

# Bachelor of Science in Radiotherapy Technology (BSc RTT)

## Semester Wise Distribution of Subjects

**Total Credits= 120; Total Marks=3600.**

Semester	Code	Subject	Credits		Total	MARKS					Total Hours	
			Theory	Practical		Internal (60)		Semester (140)		Total	Theory	Practical
					Theory	Practical	Theory	Practical				
<b>1st Semester</b>	BSc RTT -101	Human Anatomy	4	1	5	40	20	100	40	200	64	32
	BSc RTT -102	Human Physiology	4	1	5	40	20	100	40	200	64	32
	BSc RTT -103	English, Computer, Ethics and Medical terminology	4	1	5	40	20	100	40	200	64	32
	BSc RTT -104	Biostatistics /sociology	2	3	5	30	30	70	70	200	32	96
		<b>Total</b>			<b>20</b>					<b>800</b>	<b>224</b>	<b>192</b>
<b>2nd Semester</b>	BSc RTT -201	Basic radiological physics	3	3	6	40	20	100	40	200	48	96
	BSc RTT -202	Physics of Radiographic equipment	3	3	6	40	20	100	40	200	48	96
	BSc RTT -203	Hospital practice and patient care	5	3	8	40	20	100	40	200	80	96
			<b>Total</b>			<b>20</b>					<b>600</b>	<b>176</b>
<b>3rd</b>	BSc RTT -301	Physics of Radiotherapy and Radiotherapy equipment (Part 1)	3	3	6	40	20	100	40	200	48	96
	BSc RTT -302	Tumor Pathology	3	3	6	40	20	100	40	200	48	96
	BSc RTT -303	Patient care in radiotherapy	5	3	8	40	20	100	40	200	80	96
			<b>Total</b>			<b>20</b>					<b>600</b>	<b>176</b>

Semester	Code	Subject	Credits		Total	MARKS					Total Hours	
			Theor y	Practical		Internal (60)		Semester (140)		Total	Theory	Practical
					Theory	Practical	Theory	Practical				
<b>4th Semester</b>	BSc RTT -401	Immobilization and planning	3	3	6	40	20	100	40	200	48	96
	BSc RTT -402	Physics of Radiotherapy and Radiotherapy equipment (Part 2)	3	3	6	40	20	100	40	200	48	96
	BSc RTT -403	Conventional Radiotherapy technique	5	3	8	40	20	100	40	200	80	96
			<b>Total</b>			<b>20</b>					<b>600</b>	<b>176</b>
<b>5th Semester</b>	BSc RTT -501	Basic Radiobiology	3	3	6	40	20	100	40	200	48	96
	BSc RTT -502	Radiation safety	3	3	6	40	20	100	40	200	48	96
	BSc RTT -503	Physics of Special techniques in radiotherapy and related equipment	5	3	8	40	20	100	40	200	80	96
			<b>Total</b>			<b>20</b>					<b>600</b>	<b>176</b>

<b>6th Semester</b>	BSc RTT -601	Advanced Radiotherapy technique	4	2	6	40	20	100	40	200	64	64
	BSc RTT -602	QA in Radiotherapy	4	1	5	40	20	100	40	200	64	32
	BSc RTT -603	Radiotherapy and physics practical	-	9	9	-	60	-	140	200		288
			Total		20					600	128	384

Course Titles	Hours			Weekly class hours
	Theory	Practical	Total	
Internships		1920 (minimum)	1920	NA
Total			1920	

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

**INTERNSHIP – Minimum 1920 hours (calculated based on 8 hours per day, if 240 working days in one year span)**

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THE NAGALAND UNIVERSITY REGULATIONS FOR  
**BACHELOR OF SCIENCE IN RADIOTHERAPY TECHNOLOGY  
(BSc RTT)**

(Regulations of the University)

**1. SHORT TITLE AND COMMENCEMENT:**

These regulations shall be called “**THE REGULATIONS FOR THE BACHELOR OF SCIENCE IN RADIOTHERAPY TECHNOLOGY (BSc RTT) OF THE NAGALAND UNIVERSITY,**”

**Proposed academic year 2022 onwards.**

(The regulation and syllabi are subject to modifications by the standing Academic Board from time to time.)

**2. ELIGIBILITY FOR ADMISSION**

- (a) Candidates should have successfully completed Higher Secondary (10+2 level) with science subjects
- (b) Physics, Chemistry and Biology subjects taken together at the qualifying examination after a period of 12 years of study
- (c) Candidates should have passed the above examination with a minimum of 40% marks in each subject separately including English
- (d) A candidate shall, at the time of admission, submit to the Head of the Institution, a certificate of medical fitness from an authorized Medical Officer certifying that the candidate is physically fit to undergo the academic course and does not suffer from any disability or contagious disease.

**3. AGE LIMIT FOR ADMISSION:**

- (a) Applicants should have completed 17 years and be less than 30 years of age as on July 31<sup>st</sup>
- (b) Those “in Service” would be eligible for a special consideration for relaxation of the age requirement

#### **4. ELIGIBILITY CERTIFICATE:**

The candidates who have passed any qualifying examination other than the Higher Secondary course examination conducted by the Government of Nagaland shall obtain an eligibility certificate from the University by remitting the prescribed fees along with the filled in application form, Mark Sheet, Transfer Certificate, and other relevant documents required by the University before seeking admission to the affiliated Institution (s).

#### **5. REGISTRATION:**

A candidate admitted to the Bachelor of Science in Radiotherapy Technology degree course in any one of the affiliated Institution (s) of this University shall register his / her name in the prescribed application form for registration duly filled along with the prescribed fee and a declaration in the format, (as in Annexure) to the Controller of Examination of this University through the affiliated Institution within 60 days from the Cut-off date prescribed for Bachelor of Science in Radiotherapy Technology Course for admission.

#### **6. DURATION OF THE COURSE:**

3 Years (6 semesters) + 1 year Rotatory Internship (Compulsory)

#### **7. COMMENCEMENT OF THE COURSE:**

The course shall commence ordinarily from 1<sup>st</sup> October of the academic year.

