Study & Evaluation Scheme

of

Bachelor of Science in Medical Radiography and Imaging Technology

[Applicable w.e.f. Academic Session 2013-14 till revised]
[BRT306, BRT307, BRT308, BRT309, BRT355, BRT356, BRT357 amended vide approval dt. 18th, Feb, 2014 of V.C]

TEERTHANKER MAHAVEER UNIVERSITY
Delhi Road, Moradabad, Uttar Pradesh-244001
Website: www.tmu.ac.in

TEERTHANKER MAHAVEER UNIVERSITY
(Established under Govt. of U. P. Act No. 30, 2008) Delhi Road, Moradabad (U.P)

Study & Evaluation Scheme of
Bachelor of Science in Medical Radiography and Imaging Technology (BMRIT)
SUMMARY

Programme	:	Bachelor of Science in Medical Radiography and Imaging Technology (BMRIT)
Duration	:	Three years full time (Annual System) and 6 Months (Internship)
Medium	:	English
Minimum Required Attendance	:	75 %
Maximum Credits	:	90
Total credits required for the degree	:	90

Assessment (Theory) :

External	Internal	Total
70	30	100

Internal Evaluation of theory Papers :

Class Test I	Class Test II	Class Test III	Assignment (s)	Other Activity (including attendance	Total
Best two out of the three					
10	10	10	5	5	30

Evaluation of Practical/Dissertations & Project Reports :

External	Internal	Total
50	50	100

Duration of Examination :

External	Internal
3 Hr.	1.5 Hr.

To qualify the course a student is required to secure a minimum of 50% marks in aggregate including the year-end examination and teacher's continuous evaluation (i.e. both internal and external). A candidate, who secures less than 50% marks in a course, shall be deemed to have failed in that subject/course(s). A candidate who fails in four courses shall only be eligible for reappear examination while failing in four or more shall be deemed to have failed.

A candidate who has been placed under re-appear category in any of the subject shall be allowed to continue his/her studies in the next year but will have to pass the concerned subject in the supplementary examination to be conducted within six months after declaration of the result. Failure in supplementary examination will be revert back to corresponding junior batch of students and will continue his/her studies with them for rest of the program. Candidate ha s to pass all the courses as per rules in all previous years examinations before appearing in final year examination.

Note: For internal assessment purpose, there will be three Class Tests in a year and best two tests will be computed for the final result

INTERNSHIP

Internship is a phase of training wherein a graduate is expected to conduct actual practice of medical radiology technology and acquire skills under supervision so that he /she may become capable of functioning independently.

SPECIFIC OBJECTIVES

At the end of internship training the graduate shall be able to:

1. Perform all the diagnostic techniques
2. Use discretely the essential laboratory services
3. Manage all types of clinical diagnostic methods
4. Demonstrate skills in handling the modern equipments in medical imaging
5. Develop leadership qualities to function effectively as a leader in the laboratory environment
6. Render services to the laboratory set up and to communicate effectively with the doctors and the hospital management.
7. To develop skill and competency in data processing, reporting and maintenance of records & Laboratory investigations.

INTERNSHIP TIME PERIOD: 6 Months

OTHER DETAILS

(I) Entire internship shall be done in a Hospital or Medical College.

(II) Every candidate will be required, after successfully completing the final examination of Bachelor of Science in Medical Radiography and Imaging Technology, to undergo compulsory rotatory internship upto satisfaction of the University for a period of 6 months so as to be eligible for the award of the degree.

(III) The University shall issue a provisional degree of Bachelor of Science in Medical Radiography and Imaging Technology on passing the final examination after the completion of internship on demand by the candidate.

(IV) The internee shall be entrusted with laboratory responsibilities under direct supervision of Senior Medical Officer/Technician. They shall not be working independently.

(V) Internee will not issue any certified copy of investigation reports or other related documents under their signature.

ASSESSMENT OF INTERNSHIP

1. The Internee shall maintain the record of work, which is to be verified and certified by the senior medical officer/Technician under whom he /she works. Apart from scrutiny of record of work, assessment and evaluation of training shall be undertaken by an objective approach using situation tests in knowledge, skills and attitude during at the end of training. Based on the record of work and date of evaluation The Director/Principal shall issue certificate for satisfactory completion of training following which the university shall award the degree of Bachelor of Science in Medical Radiography and Imaging Technology.

