- and Two-rescuer CPR, using an AED (Automated external defibrillator), managing an emergency including moving a patient.

UNIT 3: BIO MEDICAL WASTE MANAGEMENT AND ENVIRONMENT SAFETY

Definition of Biomedical Waste, Waste minimization, BMW – Segregation, collection, transportation, treatment and disposal (including colour coding), Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste, BMW Management & methods of disinfection, Modern technology for handling BMW, Use of Personal protective equipment (PPE), Monitoring & controlling of cross infection (Protective devices).

UNIT 4: INFECTION PREVENTION AND CONTROL

Evidence-based infection control principles and practices [such as sterilization, disinfection, effective hand hygiene and use of Personal protective equipment (PPE)], Prevention & control of common healthcare associated infections, components of an effective infection control program, and guidelines (NABH and JCI) for Hospital Infection Control.

UNIT 5: ANTIBIOTIC RESISTANCE

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

UNIT 6: DISASTER PREPAREDNESS AND MANAGEMENT
Fundamentals of emergency management, psychological impact management, Resource management, Preparedness and risk reduction, Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and institutional mechanisms.

BRTT-007 Professionalism and values

SUBJECT DESCRIPTION: The module on professionalism will deliver the concept of what it means to be a professional and how a specialized profession is different from a usual vocation. It also explains how relevant is professionalism in terms of healthcare system and how it affects the overall patient environment. Topics to be covered under the subjects are as follows:

UNIT 1: PROFESSIONAL VALUES
Integrity, Objectivity, Professional competence and due care, Confidentiality.

UNIT 2: PERSONAL VALUES
Ethical or moral values

UNIT 3: ATTITUDE AND BEHAVIOUR
Professional behaviour, treating people equally

UNIT 4: CODE OF CONDUCT, PROFESSIONAL ACCOUNTABILITY AND RESPONSIBILITY, MISCONDUCT

UNIT 5: DIFFERENCES BETWEEN PROFESSIONS AND IMPORTANCE OF TEAM EFFORTS

UNIT 6: CULTURAL ISSUES IN THE HEALTHCARE ENVIRONMENT

BRTT-008 Biostatistics and introduction to research methodology

SUBJECT DESCRIPTION: 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. The topics to be covered under this subject are as follows:

UNIT 1: INTRODUCTION TO RESEARCH METHODS
Definition and purpose of research, Importance of research in health sciences, Characteristics and objectives of research, Types of research (basic, applied, clinical, qualitative, quantitative, etc.), Steps in the research process, Role of research in evidence-based practice, Limitations and challenges in conducting research, Overview of research terminology (hypothesis, variable, data etc)

UNIT 2: IDENTIFYING RESEARCH PROBLEM
Introduction and meaning of research problem; identifying and formulating a research problem; research objectives, questions and hypotheses; and assessing feasibility and relevance of the problem

UNIT 3: ETHICAL ISSUES IN RESEARCH
Meaning and importance of research ethics, Principles of ethical research (autonomy, beneficence, non-maleficence, justice), Informed consent, Confidentiality and data protection, Rights and responsibilities of researchers and participants, and research misconduct (plagiarism, falsification, fabrication).

UNIT 4: RESEARCH DESIGN
Introduction and definition of research design; types of research design - descriptive, analytical, experimental, quasi-experimental, and observational; cross-sectional, cohort, and case-control studies; selection of appropriate research design for a given problem.

UNIT 5: BASIC CONCEPTS OF BIOSTATISTICS
Definition and role of biostatistics in research; common statistical terms and symbols; descriptive statistics - mean, median, mode, range, standard deviation; inferential statistics - concept and purpose; introduction to probability and normal distribution; application of statistics in healthcare and public health research.

UNIT 6: TYPES OF DATA
Definition and importance of data in research; types of data - primary and secondary, qualitative and quantitative, discrete and continuous; scales of measurement - nominal, ordinal, interval, and ratio; classification and tabulation of data; presentation of data using tables, charts, and graphs

UNIT 7: RESEARCH TOOLS AND DATA COLLECTION METHODS
Introduction to data collection; sources of data - primary and secondary; types of research tools - questionnaires, checklists, interview schedules, and observation forms; Characteristics of a good data collection tool (validity, reliability, simplicity), methods of data collection - interview, questionnaire, and observation; procedure of data collection; pilot study

UNIT 8: SAMPLING METHODS

Definition and importance of sampling; population and sample; types of sampling - probability and non-probability; basic idea of sample size determination; common problems in sampling and ways to avoid them**.**

UNIT 9: DEVELOPING A RESEARCH PROPOSAL

Definition and purpose of a research proposal; steps in developing a proposal; basic structure and format of a proposal; common mistakes in proposal writing; presentation and submission of the proposal**.**