#### **8. EXAMINATION, EVALUATION AND DECLARATION OF RESULTS**

a) **Conduct of Examinations:** University shall conduct **II, IV, & VI** end-semester examinations and the remaining shall be conducted by the respective College (s). For all the end-semester examinations, questions papers shall be prepared by the University.

b) **Examination routine** for end-semester examinations shall be notified by the University which shall be normally of **3** hours duration.

c) **Student Assessment and Progression:** The performance of a student shall be evaluated on a **30: 70** basis *i.e.*, **30** marks for internal assessment and **70** marks for end-semester examinations.

d) **Pass Marks:** A student shall have to secure a minimum of **45%** marks in the internal assessment (IA), and **45% marks** in the end-semester examinations in theory papers with a minimum of **50% of** the total aggregate (IA + end semester exam). However, in the event of a semester with practical paper, a student shall have to secure a minimum of **55%** marks to be considered passed in a given semester.

e) **Activities for Internal Assessment**

##### **Tests:**

(i) The internal assessment for **30** marks shall be made in the following categories of activities

which will include both theory and practical:

(a) *Class Tests/Unit Tests*, (b) *Assignments*, (c) *Seminars*, (d) *Case Studies*

- i. A minimum of two written internal assessment examinations shall be conducted in each subject during a semester and the average marks of two examinations shall be taken into consideration for the award of internal marks.
  - ii. A minimum of two practical examinations shall be conducted in each subject (wherever practical have been included in the curriculum) and the average marks of these two examinations shall be taken into consideration for award of internal marks in practical.
  - iii. The internal assessment should necessarily be completed before the conduct of the end-semester examinations.
- f) **Eligibility criteria for End-Semester Examinations:** A student shall be deemed qualified to appear at the end-semester examinations only if he/she secures **minimum qualifying marks** in the **Internal Assessment Tests** and maintains **80% attendance separately** in every subject.
- g) **Admission to the Next Semester:** Advancement to the next semester shall be permitted only with a maximum of **Two Backlog Papers** from the **preceding semester**. Further, entry to the next semester shall be regulated at the level of **4th, 5th** and **6th** semesters as explained under:
- (i) Admission to **4th semester** shall be allowed only after clearing **1<sup>st</sup> semester backlog paper(s)** during **3<sup>rd</sup> Semester**.
  - (ii) Admission to **5th Semester** shall be allowed only after clearing **2nd semester backlog paper(s)** during **4<sup>th</sup> Semester**.
  - (iii) Admission to **6th semester** shall be allowed only after clearing **3rd semester backlog paper(s)** during **5<sup>th</sup> semester**.
  - (iv) **Backlog paper(s) of 4th semester** needs to be cleared during **6<sup>th</sup> Semester**.
  - (v) **Backlog paper(s) of 5th and 6th semesters** need to be cleared during subsequent examinations for these semesters within **10 semesters** with a maximum of only one chance.

## **9. MEDIUM OF INSTRUCTION:**

The medium of instruction and examination shall be in English

## **10. CURRICULUM:**

The Curriculum and the Syllabi for the course shall be as prescribed by the University from time to time.

## **11. WORKING DAYS IN AN ACADEMIC YEAR:**

There will be a total of 90 working days per semester.

## **12. ATTENDANCE REQUIRED FOR ADMISSION TO EXAMINATIONS:**

- (a) No candidate shall be permitted to appear for the University examinations, unless he/she attends the course for the prescribed period and produces the necessary certificate of attendance and

satisfactory conduct from the Head of the Institution.

- (b) Every candidate is required to put in a minimum of 80% of attendance both in theory and practical separately in each subject for admission to the examination.
- (c) A candidate having shortage of attendance as prescribed in 12(b) in any subject in theory and /or practical shall not be permitted to appear for the semester examinations.
- (d) A concession of 5% in the attendance requirements could be availed by students representing the University in various sports, cultural events. In such instances **official leave** would be granted.
- (e) However in the event that a candidate failed in his exams then, the candidate would be on Academic probation and not permitted to participate in various events.

### **13. CONDONATION OF SHORTAGE OF ATTENDANCE;**

For valid reasons, 5% relaxation of the Attendance may be considered by the College Authority.

### **14. SUBMISSION OF LOG BOOKS:**

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

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.

### **15. REVALUATION / RETOTALLING OF ANSWER PAPERS:**

- (a) (a)There is no provision for revaluation of the answer papers of failed candidates in any examination. However,
- (b) the failed candidates can apply for retotaling / revaluation.
- (c) The Academic Committee will form a moderation committee of 3 members each year. Moderation marks cannot exceed 5 for any one candidate for all papers combined. This can be given to those papers where the candidate has borderline marks by the moderation committee.
- (d) If after moderation a candidate gets less than 40 % there is no re-evaluation. Revaluation of papers between the 40%-50% would be done by two separate examiners. If the pass percentage of 50% was not achieved even after these evaluations, the candidate would be deemed to have failed the exam.

### **16. RE-ADMISSION AFTER BREAK OF STUDY:**

- (a) In the event of a break in studies exceeding 6 months, a special condonation letter should be availed from

the University.

- (b) The candidates have to complete the course within 4 years of date of admission or within double the course period.

**17. VACATION:** 2 weeks in each semester

**18. PATTERN OF QUESTION PAPER FOR UNIVERSITY EXAMINATION:**

Descriptive type Questions = 30%

Descriptive Short Notes =30%

Short Answer questions =20%

MCQ Type = 20%



**DETAIL SYLLABUS FOR**  
**BACHELOR OF SCIENCE IN RADIOTHERAPY TECHNOLOGY (BSc RTT) COURSE**  
**SEMESTER-1: 20 CREDITS**

**BSc RTT-101: HUMAN ANATOMY**

**SUBJECT DESCRIPTION:** Human anatomy is designed to provide students with the working knowledge of the structure of the human body which is essential foundation for their clinical studies.

**THEORY**

- **BASIC CONCEPTS OF ANATOMY:**

Subdivisions of anatomy, anatomical position and anatomical terms: - Regions, cavities and systems of the body. General Tissues:- Definition of tissues, Classification, location and function of different types of tissues. General features of cartilage - Types of cartilage and their location. General features and classification of bones and joints: Parts of developing long bone, Classify bones with example, Synovial joint with diagram. General features of muscles, vessels and nerves: Classify the types of muscle, their location and functions, Parts of a muscle – belly and tendon, Differentiate artery and vein, Layers of blood vessel.

- **SKELETAL SYSTEMS:**

Describe the features of bones and joints of the skull, upper limb, lower limb, vertebral column, ribs, sternum - Parts of a long bone , Describe briefly the salient features of clavicle, scapula, humerus, radius, ulna, phalanges, hip bone, femur, fibula, tibia, sternum - Parts of a typical rib and the vertebra , Names of skull bone, carpal bones and tarsal bones , Description of major joints like shoulder, elbow, hip and knee joint.