References:

(a) Croxton – elementary statistics

(b) Biostatistics: Basic Concepts and Methodology for the Health Sciences- Wayne W. Daniel, Chad L. Cross

(c) Introduction to Biostatistics and Research Methods Fifth Edition- P.S.S. Sundar Rao, J. Richard

(d) Mahajan's Methods in Biostatistics for Medical Students and Research Workers-Bratati Banerjee

BRTT-009 Principals of Management

SUBJECT DESCRIPTION: The course is intended to provide a knowledge about the basic principles of Management. The topics under this subject are as follows:

UNIT 1: INTRODUCTION TO MANAGEMENT

Definition, nature, and scope of management, Importance and functions of management, Levels of management — top, middle, and lower, Managerial roles and skills (Mintzberg's classification), Evolution of management thought: classical, behavioural and modern approaches, Management vs. administration, Principles of management (Fayol, Taylor, etc.), The management process: planning, organizing, leading, controlling, social responsibility and ethics in management.

UNIT 2: STRATEGIC MANAGEMENT

Definition and importance of strategic management, Levels of strategy: corporate, business, and functional, Strategic management process — formulation, implementation, evaluation, Vision, mission, goals, and objectives, SWOT analysis (Strengths, Weaknesses, Opportunities, Threats), Environmental scanning (internal and external factors), Competitive advantage and core competencies, Strategy evaluation and control.

UNIT 3: FOUNDATIONS OF PLANNING

Meaning, nature, and importance of planning, Types of plans — strategic, tactical, operational, contingency, Steps in the planning process, Characteristics of good planning, Barriers to effective planning and how to overcome them, Planning premises and assumptions, Integration of planning with other management functions, The role of forecasting in planning.

UNIT 4: PLANNING TOOLS AND TECHNIQUES

Overview of planning tools and their importance, Quantitative and qualitative tools, Management by Objectives (MBO), Gantt charts and project scheduling tools, PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method), Budgeting and forecasting techniques, Break-even analysis, Benchmarking and performance measurement, Decision tree analysis and simulation methods.

UNIT 5: DECISION MAKING, CONFLICT AND STRESS MANAGEMENT

Definition and importance of decision making, Types of decisions — programmed and non-programmed, Decision-making process and models (rational, bounded rationality, intuitive), Group vs. individual decision-making, Nature and types of conflict (intrapersonal, interpersonal, organizational), Conflict resolution techniques and negotiation skills, Concept of stress and its causes in the workplace.

UNIT 6: MANAGING CHANGE AND INNOVATION

Concept and importance of organizational change, Types and sources of change (planned, unplanned, internal, external), Models of change management (Lewin's, Kotter's 8-Step Model), Resistance to change — causes and management, Role of leadership in change implementation, Innovation — definition, types, and process, Fostering a culture of creativity and innovation, Relationship between change, innovation, and organizational growth.

UNIT 7: UNDERSTANDING GROUPS AND TEAMS

Definition and importance of groups and teams in organizations, Types of groups — formal and informal, Stages of team development (forming, storming, norming, performing, adjourning), Characteristics of effective teams, Group dynamics and cohesiveness, Roles and norms in group behaviour, Communication and coordination within teams, managing team conflicts and promoting collaboration.

UNIT 8: LEADERSHIP

Definition and importance of leadership in management, Leadership vs. management, Theories of leadership (Trait theory, Behavioural theory, Contingency theory, Transformational and transactional leadership), Leadership styles (autocratic, democratic, laissez-faire), Role of emotional intelligence in leadership, Ethical leadership and values-based management, Developing leadership skills in organizations.

UNIT 9: TIME MANAGEMENT

Definition and importance of time management, Common time-wasters and how to eliminate them, Time management tools and techniques (to-do lists, prioritization, delegation), The Eisenhower Matrix (urgent vs. important tasks), Goal setting and scheduling, Managing deadlines and multitasking, Work-life balance strategies, Role of discipline and self-management in effective time use.

UNIT 10: COST AND EFFICIENCY

Definition and significance of cost management, Types of costs (fixed, variable, direct, indirect), Cost control vs. cost reduction, Budgeting and financial planning, Productivity and efficiency — concepts and relationship, Methods to improve operational efficiency, Performance indicators (KPI) and cost-effectiveness analysis, Resource optimization and waste reduction, Continuous improvement and quality management (Kaizen, Lean principles).

BRTT-010 Community orientation and clinical visit

(including related practical to course 001)

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

OBJECTIVES:

1. The community orientation and clinical visit will include visit to the entire chain of healthcare delivery system -Sub centre, PHC, CHC, SDH, DH and Medical college, private hospitals, dispensaries and clinics.

2. Governance at village level including interaction and group discussion with village panchayat and front-line health workers.

3. Clinical visit to their respective professional department within the hospital.

SEMESTER -2: 20.5 credits

BRTT -011 Elementary Mathematics and Physics

SUBJECT DESCRIPTION: 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.

UNIT 1: ELEMENTARY MATHEMATICS

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

UNIT 2: BASIC PHYSICS, ELECTROSTATICS, MAGNETISM & CURRENT ELECTRICITY

Units & Dimension, Newton's Laws of Motion, Velocity & Speed, Force, Momentum etc. 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. Instruments: Electrometer, Galvanometer, Ammeter, & Voltmeter.

UNIT 3: RECTIFICATION AND TRANSFORMERS

Principle of rectification, wave form of half wave and full wave current/voltage wave form; Rectifiers: Introduction, energy bands in solids, the semiconductor, p-type and n-type semiconductors, density of charge carriers and conductivity, p-n junction, p-n junction diode, p-n junction diode as rectifier (half- wave and full-wave rectifier), rectifiers relative merits and demerits; silicon, germanium diodes. Principles of transformer, Electromagnetic induction, transformer design, efficiency of transformer, source of power loss.

BRTT -012 Human Anatomy and Physiology

SUBJECT DESCRIPTION: 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.

UNIT 1: STRUCTURE AND FUNCTION OF CELL
Cell division; tissue: definition and classification.

UNIT 2: GENERAL ANATOMICAL TERMS AND TOPOGRAPHY OF THE BODY
Planes regions, positions, movements.

UNIT 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.

UNIT 4: MUSCLES
Classification, structure and function.

UNIT 5: BRAIN & SPINAL CORD
Brain and spinal cord with its coverings and cavities including cerebrospinal fluids and pituitary gland (Macroscopic anatomy and surface anatomy only)

UNIT 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).

UNIT 7: THORAX
Structure of Thoracic cage, Oesophagus, Trachea, Lungs & Pleura, The Mediastinum including Thymus, Heart and Great Vessels and Diaphragm (Macroscopic and Surface Anatomy)

UNIT 8: ABDOMEN
Structure of Abdomen & Peritoneum, Retro Peritoneal structures (including Kidney), Stomach, Small Intestine, Colon, Liver, Pancreas, Spleen (Macroscopic and Surface Anatomy)

UNIT 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)

UNIT 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.

UNIT 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

UNIT 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.

UNIT 13: THE SKIN
Structure and functions.

UNIT 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.

UNIT 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.

UNIT 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.

UNIT 17: ENDOCRINE SYSTEM
Short description of various endocrine glands and their functions.

UNIT 18: REPRODUCTIVE SYSTEM
Male and female reproductive system, Histology of Gonads, ovarian cycle and ovulation, Fertilization, Fertility control.

References:

a. Textbook of Physiology by A.K. Jain
b. Textbook of Physiology by Chaudhuri Sujit K
c. Ghai's textbook of practical physiology by VP Varshney & Mona Bedi

BRTT -013 Radiographic Anatomy

SUBJECT DESCRIPTION: This subject will provide the understanding of the body's normal internal structures as they appear on radiographic images, such as X-rays, CT scans, and MRIs as well the interpretations of these imaging.

UNIT 1: INTRODUCTION

Difference between gross anatomy and radiographic anatomy, Role of radiographic anatomy in medical imaging and diagnosis, Basic principles of X-ray image formation, Terminology used in radiographic positioning and anatomy, Anatomical planes, body positions, and movements. Identification of normal anatomical landmarks on radiographs.
Standard view of radiographs, Types of Radiographs, X-ray appearance of normal skeleton.

UNIT 2: SKELETAL SYSTEMS

Bones of the upper limb — shoulder girdle, arm, forearm, and hand, Standard radiographic projections (AP, lateral, oblique), Radiographic appearance of the clavicle, scapula, humerus, radius, ulna, and hand bones, Joints — shoulder, elbow, wrist, Common radiographic landmarks and positioning errors, Interpretation of normal vs. abnormal findings.

Bones of the lower limb — pelvis, femur, tibia, fibula, foot, Standard radiographic projections (AP, lateral, oblique), Radiographic anatomy of the hip, knee, and ankle joints, Anatomical landmarks for positioning, Radiographic appearance of soft tissues and bone density, Normal vs. pathological variations.