RADIOLOGICAL ANATOMY: Introduction: Standard view of radiographs, Types of Radiographs, X-ray appearance of normal skeleton. Radiographic appearance of shoulder, elbow, wrist and hand, hip, knee, ankle foot

PATHOLOGICAL CONSIDERATION: Fracture, dislocation, arthritis, tumors of bone, healing of fractures, Kyphosis, scoliosis

- **MUSCULAR SYSTEMS:**

Name the muscles and know the attachments, nerve supply and actions of important muscles of head & neck, trunk, upper limb and lower limb. Describe the location and nerve supply of: Deltoid, Pectoralis major, Intercostal muscles, Diaphragm, Gluteus maximus, Gluteus medius, Gluteus minimus, sternocleidomastoid

- **CIRCULATORY SYSTEMS:**

**The heart** – covering, chambers, and external features, Blood supply , Great vessels of the heart , Pericardium and pericardial cavity, Surface marking of apex of heart, Chambers of heart , Valves of heart , Coronary vessels supplying the heart , Branches of Aorta.

**Blood vessels** - position and distribution of major arteries and their branches, Position and the tributaries of superficial and deep veins, dural venous sinuses – Position and branches of brachial artery, radial artery, ulnar artery, palmar arches, femoral artery, popliteal artery, anterior and posterior tibial artery, dorsalis pedis artery – Position of cephalic, basilic and median cubital vein of the upper limb - Position of long and short saphenous vein of lower limb - Location of superior sagittal sinus, inferior sagittal sinus, straight sinus, transverse sinus and sigmoid sinus in the cranial cavity

RADIOLOGICAL ANATOMY: Chest – PA view, oblique view

PATHOLOGICAL CONSIDERATIONS: Congenital heart diseases, acquired heart diseases, infarction, collateral circulation

- **LYMPHATIC SYSTEM:**

General and regional arrangements of the lymphatic system , the lymphatic organs , lymph nodes of axilla, inguinal region, thorax, abdomen and neck , Location and drainage areas of different groups of lymph nodes in the body, Location and functions of thymus, spleen, lymph nodes and tonsils

- **RESPIRATORY SYSTEM:**

The nasal cavity, larynx, trachea, lungs and pleura, the paranasal air sinuses - Describe briefly the conducting and respiratory part , Types and location of paranasal sinuses . Larynx - Extend and relation of trachea with the esophagus , Pleura and pleural cavity , Lobes of lung and difference between the right and left lung.

RADIOLOGICAL ANATOMY: Plain X-ray chest, Bronchogram

PATHOLOGICAL CONSIDERATION: Tracheostomy, pleural effusion, pneumothorax, bronchoscopy

- **DIGESTIVE SYSTEM:**

Mouth, salivary glands, pharynx, esophagus, stomach, small and large intestine, the liver and biliary system, and the pancreas. Types of major salivary gland, their location and functions , Parts of pharynx , Location and the parts of stomach. Parts of large and small intestine and their location , Lobes of liver and portal triad . Location and parts of gall bladder - Parts of pancreas, its secretion and functions . Blood supply of the stomach and intestine , Portal vein formation

RADIOLOGICAL ANATOMY: Barium swallow, barium meal, barium enema, cholecystogram

PATHOLOGICAL CONSIDERATION: Hypertrophic congenital pyloric stenosis, peptic ulcers, carcinoma, cholecystitis, cholelithiasis, oesophagoscopy, gastroscopy, sigmoidoscopy gastrostomy, ileostomy, colostomy, gastrectomy, colectomy, cholecystectomy

- **URINARY SYSTEM:**

Kidneys, ureter, urinary bladder, urethra - Location and internal structure of kidney - Microscopic structure of a nephron - Extend of ureter and the constrictions - Position of urinary bladder and its relation in males and females.

RADIOLOGICAL ANATOMY: X-ray KUB, IVP

PATHOLOGICAL CONSIDERATION: Dysuria, cystitis, pyelonephritis, calculus kidney

- **REPRODUCTIVE SYSTEM:**

Male reproductive organs – testes, epididymis, seminal vesicle and prostate - relation of prostate with the neck of urinary bladder.

Female reproductive organs - uterus, ovary, fallopian tube, cervix, vagina and mammary gland - Uterus – location, parts and layers - Parts of fallopian tube - Location of ovary and ovulation

RADIOLOGICAL ANATOMY: Hysterosalpingogram

PATHOLOGICAL CONSIDERATION: Abnormalities of uterus, polycystic ovary, cancer cervix, benign prostatic hypertrophy, cancer prostate.

- **NERVOUS SYSTEM:**

Central nervous system – Brain – lobes, sulci and gyri, ventricular system, blood supply, circle of Willis and spinal cord. Parts of brain, Lobes of brain, Major sulci - central sulcus, lateral sulcus, parietooccipital and calcarine sulcus, Major gyri - pre and postcentral gyrus. Important functional areas - Motor, sensory, visual and auditory areas - Ventricles of brain and Flow of Cerebrospinal fluid - Circle of Willis and significance - External features of spinal cord - Meninges

- **PERIPHERAL NERVOUS SYSTEM:**

Cranial nerves and somatic nerves; Formation and branches of brachial, lumbar and sacral plexus. The basic organization of the autonomic nervous system - Spinal nerves - Cranial nerves in order, Major branches of brachial plexus - ulnar nerve, radial nerve, musculocutaneous nerve, axillary nerve and median nerve in the upper limb, Major nerves from the lumbosacral plexus - femoral nerve and sciatic nerve

RADIOLOGICAL ANATOMY: X-ray skull

PATHOLOGICAL CONSIDERATION: Hemiplegia, quadriplegia, paraplegia, hydrocephalus, Erb's paralysis, claw hand, wrist drop, foot drop

- **ENDOCRINE SYSTEM:**

The location of pituitary, thyroid, parathyroid, pancreas, adrenal, testis and ovary Pathological consideration: Pituitary tumors, gigantism, acromegaly, thyrotoxicosis, goitre, hyperthyroidism, hypothyroidism, diabetes mellitus

- **SENSORY ORGANS**

Basic structure and function of eye, ear and skin

CROSS-SECTIONAL ANATOMY: At the level of lateral ventricle, At the level of medulla oblongata, At the level of T5, At the level of L2, At the level of mid-arm, At the level of mid-forearm, At the level of mid-thigh, At the level of middle of leg

- References:** a) Textbook of Anatomy Vol. 1,2,3 by Inderbir Singh  
b) Textbook of Anatomy Vol. 1,2,3 by B.D. Churasia

## BSc RTT -102: HUMAN PHYSIOLOGY

**SUBJECT DESCRIPTION:** The course in Physiology over the first year is designed to give the student an in-depth knowledge of fundamental reactions of living organisms, particularly in the human body.

### **THEORY**

- **BLOOD:**

Composition, properties and functions of blood, Blood groups, Blood indices - MCV, MHC, MCHC, ESR, PCV, Lymph – Formation, circulation, composition and functions of lymph.