Anatomy of the vertebral column — cervical, thoracic, lumbar, sacral regions, Standard projections for each spinal region, Identification of normal vertebral alignment and curvatures, Radiographic features of intervertebral spaces and spinous processes, Differences between cervical, thoracic, and lumbar vertebrae on X-ray, Common pathologies (scoliosis, spondylosis, fractures)

Bones of the skull — cranial and facial bones, Standard radiographic projections (PA, lateral, Towne's, Waters', Caldwell's views), Identification of key anatomical landmarks — sella turcica, sinuses, orbits, mastoid, Radiographic anatomy of paranasal sinuses and mandible, Differences between adult and pediatric skull radiographs, Common abnormalities (fractures, sinusitis, bone lesions).

UNIT 3: CIRCULATORY SYSTEM

Chest – PA view, oblique view, Overview of CT angiogram.

UNIT 4: RESPIRATORY SYSTEM

Anatomy of the thoracic cage — ribs, sternum, and vertebrae, Anatomy of the lungs, heart, and mediastinum, Chest radiography — PA, AP, and lateral views, Identification of normal chest radiograph structures (diaphragm, hilum, costophrenic angles), Differences between adult and pediatric chest radiographs, Common radiographic abnormalities (e.g., consolidation, pneumothorax, effusion)

UNIT 5: DIGESTIVE SYSTEM

Anatomical structures visible in abdominal radiographs, Organs — liver, spleen, kidneys, bladder, intestines, Bony landmarks — lumbar vertebrae, pelvis, sacrum, Normal gas patterns and soft tissue shadows, Radiographic positions (supine, erect, decubitus), Interpretation of abdominal X-rays — normal vs. pathological findings Barium swallow, barium meal, barium enema, cholecystogram.

UNIT 6: URINARY SYSTEM

Radiographic anatomy of the urinary tract (IVU, KUB), X-ray KUB, IVP

UNIT 7: REPRODUCTIVE SYSTEM

Hysterosalpingogram

UNIT 8: PERIPHERAL NERVOUS SYSTEM

X-ray skull

UNIT 9: CROSS-SECTIONAL RADIOGRAPHIC ANATOMY

Introduction to cross-sectional anatomy, Comparison between radiographic, CT, and MRI anatomy, Identification of axial, coronal, and sagittal planes, Cross-sectional anatomy of the brain, thorax, abdomen, and pelvis, Importance of recognizing normal structures in advanced imaging, Clinical correlation — using CT/MRI for diagnostic interpretation.

BRTT -014 Oncology Science

SUBJECT DESCRIPTION: 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.

UNIT 1: INTRODUCTION:

Basic functioning of various organ systems, central of vital functions, path physiological alternation in diseased states, interpretation of symptoms & sign in relation to path physiology. Pathological changes in various organs associated with tumors. Scope of radiotherapy, growth, the cell, Reproduction of cell, tumors, benign and malignant, cause of cancer, spread of cancer in the body, Lymphatic, Metastasis, other uses of Radiotherapy, Biopsy purpose and method.

UNIT 2: PATHOLOGY

General pathology of tumours, Therapeutic intervention, possible distinction between different types of tumors, grading immunological effects & genetic alterations - various microorganisms - their pathogenic potential, important organism commonly seen - levels of therapeutic interventions possible in preventing and /or eradicating organism. Volume doubling times, potential volume doubling times, repopulation, and accelerated repopulation

UNIT 3: MALIGNANCIES

Local and general effects of tumours and its spread, Basic pathology Carcinoma, Sarcoma & Lymphoma - Pattern of Spread, Biopsy/Investigations related to malignant tumor staging work up and TNM. Introduction of different malignant tumor treated in radiotherapy department including TNM Skin – lip- oral cavity & Paranasal sinus Nasopharynx-orophaynx-hypopharynx-larynx-thyroid-postcricoid—oesophagus mediastinum- lungs-pancreas-liver-breast-cervix-body of the Uterus-vagina-vulva-kidney, ureter, bladder, rectum prostate, penis, testis proreticulum tissue- bone marrow - CNS, eye, orbit- soft tissue & bone - pediatric tumors, retinoblastoma, Wilms tumor, rhabdomyosarcoma.

UNIT 4: CARCINOGENESIS

Definition and concept of carcinogenesis, Multistage process of cancer development (initiation, promotion, progression), Types of carcinogens (physical, chemical, biological), Mechanisms of carcinogenesis, Oncogenes and tumor suppressor genes, Role of mutations and DNA repair mechanisms, Epigenetic changes in carcinogenesis, Hormonal and viral carcinogenesis, Environmental and occupational factors in cancer development, Molecular pathways involved in cancer progression.

UNIT 5: CO-MORBIDITIES

Definition and significance of co-morbidities in cancer patients, Common co-morbid conditions (diabetes, hypertension, cardiovascular disease, COPD), Impact of co-morbidities on cancer treatment and prognosis, Assessment tools for co-morbidity evaluation (Charlson Index, etc.), Management strategies for co-existing diseases during cancer therapy, Palliative considerations in patients with multiple conditions, Role of multidisciplinary care in managing co-morbidities.

UNIT 6: ETIOLOGY AND EPIDEMIOLOGY

Definition of etiology and epidemiology in oncology, Determinants of cancer — genetic, environmental, lifestyle factors, Patterns and trends in global and national cancer incidence, Risk factors for major cancers (lung, breast, colorectal, cervical, prostate), Methods of epidemiological studies — descriptive, analytical, experimental, Cancer registries and data collection methods, Role of screening and surveillance in cancer control, Interpretation of cancer statistics (incidence, prevalence, mortality, survival rates).

UNIT 7: GENETICS

Role of genetics in cancer development, Inherited vs. acquired mutations, Genetic syndromes associated with cancer (BRCA, Lynch, Li-Fraumeni, etc.), Mechanisms of gene mutations and chromosomal abnormalities, Genetic testing and counseling in oncology, Oncogenes, tumor suppressor genes, and DNA repair genes, Epigenetic regulation and gene expression in cancer, Ethical considerations in genetic screening for cancer.

UNIT 8: PREVENTION

Levels of cancer prevention — primary, secondary, tertiary, Lifestyle modifications for cancer prevention (diet, exercise, avoiding tobacco/alcohol), Vaccination in cancer prevention (HPV, Hepatitis B), Occupational and environmental exposure control, Role of health education and policy in prevention, Screening programs and preventive health check-ups, Role of healthcare professionals in promoting prevention awareness.

UNIT 9: EARLY DETECTION

Importance of early detection in improving prognosis, Screening vs. diagnostic testing, Common screening methods for major cancers (Pap smear, mammography, colonoscopy, PSA, LDCT), Criteria for an effective screening program, Role of biomarkers in early detection, Community-based cancer screening initiatives, Barriers to early detection and strategies to overcome them.

UNIT 10: SIGNS AND SYMPTOMS

General warning signs of cancer (CAUTION mnemonic), Local and systemic manifestations of cancer, Signs and symptoms specific to major cancers (breast, lung, colorectal, cervical, prostate, etc.), Paraneoplastic syndromes, Diagnostic approach to suspected cancer patients, Importance of history-taking and physical examination, Differentiating benign from malignant symptoms.

UNIT 11: PUBLIC AWARENESS ON EARLY SIGNS AND SYMPTOMS

Importance of public education in cancer control, Strategies for community awareness and health promotion, Role of mass media and social media in cancer awareness, School and workplace awareness programs, Collaboration with NGOs and government health agencies, Use of IEC (Information, Education, Communication) materials, Evaluating the impact of awareness campaigns on early detection.

UNIT 12: HIGH RISK GROUPS

Definition of high-risk groups for cancer, Genetic predisposition and family history,Occupational and environmental exposure risks. Age, gender, and lifestyle risk factors, Immunocompromised individuals and cancer risk, Screening guidelines for high-risk populations, Targeted prevention and surveillance strategies.

BRTT -015 Principles of radiotherapy and radiotherapy techniques

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

UNIT 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

UNIT 2: APPLICATION OF RADIOTHERAPY IN BENIGN CONDITIONS
Definition and scope of benign radiotherapy, Rationale for using radiotherapy in non-malignant diseases, Radiobiological basis (anti-proliferative, anti-inflammatory effects), Dose–response relationship and tissue tolerance, Fractionation principles for benign diseases, Risk–benefit assessment and justification of treatment, ALARA principle and radiation protection considerations, Common Benign Conditions Treated with Radiotherapy, particle therapy in treatment of benign tumours.

UNIT 3: APPLICATION OF RADIOTHERAPY IN MALIGNANT CONDITION
Radiobiological basis (cell kill mechanisms, 4 Rs of radiobiology), Tumor dose–response relationship, Fractionation principles in malignant diseases, Tumor control probability (TCP) and normal tissue complication probability (NTCP), Radiosensitivity and radioresistance of different tumors, Types of Radiotherapy, Applications in Major Cancer Sites, Principles and indications, Typical dose schedules.

UNIT 4: SINGLE AND MULTIPLE FIELD TECHNIQUES FOR ALL TREATMENT SITES (FROM HEAD TO FEET) WITH APPROPRIATE IMMOBILIZING DEVICE(S).

UNIT 5: FIX, ROTATION, ARC AND SKIP THERAPY PROCEDURES.

UNIT 6: USE OF RUBBER TRACTION, POP, ORFIT, BODY FRAME IN TREATMENT TECHNIQUE.