- **MUSCULAR SYSTEM:**

Neuromuscular junction Muscle tone

- **CARDIOVASCULAR SYSTEM:**

Function of heart – systole, diastole, heart sound, cardiac output, conducting system of heart, blood pressure, circulation of blood

- **RESPIRATORY SYSTEM:**

Mechanism of Respiration, Gaseous exchange in lungs and tissues, lung volume and capacities

- **DIGESTIVE SYSTEM:**

Deglutition, peristalsis, movements of the stomach, small intestine & large intestine, defecation, Functions of the liver, gall bladder, bile, pancreas

- **EXCRETORY SYSTEM:**

Functions of kidneys, formation of urine, micturation

- **REPRODUCTIVE SYSTEM:**

Oogenesis, Menstrual cycle, ovarian cycle, Spermatogenesis, maturation of sperm

- **NERVOUS SYSTEM:**

Reflex action, Sensory pathway, Motor pathway, CSF formation, circulation properties and composition, lumbar puncture

- **ENDOCRINE SYSTEM:**

Functions of pituitary, thyroid, parathyroid, adrenals, pancreas, gonads

- **SENSE ORGANS:**

Visual and accommodation pathway, Mechanism of hearing

**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

## BSc RTT -103: ENGLISH, COMPUTER, ETHICS AND MEDICAL TERMINOLOGY

**SUBJECT DESCRIPTION:** The subject is on communicative English, learning word processing, other basic computer application such as excel, power point and Medical ethics for technologists

- **ENGLISH:**

STUDY TECHNIQUES: Organization of effective note taking and logical processes of analysis and synthesis  
Use of the dictionary. Enlargement of vocabulary Effective diction

APPLIED GRAMMAR: Correct usage the structure of sentences the structure of paragraphs Enlargements of Vocabulary

WRITTEN COMPOSITION: Precise writing and summarizing Writing of bibliography Enlargement of Vocabulary

READING AND COMPREHENSION: Review of selected materials and express oneself in one's words.  
Enlargement of Vocabulary.

THE STUDY OF THE VARIOUS FORMS OF COMPOSITION:

Paragraph, Essay, Letter, Summary, Practice in writing

VERBAL COMMUNICATION: Discussions and summarization, Debates, Oral reports, use in teaching

LANGUAGE AND COMMUNICATION SKILLS: Basic concepts in English communication - Grammar and Usage - Pronunciation. Communication Skills: Formal conversation, Informal conversation, Telephone conversation - Case Presentation - Interviews. Writing Skills: Writing paragraphs, formal letters, reports - Case study - E-mails. Study Skills: How to take notes – preparing assignments - listening to lectures – summary writing - exam preparation

- **MEDICAL ETHICS**

Medical ethics – Definition, Goal ,Scope , Basic principles of medical ethics - Confidentiality ,Malpractice and negligence , Autonomy and informed consent ,Right of patients ,Medico legal aspects of medical records, Medico

legal case and type ,Records and documentation , Development of standardized protocol to avoid near miss or sentinel events - Obtaining an informed consent. Introduction to NABH guidelines

- **COMPUTER**

Introduction to computer - Input & output devices, CPU, Memory, Storage devices. Introduction of Windows OS - MS-Word: Creating, opening, inserting, formatting, saving, and printing the document , Spell check, Creating and editing table , Mail merge. MS-Excel: Creating, data entry, formatting, saving, and printing the worksheet - Creating graphs. MS-Power point: Creating and formatting presentations , enhancing text , slides with graphs and tables. Computer networks: Types of network - LAN, WAN, Intranet. Internet and its Applications , Application of Computers in clinical settings.

Introduction to - PACS-Picture Archiving in Communication in Medicine

DICOM – Digital Imaging for Communication in Medicine

- References:** a) Manipal Academy of higher education; English book for Nurse by Selva Rose, 3rd Edition  
b) Quirk Randolph and Greenbaum Sidney, 1987. A University Grammar of English, Hong Kong: Longman group (FE) Ltd/ Pearson.  
c) Computer Fundamentals: Pearl Software  
d) Fundamentals of Computers: E. Balagurusamy  
e) Principles of Bio-Ethics: Tom Beauchamp & Childress

## BSc RTT 104: BIOSTATISTICS/SOCIOLOGY

### a) Biostatistics

#### General Statistics

- Definition and importance of biostatistics
- Types of data, rates and ratio
- Methods of collection of data-primary and secondary data
- Sampling of data
- Measures of central tendency (Mean, median, mode)
- Measures of Dispersion (Mean deviation, standard deviation, Range)
- Presentation of data (Bar diagram, Pie diagram, Histogram, Frequency, Polygon, Frequency curve, Cumulative frequency curve, Line diagram)
- Correlation and Regression analysis
- Basic concept of probability



Reference: Introduction to Biostatistics and Research Methods (5<sup>th</sup> Edition)– P.S.S. Sundar Rao& J. Richard.

## **b) Sociology and Environment Health: Practical including field work**

### **Sociology and health**

- Difference between community health and clinical medicine
- Concepts in sociology which influence health and disease.
- Social structure, social behavior, social institutions, socialization, culture, custom, acculturation. standard of living, social problems, social stress and social surveys
- Types of family, functions of family, family and health, broken family.
- Demography and health.
- Influence of social factors on health.

References – Text book of preventive Medicine by Park and Park Chapters 12 and 13.

### **Environment health: The influence of environment on health and preventive measures.**

- Water, air, soil, housing, waste, radiation
- Water - Sources of water, quality of water, water pollution, purification of water, disinfection.
- Air –air pollutants, sources of air pollution, effects of air pollution.
- Housing – types and influence on health
- Waste disposal - excreta disposal, hospital waste disposal impact on health
- Radiation exposure and effect on health

References – Text book of preventive Medicine by Park and Park Chapters 12 and 13.

## **SEMESTER-2: 20 CREDITS**

### **BSc RTT -201: BASIC RADIOLOGICAL PHYSICS**

**SUBJECT DESCRIPTION** – This subject will introduce student to the basic physics concepts, principles necessary to learn the physics related to radiology and radiotherapy.

- **STRUCTURE OF MATTER:**

Constituents of atoms, atomic and mass, energy units, electron shells, atomic energy levels, Nuclear forces, Nuclear energy levels. Atomic structure Nucleus, Electromagnetic spectrum, Energy quantization, Relationship between wavelengths, Frequency, Energy.

**PHYSICS UNITS AND MEASUREMENTS**

Force, Work, Power, energy temperature and heat SI units of above parameters. Atomic Number, Mass No., electron orbit and energy levels Periodic table, Isotopes, Isobars, Ionization and excitation. Electromagnetic radiation.

ELECTRICITY AND MAGNETISM: Electric charges, Coulomb's law Unit of charge Electric potential, unit of potential Electric induction, capacitance and capacitors, series and parallel connection electric current, unit, resistance, ohm's law, electric power, Joule's law Magnetism: Magnetic induction magnetic Properties Hysteresis magnetic effect of current Electrical instruments, Galvanometer, voltmeter, ammeter and multimeter. Transformer, rectifiers, single phase, three phase, A/C and D/C generators.

- **X-RAYS:**

Electromagnetic waves-quantum theory of radiation, visible light, fluorescence.

X-Rays, Production of X-rays: The X-ray tube, Physics of X-ray production, continuous spectrum, characteristic spectrum, Basics of X-ray Circuits measurement of high voltage, control of KV circuit, MA circuit, Distribution of X-rays in space, specifications of beam, the quality and intensity of x-rays, the Current affecting quality and intensity

- **RADIOACTIVITY:**

Natural and artificial radioactivity, Laws of radioactive decay, Isotope, isobar and isotone, isomer, isomeric transmission. Half-life, alpha decay beta decay and spectra, gamma emission, positron decay, electron capture and internal conversion, Radiation sources, Natural and artificial production of radio isotopes, reactor produced isotopes, Fission products, Gamma ray source for Medical uses, radioactive equilibriums.

- **RADIATION QUANTITIES AND UNITS:**

Exposure – Roentgen , Intensity,absorbed dose , rad , Gray, Roentgen to rad conversion , activity , Curie ,Becquerel specific activity, Flux-Fluence-absorbed dose and KERMA, exposure rate constant , gamma ray constant , Measurement of exposure (Free are chamber, Thimble chamber,) Victorian Electrometer , Secondary standard dosimeters

- **INTERACTION OF RADIATION WITH MATTER**

Attenuation of X-ray or Gamma rays, absorption and scattering, half value layer, Coherent scattering, Photoelectric absorption, Compton scattering, Pair production and photoelectric disintegration. X-ray transmission of through Medium, Linear and mass attenuation coefficients. HVT, TVT and interaction of charged particle and neutrons with matter. LET, Total attenuation coefficient. Interaction of X and Gamma rays in body, fat, soft tissue, and bone. Relative important of different types of interactions.

- 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 & Christensen
  - c) Fundamental of Xray Fundamental of Xray and Radium Physics Joseph
  - d) Basic Medical Radiation Physics – Stanton

## BSc RTT - 202: PHYSICS OF RADIOGRAPHIC EQUIPMENT

**SUBJECT DESCRIPTION:** The students will be able to understand and appreciate the construction, essential parts and functioning of radiographic equipment used for imaging and treatment

- **RADIOGRAPHIC IMAGE:**

Primary radiological image formation, use of contrast media. Density, contrast, brightness, X-ray film construction and film characteristics, exposure to x-rays, developer, effect of temperature and development time ,constituents of developer ,film processing methods- Optical density measurements. Image quality - Unharness, Resolution, Fog and noise. Grid, digital radiography.

- **FLUOROSCOPY:**

Direct fluoroscopy – fluoroscopic image, fluorescent screen in Radiology Factors affecting the Fluoroscopic image. Image intensifiers – principle, construction, and function regarding intensified

image. The television process – The Television camera tube, the Cathode ray tube, Television image, Modern fluoroscopy.

- **TOMOGRAPHY:**

Theory of tomography – multi section radiography, tomographic equipment Computed tomography, Scanning principle ,Generations of CT, Reconstruction of image ,storing the image ,viewing the image ,evaluation of the image. Equipment for computed tomography, Table, scanning gantry X-ray generator, image quality

- **MRI**

Magnetic Resonance imaging – Basic principle, Imaging methods, Slice section ,Image contrast, Factors affecting Image quality , Difference CT and MRI images , Instrumentation. imaging sequences Bio effects of MRI

- **BASICS OF SPECT AND PET CT**

Gamma Camera — Single photon emission computed tomography (SPECT) and Positron emission tomography (PET) and PET-CT, Physics principles and construction

**References:** a) Christensen's Physics of Diagnostic Radiology – Christensen & Christensen

b) Physics for Radiography Hay and Hughes

c) Handbook of Physics in Diagnostic Imaging - Roshan S. Livingstone

d) The Essential Physics of Medical Imaging - Jerrold T. Bushberg

e) Physics of Radiology and Imaging by Thayalan

## BSc RTT -203: HOSPITAL PRACTICE AND PATIENT CARE

**SUBJECT DESCRIPTION:** The students will be able to learn and appreciate the role of technologists in patient care, hospital practice, their principles and procedures such as first aid, managing infections and departmental procedures

- **GENERAL PRINCIPLE OF HOSPITAL PRACTICES:**

Modern hospital treatment is based on teamwork; it is essential that the student should appreciate the technologists' role and that the importance of co-operation with wards and other departments. The students should be attached to wards or the accident and emergency department for a definite training period, the length of time being suited to the individual hospital.

Hospital procedure: Hospital staffing and organization; records relating to patients and departmental statistics; professional attitude of the technologist to patients and other members of 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.

- **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 patient who has a colostomy; bedpans and urinals; simple application of a sterile dressing.

- **FIRST AID:**

Aims and objectives of first aid; wounds and bleeding, dressing and bandages; pressure and splints, supports etc. Shock; insensibility; asphyxia; convulsions; resuscitation, use of suction apparatus, drug reactions; prophylactic measures; administration of oxygen; electric shock; burns; scalds; hemorrhage; pressure points; compression band. Fractures; splints, bandaging; dressing, foreign bodies; poisons; Basic life support, CPR

- **INFECTION:**

Bacteria, their nature and appearance; spread of infections; auto-infection or cross infection; the inflammatory process; local tissue reaction, general body reaction; ulceration; asepsis and antisepsis

- **PRINCIPLES OF ASEPSIS:**

Sterilization - methods of sterilization; use of central sterile supply department; care of identification

of instruments, surgical dressings in common use, including filamented swabs, elementary operating theatre procedure; setting of trays and trolleys in the radiotherapy department (for study by radiotherapy students only)

- **DEPARTMENTAL PROCEDURES:**

Department staffing and organization; records relating to patients and departmental statistics; professional attitudes of the technologist to patients and other members of the staff, medico-legal aspects accidents in the department; appointments; organization; minimizing waiting time; out-patient and follow up clinics; stock taking and stockkeeping.

- **DRUGS IN THE DEPARTMENT:**

Storage: classification; labelling and checking, regulations regarding dangerous and other drugs; units of measurement, special drugs, anti-depressive, anti-hypertensive etc.

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

b) Principles and practice of nursing –Sr Nancy .Vol 1&2

### **SEMESTER-3: 20 CREDITS**

## **BSc RTT - 301: PHYSICS OF RADIOTHERAPY AND RADIOTHERAPY EQUIPMENT (PART 1)**

**SUBJECT DESCRIPTION:** The students should learn and appreciate the physics principles and technology of basic radiotherapy equipment.