UNIT 7: EVALUATION OF PATIENT SETUP FOR SIMPLE TECHNIQUES.
Use of imaging such as electronic portal imaging device (EPID), cone beam CT (CBCT) and optical imaging (surface guidance technique)

UNIT 8: USE OF BEAM MODIFYING DEVICES
Use of modifying devices such as wedges, tissue compensators, mid line block (MLB) in the treatment of respective sites- Customized shielding blocks and its properties, asymmetric jaws, motorized wedges.

UNIT 9: SIMULATION PROCEDURES INCLUDING CT SIMULATION

BRTT -016 Radiation Quantities, Units and Detection/Measurement

SUBJECT DESCRIPTION: In this paper the students will learn about the various radiation quantities, their measuring units and various types of survey meters/dosimeters. The topics to be covered under this topic are as follows:

UNIT 1: RADIOACTIVITY,

Natural and Artificial Radioactivity, Isotope, Isobar and Isotone, Alpha Decay Beta Decay and Spectra, Gamma Emission, Positron Decay, Electron Capture and Internal Conversion, Exponential Decay. Half-Life. Activity, Curie, Becquerel Specific Activity.

Radiation Sources Natural and Artificial Production of Radio Isotopes Nuclear Fission, Nuclear Reactor, Reactor Produced Isotopes, Fission Products Gamma Ray Source for Medical Uses.

UNIT 2: RADIATION QUANTITIES AND UNITS

Photons, Flux, Fluence, Exposure- Roentgen, Absorbed Dose, rad, Gray, Roentgen to rad conversion, Equivalent Dose, Flux-Fluence-absorbed does and KERMA, exposure rate constant, Gamma ray constant, measurement of exposure, free air chamber, thimble chamber, Weighting Factors, Effective Dose, Natural Background Radiation, Occupational Exposure Limits, Dose limits to Public.

UNIT 3: DETECTION AND MEASUREMENT OF RADIATION

Ionisation of gases, Fluorescence and phosphorescence, Effect on photographic emulsion, Ionisation chambers, Proportional Counters, G.M. Counters, Scintillation Detectors, Liquid scintillator, Pocket Dosimeters, TL Dosimeters and their use in personnel monitoring badges. Advantages and disadvantages of various detectors, appropriateness of different types of detectors for different types of radiation measurement.

RTT Directed Clinical Education – part I (studentship)

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

SEMESTER 3:19 credits

BRTT -017 Basic Radiation Physics

The topics to be covered under this subject are as follows:

UNIT 1: Atomic Structure, Nucleus, Atomic No., Mass No., Electron orbit and energy levels, Isotopes and isobars, Radioactivity, Radioactive decay, Half-life, Particle radiation, Electromagnetic Radiation, Production of X-rays, Continuous X-ray spectrum, Bremsstrahlung radiation Characteristic X-rays, Filters, Quality of X-rays, Effect of voltage and current on the intensity of X-rays, Properties of X-rays.

UNIT 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.

References:

a) The physics of radiation therapy, Faiz M. Khan, 5th edition (2014), Lippincott, Williams and Wilkins, USA.
b) Christensen's Physics of Diagnostic Radiology – Christensen & Christense
c) Fundamental of Xray Fundamental of Xray and Radium Physics Joseph
d) Basic Medical Radiation Physics – Stanton
e) Physics for Radiography - Hay and Hughs
f) Ball and mores essential physics radiographers, IV edition, Blackwell publishing.
g) Basic Medical Radiation physics – Stanton.
h) Christensen's Physics of Diagnostic Radiology – Christensen

BRTT -018 Oncology Science-II

SUBJECT DESCRIPTION: 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.

UNIT 1: CLINICAL EXAMINATION

UNIT 2: BIOPSY

UNIT 3: LABORATORY TESTS

UNIT 4: IMAGING METHODS

Radiological diagnostic procedures, X-ray, ultrasound, CT scan, MRI, Mammogram- Radio nuclide investigation Tumor localization & check film and application of simulation in radiotherapy

UNIT 5: STAGING AND GRADING

UNIT 6: TNM STAGING SYSTEM, OTHER COMMONLY USED SYSTEMS

Purpose and importance of tumor staging, TNM classification system — tumor size (T), lymph node involvement (N), metastasis (M), Other staging systems (FIGO, Ann Arbor, Duke's, etc.), Grading vs. staging — differences and relevance, Methods used in staging — imaging, biopsy, surgical findings, Clinical, pathological, and radiological staging. Impact of staging on prognosis and treatment planning.

UNIT 7: TREATMENT INTENT- RADICAL, ADJUVANT, PALLIATIVE

UNIT 8: NON-MALIGNANT DISEASES

BENIGN DISEASES Radiotherapy in non-malignant diseases Application of radiotherapy in malignant condition.