- **RADIOTHERAPY EQUIPMENTS:**

Historical developments in Radiotherapy- Kilo voltage Unit, Grenz Ray Therapy, contact therapy, superficial therapy, Deep Therapy, Megavoltage therapy. Van de Graff generator

Radio Isotope units –Physical Components of Cobalt 60 unit, source housing, beam collimation penumbra, penumbra trimmers, wedge, shielding. Caesium 137 units, Advantages and Disadvantages descriptions

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.

Radiotherapy Simulator: Conventional simulator - Sim CT, CT simulator. lasers – moving and fixed. 4D CT.

Brachytherapy – Low dose rate (LDR), medium dose rate (MDR) and High dose rate (HDR), Pulse dose rate (PDR) Manual brachytherapy, Remote after loading Brachytherapy Unit, Brachy therapy source and their properties ,Methods of brachytherapy – Interstitial, Intra luminal, intra cavitory and mould, permanent implant brachytherapy

- **PHYSICS PARAMETERS FOR DOSE CALCULATION:**

Source to skin distance (SSD) – Source to Axis distance (SAD), Focus to Axis distance (FAD). Isocentre, Percentage depth dose (PDD), off axis factor (OAR), beam profile , Tissue Air Ratio (TAR), Tissue maximum Ratio (TMR), Tissue Phantom Ratio (TPR), Back scatter factor, Scatter Air Ratio (SAR), Scatter Maximum Ratio (SMR), Physics of Bolus and phantom materials. Field size , equivalent square , output, output factor or relative dose factor , shielding tray factor ,wedge factor ,determination of treatment time / monitor unit

Physics of electron beam –electron depth dose curve, range and clinical application of electron beams , Calibration of therapy beams

**References:** 1. The physics of radiology by H.E. Johns and Cunningham

2. 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

**SUBJECT DESCRIPTION** - The course in tumour pathology, the student is expected to understand pathology related to Radiotherapy practice.

- **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.

- **PATHOLOGY RELATED TO ONCO-RADIOTHERAPY PRACTICE:**

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

- **INTRODUCTION TO MALIGNANT TUMOR:**

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-oralcavity & Paranasalsinus

-Nasopharynx-orophaynx-hypopharynx-larynx-thyroid-postericoid—oesophagus-mediastinum-lungs-pancreas-liver-breast-cervix-body of the

uterus-vagina-valva-kidney, ureter, bladder, rectum prostate, penis, testis poreticulam tissue- bone marrow - CNS ,eye, orbit- soft tissue & bone - pediatric tumor, retinoblastoma, Wilms tumor, rhabdomyosarcoma

- **TUMOUR LOCALIZATION:**

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



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

- References:** a) Fletcher Diagnostic and Histopathology of tumors.  
b) Introduction to Clinical Pathology – Harsh Mohan  
c) Short textbook of radiotherapy Walter and Miller  
d) Cancer explained, Sultan and Maurice  
e) Radiation therapy in the management of cancers; Fletcher, Gilbert

### BSc RTT -303: PATIENT CARE IN RADIOTHERAPY

**SUBJECT DESCRIPTION** - The students should learn and appreciate the principles and practice of patient care in relation to radiotherapy planning and treatment

- **PREPARATION OF PATIENTS FOR GENERAL RADIOTHERAPY PROCEDURES:**

Departmental instructions to outpatients or ward staff- use of aperients; enemas and colonic irrigations flatulence and flatus, causes and methods of relief principles of catheterization and intubation, premedication. Its uses and methods; anesthetized patients; diabetic patients' special attention to food hazards of trauma. Preparation of the patients of biopsy and trolley setup; trolley set up for ENT examination, preparation of the patients for pelvic examination and trolley set up, general welfare of the patients during and after the treatment including the care of any inter current diseases (diabetes, tuberculosis, arthritis), diet and fluid intake.

The observation and reporting any change in the signs and symptoms of patients receiving treatment, the use of blood count in the control of certain treatment, the care of blood counts, the care of local and systematic reaction, local reaction showed includethose in the ear, nose, throat and eye and those arising from treatment given to the pelvis, instrumentation, the absolute necessity for accuracy in every aspects of each individual treatment, the terminal care of dying patients.

- **CARE OF PATIENTS RECEIVING R.T:**

General welfare of the patient during and after the treatment including the care any intercurrent disease (diabetic, tuberculosis, arthritis). Diet and fluid intake. The observation and reporting any change in the signs and symptoms of patients receiving treatment...Identification and care of radiation reaction (Mucositis, Dermatitis, Cystitis, and proctitis) - Use of blood counts - Diet and nutrition - Communication and counselling.

Management of special procedures (Tracheostomy, Colostomy, Ileal bladder, Breast prosthesis).  
The use of blood count in the control of certain treatment. The care of local and systemic reaction

- **ORGANIZATION OF RADIOTHERAPY:**

Department practice, appointment organization in the planning room, treatment area. Management of waiting patients.

- **DRUGS USED IN RADIOTHERAPY:**

Basic knowledge on drugs used in the dept.

- References:** a) A guide to Oncology nursing - (Livingstone) Deeley  
b) Practical nursing and first aid- Ross and Wilson. Livingstone  
c) Radiation therapy in the management of cancers -Fletcher, Gilbert:

## **SEMESTER-4: 20 CREDITS**

### **BSc RTT -401: IMMOBILIZATION AND PLANNING**

**SUBJECT DESCRIPTION:** The students will be able to understand the concepts, different types and application of immobilization for various radiotherapy treatment techniques.

- **IMPORTANCE OF IMMOBILIZATION IN RADIOTHERAPY:**

Immobilization methods - Method of beam alignment, Treatment execution, Treatment verification changes in patient position, target volume and critical volume during course of treatment

- **MOULD ROOM TECHNIQUE:**

Construction of casts, Construction of applicator and moulds, Construction of shields

- **CT PLANNING-MRI PLANNING:**

Interpretation of treatment prescription Record keeping relevant to planning – patient position, support, immobilization, Landmarks, Mould room techniques and immobilization. Treatment positioning in radiotherapy to various cancers; CNS-benign-pituitary-craniopharyngioma etc. Malignant tumor-primary and secondary; orbit eye –middle ear- parotid buccal mucosa-tongue-hard palate-maxillary antrum- naso pharynx- oropharynx- hypo pharynx- larynx- oesophagus- media sternum- lung- bladder- prostate-penis- testis-cervix-body of the uterus—vagina-vulva-lymphoma

- **CHEMOTHERAPY-CHEMO-RADIATION:**

Concepts of combined modality treatment and the significance of radiation and chemotherapy in comprehensive management of cancer.

Sequelae associated with multimodality therapy and their management

**References:** a) The physics of radiation therapy, Faiz M. Khan, 5th edition (2014), Lippincott, Williams and Wilkins, USA.

## BSC RTT -402: PHYSICS OF RADIOTHERAPY AND RADIOTHERAPY EQUIPMENT (PART 2)

**SUBJECT DESCRIPTION:** The students should learn and appreciate the physics principles and technology of advanced radiotherapy equipment.

- **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.

- **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.

- **BODY INHOMOGENITIES:**

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

- **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

## **BSc RTT -403: CONVENTIONAL RADIOTHERAPY TECHNIQUE**

**SUBJECT DESCRIPTION:** The students should learn and appreciate the procedures, principles, and technique of conventional radiotherapy treatments.

- **EXTERNAL BEAM THERAPY PRACTICAL EXPERIENCE:**

Technique of fixed beam treatments- single field, parallel fields, multiple fields, regional fields.  
The use of wedge filters, compensators and shaping blocks, diaphragms and applicators.  
Immobilization of the patient- Rotation and arc therapy- beta ray and electron beam therapy.  
Care of machine- Set up single, multiple fields. Use of wedges, shields and tissue compensators,  
Use of beam directional devices, methods of patient immobilization, Knowledge of technique  
involving electron beam therapy moving beam therapy, conformal therapy, stereotactic radio  
surgery and radiotherapy, Handling emergencies in Tele therapy.

- **ELECTRON BEAM THERAPY:**

Production of electron beams: using accelerators - Characteristics of electrons. Surface dose,  
percentage depth dose, beam profiles, Isodose curves and charts, Flatness and symmetry. Beam  
collimation, variation of percentage depth dose and output with field size, and SSD, photon  
contamination. Energy spectrum Energy and field size choice, air gaps, and obliquity, Tissue in  
homogeneity lung, bone, air filled cavities. Field junctions, External and internal shielding. Arc

therapy, use of bolus in electron beam. -Total skin Electron Irradiation, Intraoperative Radiation Therapy.

- **BRACHYTHERAPY:**

Radioactive sources – exposures rate constant, calibration of Brachytherapy sources- Brachytherapy methods - Mould, Implant ,intracavitary -radiography examination of implant – radiographic examination of intracavitary application and implant dosimetry – Radiographic verification of implant-Orthogonal verification of intracavitary application- dose calculation in intracavitary application- dose calculation methods. After loading systems -BARC Cs-137 kit - LDR remote after loading system and HDR remote after loading system -Physical components of LDR, HDR Brachy unit. Various type of sources used in brachytherapy and their properties

**SEMESTER-5: 20 CREDITS**

**BSc RTT - 501: BASIC RADIOBIOLOGY**

**SUBJECT DESCRIPTION:** The students should learn and appreciate the mechanism of radiation effects in human body and its application in radiotherapy.

- **BIOLOGICAL EFFECTS OF RADIATION:**

Direct effect, indirect effects, Radiology of water, Effects of various radiation on normal tissues and malignant tumor: Early and late reaction on Skin, Mucous membrane, GI tract, Genito urinary system, respiratory system, CNS - Effects of radiation on living cell, action on cancer tissue Radio sensitivity of different tissues, skin reaction and their treatment, Reaction on muscle membrane, Late effects on workers, effects on blood, effects on reproductive organs, effects on other organs, Radiation sickness. Effect of low LET and high LET radiation on cell. Cell survival curves. Effect of sensitizing and protective agents. Dose modifying factors and their determination. Variation of response with growth and the progression of cell through the phases of cell cycle. Hyper thermic and photodynamic injury. Chromosomal aberration and application for the biological dosimetry.

Acute and chronic exposure, LD<sub>50/60</sub>

Biological hazards of irradiation - effects on the embryo and the fetus, life shortening, leukaemogenesis and carcinogenesis, genetic and somatic hazards for exposed individuals and population. Biological basis of radiological protection. -Importance of correct dosage, Blood supply, time factor, fractionation, Quality Radical and palliative treatment.

- **FACTORS INFLUENCING RADIATION RESPONSE:**

Physical factors: dose, dose quality, dose rate temperature - Chemical factor: Oxygen, radio sensitizers, radio protectors- Biological factors: Type of organism, cell type and stage, cell density and configuration, age, sex.- Host factors: Partial and whole body exposure, 4 R's of radiobiology, tumor doubling time

- **METHODS OF TREATMENT OF MALIGNANT DISEASE:**

Principle affecting the treatment of malignant disease; Chemotherapy, Hormone therapy, Radiotherapy and surgery in management of malignant disease, relative value of each method for individual tumors or tumor sites.

- **CHOICE OF TREATMENT:**

Anatomical site, relation to other tissue, extent of tumor and histology, place of previous treatment, place of radical and palliative therapy.

- **CHOICE OF RADIOTHERAPY:**

Tumor sensitivity, anatomical site, relation to other structure availability of equipment.

**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

## BSc RTT - 502: RADIATION SAFETY

**SUBJECT DESCRIPTION:** The students should learn and appreciate the principles and practice of Radiation Protection in general and to radiation therapy.

- **RADIATION QUANTITIES AND UNITS:**

Equivalent Dose, Weighting Factors, Effective Dose - RBE - LET - quality factor - dose equivalent - rem, Sievert. Natural Background Radiation,

RADIATION EFFECT: Somatic and genetic effect, stochastic and deterministic effect, tissue reaction

- **RADIATION PROTECTION METHODS & PRINCIPLES:**

Time, Distance and shielding. Concept of “As Low As Reasonable Achievable” (ALARA), Justification, optimization and dose limits, dose limits for radiation worker and public

- **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 radiotherapy practices.

- **RADIATION EMERGENCY PREPAREDNESS:**

Safety and security of radiation sources, case histories of emergency situations and preparedness, equipment and tools. Regulatory requirements and prevention of emergency, Preventive maintenance and Safety Culture,

Role of technicians in handling radiation emergencies.

- **DETECTION AND MEASUREMENT OF RADIATION & MEASURING INSTRUMENTS:**

Radiation Detectors: Gas. Solid state, Scintillation, Thermoluminescence, Ionisation chambers, Proportional counters, G.M. Counters, Liquid scintillator, Visual Imaging (Film, Fluorescent



screens) and their examples. Concepts, Phantoms, protocols- dose determination in practice– Advantages & disadvantages of various detectors & its appropriateness of different detectors for different type of radiation measurement

- **PERSONNEL AND AREA MONITORING:**

Need for personnel monitoring, Principle of film badge.- TLD badge used for personnel monitoring. Pocket dosimeter, Need for area monitoring, Gamma Zone Monitors, Survey meters. Pocket dosimeter Radiation survey meter- wide range survey meter, zone monitor contamination monitor, their principle, function and uses.