UNIT 9: PRIMARY MANAGEMENT OF MALIGNANCY

UNIT 10: PERFORMANCE STATUS

BRTT -019 Radiotherapy Equipment –I

SUBJECT DESCRIPTION: 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.

UNIT 1: HISTORICAL

Kilo voltage Unit, Grenz Ray Therapy, contact therapy, superficial therapy, Deep Therapy, Megavoltage therapy. Van de Graff generator

UNIT 2: BRACHYTHERAPY

Design features, Radiation sources, Technique, High dose-rate (HDR), Low dose-rate (LDR), Pulsed dose-rate (PDR), various types of applicators. Brachytherapy source and their properties, Methods of brachytherapy – Interstitial, Intra luminal, intra cavitary and mould, permanent implant brachytherapy.

UNIT 3: TELETHERAPY MACHINES & ACCESSORIES

Telecobalt Machines, Medical linear accelerators, Tomotherapy, Machine properties Beam directing, modifying and defining devices, other accessories. Electron Accelerator - Betatron, microtron, Cyclotron, Physical components of Linear accelerator, detailed description of modern, dual mode linear accelerator, head and its constituents, safety mechanisms, computer controlled linear accelerators, record and verify systems, accuracy of mechanical or digital readout for gantry, couch, and collimator rotation. Beam symmetry, jaw symmetry, uniformity checks, field flatness, wedges, physical and virtual wedges (dynamic and motorized), mechanical safety, collision devices check.

References:

a) The physics of radiology by H.E. Johns and Cunningham

b) The Modern Technology of Radiation Oncology (vol 1-4), A Compendium for Medical Physicists and Radiation Oncologists Editor: Jacob Van Dyk: Publisher: Medical Physics Publishing Madison, Wisconsin.

BRTT -020 Radiation Safety

SUBJECT DESCRIPTION: 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.

UNIT 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.

UNIT 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.

UNIT 3: REGULATORY REQUIREMENTS

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

UNIT 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.

References:

a) Textbook of Radiological Safety by K Thayalan
b) AERB safety code of practice

BRTT -021 Patient care, positioning and immobilization

SUBJECT DESCRIPTION: 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.

UNIT 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.

UNIT 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.).

UNIT 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.

UNIT 4: PRINCIPLES OF POSITIONING AND IMMOBILIZATION

Positioning aids- Breast boards, Lung boards, Belly boards, Head-and neck fixation devices, Vacuum packs, Stereotactic systems. Internal organ motion control- Bite blocks, Gating systems, Active breathing control, Diaphragm compression, Prostate immobilization, Tracking systems, Laser/ positioning systems. Marking systems, Isocentre determination, Reference points, Treatment couch, Image acquisition for planning (and/or verification), Modalities for image acquisition for planning, Simulation- Conventional Simulation, CT Simulation, Virtual Simulation, Image processing and archiving, Treatment verification, 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.

References:

a) Principles of Hospital Practice and Patient Care by P Srinivasulu Reddy, Paras Medical Books Pvt Ltd
b) Textbook of nursing foundation -I Clement
c) Principles and practice of nursing –Sr Nancy. Vol 1&2
d) The physics of radiation therapy, Faiz M. Khan, 5th edition (2014), Lippincott, Williams and Wilkins, USA.

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 4: 19credits

BRTT -022 Radiotherapy Equipment –II

SUBJECT DESCRIPTION: 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:

UNIT 1: Familiarization with treatment planning systems: External beam planning and brachytherapy

UNIT 2: Various types of phantoms including the water-phantoms, RFA

UNIT 3: Various types of dosimeters including in-vivo dosimeters

UNIT 4: EPID and other on-board imaging systems

UNIT 5: Record and Verify Systems, Oncology Information Systems, Image/Patient data archiving, storage and transfer.

UNIT 6: CT Simulator

UNIT 7: Beam Modifying and Shaping Devices:
Wedge filters and their use, wedge angle, Wedge Factors, Wedge systems, Wedge Isodose curves Bolus, Build-up material, Compensators, Merits and Demerits.- Shielding of dose limiting tissue: Non-divergent and Divergent beam blocks, - Multileaf collimators, Merits and Demerits.

References:

a) The physics of radiology by H.E. Johns and Cunningham
b) The Modern Technology of Radiation Oncology (vol 1-4), A Compendium for Medical Physicists and Radiation Oncologists Editor: Jacob Van Dyk : Publisher: Medical Physics Publishing Madison, Wisconsin

BRTT -023 Quality Assurance in Radiotherapy-I

SUBJECT DESCRIPTION: Quality assurance (QA) refers to the systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled. It is the systematic measurement, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention and provides accuracy of treatment. The following topics will be covered:

UNIT 1: ACCESSORIES AND TOOLS USED FOR QA TESTS IN RADIOTHERAPY
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.