- **RADIATION PROTECTION AND REGULATORY ASPECTS:**

Principle underlying international Commission on Radiation- recommendations. ICRP and National radiation protection rules, Atomic Energy Regulatory Board (AERB) standards- Organizations, Safety standards, Codes & Guides, Responsibilities of licenses, Registrants and employers and Enforcement of Regulatory requirements. Effective dose limits- radiation worker, trainees, pregnant woman and Public, Regulatory consent: NOCs, periodical report to AERB and Radiological Physics and Advisory Division of Bhabha Atomic Research Centre (BARC).

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

## **BSc RTT -503: PHYSICS OF SPECIAL TECHNIQUES IN RADIOTHERAPY AND RELATED EQUIPMENT**

**SUBJECT DESCRIPTION:** The students should learn and appreciate the physics principles of advanced radiotherapy techniques and the technology of radiotherapy equipment used for advanced and special techniques

- **INTRODUCTION TO SPECIAL TECHNIQUES IN RADIOTHERAPY:**

SRS, SRT, IMRT, IGRT & Helical Tomotherapy, and Volumetric modulated arc therapy, Robotic radiotherapy, PET in radiotherapy treatment planning, Particle therapy with proton beam and heavy ions and Challenges in technologist's job due to the introduction of new technologies.

- **CONFORMAL RADIOTHERAPY(CRT):**

Principles, Advantages over conventional methods Virtual Simulation: Principles, CT simulation, TPS based simulation, Differences, Merits and Demerits, Practical considerations- Essential requirements for conformal radiotherapy-various methods of CRT,

Modulated Radiation Therapy (IMRT) - Using 3 D compensators - Static IMRT - Dynamic **IMRT** -Dynamic arc IMRT - Micro - MLC - Tomotherapy methods - Time gated (4D) radiotherapy - Merits anddemerits of IMRT – Volumetric Modulated Arc Therapy (VMAT) and Image Guided Radiotherapy (IGRT)

- **STEREOTACTIC IRRADIATION METHODS:**

Physics principles, Merits and demerits, stereo tactic Radio surgery (SRS) and stereo tactic Radiotherapy (SRT), whole body stereotactic frame.

- **Total Body Irradiation (TBI)** : Physics principles of TBI, commissioning, calibration and in-vivo dosimetry for TBI

- **TOTAL SKIN ELECTRON TREATMENT (TSET):** Physics principles of TSET, commissioning and in-vivo dosimetry requirements.

- **HIGH LET RADIATION:**

Comparison and contrast with low LET radiation. - Proton therapy, Neutron source and boron neutron capture Advantages and disadvantages, RBE values, hazards of low dose and low energy neutrons, RBE values, hazards of low dose and low energy neutron, use in radiotherapy, combination with low LET, current clinical results.

- **HYPERTHERMIA:**

Sources, rationale, advantages and disadvantages, thermo tolerance. Cellular damage: comparison

and contrast with radiation, thermal and non-thermal effects of ultrasound, microwaves, radiofrequency, etc. General host responses Use along with radiotherapy and chemotherapy: optimum sequencing of combined modalities. Current limitations to the clinical use of hyperthermia

**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

### **SEMESTER-6: 20 CREDITS**

## **BSc RTT -601: ADVANCED RADIOTHERAPY TECHNIQUES**

**SUBJECT DESCRIPTION** - The students should learn and appreciate the principles of advanced radiotherapy techniques, treatment methods

- **ADVANCE TECHNIQUES IN RADIOTHERAPY**

3D dimensional Radiotherapy – Intensity modulated radiotherapy (IMRT) – Volumetric modulated Arc therapy (VMAT) – Tomotherapy

Surface Guided Radiotherapy (SGRT) – optical system - structured light system – camera

Stereotactic Irradiation – methods of Stereotactic Radiosurgery - stereotactic radiotherapy – stereotactic body radiotherapy (SBRT)

Image Guided Radiotherapy – 2D image guidance - Electronic portal imaging devices –(EPID) – Kv Planar imaging (OBI) – 3D image guided Radiotherapy - In-room CT –Kv CBCT - MV CBCT – MV CT (Tomotherapy) – MR guided Radiotherapy (MRgRT)

Total Body Irradiation (TBI) – Historical development – current methods of delivering TBI – Total lymphoid irradiation (TLI) – Total Marrow and Lymphoid irradiation – planning – patient positioning and simulation - treatment

Total Skin Electron Treatment (TSET) – methods of treatment – patient positioning – delivery

**References:** a) The Modern Technology of Radiation Oncology, Volume 4 (4th Edition) – Jacob Van Dyk

- 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.

## BSc RTT -602: QA IN RADIOTHERAPY

**SUBJECT DESCRIPTION** - The students should learn and appreciate the physics quality assurance methods for radiotherapy equipment and treatment procedures.

- **QUALITY ASSURANCE IN RADIOTHERAPY :**

Definition and practical advantages, Construction, Development and Implementation of Quality System

Acceptance testing of simulator, Treatment planning system, <sup>60</sup>Co unit, linear accelerator. -

Quality Assurance of Simulator, image quality check – verification isocentre, field size and field delineator.

Quality assurance of Treatment Planning system – verification of DICOM import –export, export of treatment plan to linac console – verification of dose calculation algorithm

Quality assurance of <sup>60</sup>Co unit - verification isocentre, field size and output - safety interlock verification - verification of gamma zone monitor functioning

Quality assurance of linear accelerator - verification isocentre, field size and output - safety interlock verification

Accessories tools used in for QA tests in Radiotherapy - front pointer, Back pointer, Laser alignment tool, - Optical and radiation field congruence, Beam shaping blocks, Diaphragm movements, Patient support system, Beam ON & OFF mechanisms, Technicians role in QA test on Tele Cobalt/ Linear Accelerator/ Brachytherapy/ Gamma Knife/Simulator/ CT Simulator machines.

Quality assurance of Brachytherapy – HDR remote after-loading – verification of safety interlocks – functioning of gamma zone monitor and CCTV system. Source position check – verification of source activity

Quality assurance for multi-leaf collimator -step and shoot movement and dynamic MLC – verification of

virtual wedges – wedge angle, wedge profile and wedge factor (as required)

Quality assurance of IGRT system

Quality assurance of Electronic portal imaging system – kV cone beam CT – geometric accuracy and image quality

**References:** a) The physics of radiation therapy, Faiz M. Khan, 5th edition (2014), Lippincott, Williams and Wilkins, USA.

## BSc RTT -603: RADIOTHERAPY AND PHYSICS PRACTICAL :

- **Clinical**

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.

- **Safety & Quality Assurance**

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.

- **Physics**

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. Daily Quality Assurance test for Tele cobalt and Brachytherapy unit.