BRTT -024 Basic Radiotherapy Physics

The following topics are to covered under basic radiotherapy physics:

UNIT 1: 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.

UNIT 2: CONVENTIONAL TREATMENT PLANNING CONCEPT:
Physics of Bolus & Phantom material • Isodose Curves, Comparison of isodose curves, measurement of isodose curve ,factors affecting the isodose distribution, isodose curves for wedge fields , compensating filters ,Shielding Blocks, Patient immobilization devices, Port film, Processing and development, Dose calculations with isodose curves and wedge fields , Isodose curves for electron beam, computerized Treatment planning system (TPS) , Tissue compensation ,Field blocks ,field shaping , Independent jaws ,Asymmetric fields , multileaf collimator, separation and gap calculation of adjacent fields. • Electron contamination, penumbra Beam directional devices - front and back pointer, pin and arc• lasers, their application in radiotherapy.

UNIT 3: TEST CASES:
Periodic checks of decay correction of output, repetition of quality assurance tests after software up gradation, speed of processor. Measurement of entry and exit doses, doses to critical organs.

UNIT 4: BODY INHOMOGENITIES:
Effects of patient contour, Bone, Lung cavities, Prosthesis on dose distribution. Dose within bone/lung cavities, Interface effects, Electronic disequilibrium

BRTT -025 Biological Effects of Radiation

The following topics are to covered under biological effects of radiation:

UNIT 1: 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.

References:

a) Radiobiology for the Radiologist 8th Edition by Eric J Hall
b) Handbook of Radiobiology 1st Edition by K. Thayalan
c) Radiation Biology for Medical Physicists, By C. S. Sureka, Christina Armpilia

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 5: 16 credit

BRTT -026 Clinical Radiobiology

SUBJECT DESCRIPTION: 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.

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

BRTT -027 Mould Room /Motion Management Techniques

SUBJECT DESCRIPTION: 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:

UNIT 1: Historical evolution of the mould materials and techniques to make moulds
Construction of casts, Construction of applicator and moulds, Construction of shields
UNIT 2: Thermoplastic moulds
UNIT 3: Breath hold, motion reduction, tracking and gating techniques

BRTT -028 Special RT Techniques and Recent advances

The following topics are to be covered under this subject:

UNIT 1: Wedges-tissue compensator-irregular field-SSD&SAD technique-oblique field arcrotational and moving field

UNIT 2: Mantle field-irregular field-Hemi body irradiation-whole body irradiation-total body skin irradiation

UNIT 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.

UNIT 4: Conformal Radiotherapy
Principles of 3 D treatment.

UNIT 5: Recent developments in radiotherapy and treatment techniques

UNIT 6: Proton therapy and carbon ion therapy

UNIT 7: Artificial intelligence

Reference:

a) The physics of radiology by H.E. Johns and Cunningham
b) The Modern Technology of Radiation Oncology (vol 1-4), A Compendium for Medical Physicists and Radiation Oncologists Editor: Jacob Van Dyk : Publisher: Medical Physics Publishing Madison, Wisconsin.
b) Johns and Cunningham's the Physics of Radiology
c) The physics of radiation therapy, Faiz M. Khan, 5th edition (2014), Lippincott,Williams and Wilkins,USA.

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 6: 17 credits

BRTT -029 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.

UNIT 1: 2D (radiography, fluoroscopic, USG), 3D (CT, MRI) and functional (PET/SPECT) imaging and their application in radiotherapy planning.

UNIT 2: Gross Tumour Volume (GTV), Clinical Target Volume (CTV),
Internal Target Volume (ITV), Planning Target Volume (PTV), Organs at Risk (OAR) delineation.

UNIT 3: Image fusion at the treatment machine console.

UNIT 4: Bony matching.

UNIT 5: Soft tissue matching for estimating the preliminary data for applying shifts.

UNIT 6: Prepare documentation.

UNIT 7: The RTT should understand the principles of: Four-dimensional (4D) planning and be familiarized with IMRT and IGRT planning.

BRTT -030 Radiotherapy treatment delivery

SUBJECT DESCRIPTION: 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.

UNIT 1: ORTHOVOLTAGE / SUPERFICIAL

UNIT 2: SUPERVOLTAGE / MEGAVOLTAGE

UNIT 3: BRACHYTHERAPY

UNIT 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.

BRTT -031 Operational Issues in Radiation Therapy

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

RTT Directed Clinical Education – part V (studentship)

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

RTT INTERNSHIP/EXTERNSHIP

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

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

.