2. Satisfactory completion shall be determined on the basis of the following.
   a) Proficiency of knowledge required for each Laboratory techniques.
   b) The competency and skills expected to manage each laboratory technique.
   c) Responsibility, punctuality work up of laboratory techniques, involvement in special procedures and preparation of reports.
   d) Capacity to work in a team (behaviour with colleagues, nursing staff and relationship with medical and paramedical.
   e) Initiating, participating in discussions and developing research aptitude.
3. Only six leave are allowed to an internee during the period of his/her internship. If he/she extends his/her leave in the duration of internship, the period the internship shall be extended by double the days for which the student was absent.

PROJECT

Submitted by the candidate will be duly verified & a viva voce shall be conducted on the same at the time of Practical Examination of final year.

Study & Evaluation Scheme

Program: Bachelor of Science in Medical Radiography and Imaging Technology(BMRIT)

Year –I

S. No.	Course Code	Subject	Periods			Credit	Evaluation Scheme		
			L	T	P		Internal	External	Total
1	BRT101	Human Anatomy	3	-	-	3	30	70	100
2	BRT102	Human Physiology	3	-	-	3	30	70	100
3	BRT103	Fundamental of Medical Imaging & Radiotherapy	3	-	-	3	30	70	100
4	BRT104	Medical Biochemistry	3	-	-	3	30	70	100
5	BRT105	Community Healthcare	3	-	-	3	30	70	100
6	BRT106	Foundation English	2	2	-	3	30	70	100
7	BRT107	Basics of Computers	2	-	-	2	30	70	100
8	BRT108	Basics Radiation Physics	4	-	-	4	30	70	100
9	BRT151	Human Anatomy (Practical) *	-	-	2	1	50	50	100
10	BRT152	Human Physiology (Practical) *	-	-	2	1	50	50	100
11	BRT153	Fundamental of Medical Imaging & Radiotherapy(Practical)*	-	-	2	1	50	50	100
12	BRT154	Medical Biochemistry (Practical)*	-	-	2	1	50	50	100
13	BRT155	Basics of Computers (Practical)*	-	-	2	1	50	50	100
14	BRT156	Hospital Postings	-	-	10	5	100	-	100
Total			**23**	**2**	**20**	**34**	**590**	**810**	**1400**

*** = Alternate week in batches**

Year II

S. No.	Course Code	Subject	Periods			Credit	Evaluation Scheme		
			L	T	P		Internal	External	Total
1	BRT201	Advanced Radiographic Techniques	4	-	-	4	30	70	100
2	BRT202	Radiation Physics & Radiation Protection	4	-	-	4	30	70	100
3	BRT203	Equipments of Radiotherapy	4	-	-	4	30	70	100
4	BRT204	Special Radiographic Technique & Procedures	4	-	-	4	30	70	100
5	BRT205	Orientation in Para-Clinical Sciences	4	-	-	4	30	70	100
6	BRT206	English Communication	2	2	-	3	30	70	100
7	BRT251	Advanced Radiographic Techniques (Practical)*	-	-	2	1	50	50	100
8	BRT252	Special Radiographic Technique & Procedures (Practical)*	-	-	2	1	50	50	100
9	BRT253	Hospital Postings	-	-	10	5	100	-	100
Total			**22**	**2**	**14**	**30**	**380**	**520**	**900**

Year III

Student will opt for subjects either from Group-1 or Group-2 and Group 3 Compulsory for all students.

S. No.	Course Code	Subject	Periods			Credit	Evaluation Scheme		
			L	T	P		Internal	External	Total
Group 1									
1	BRT301	Radiotherapy Planning and Quality Control	3	-	-	3	30	70	100
2	BRT302	Equipment of Radio Diagnosis	3	-	-	3	30	70	100
3	BRT303	Interventional Radiology & Drugs Used in Diagnostic Radiology	3	-	-	3	30	70	100
4	BRT304	Radiotherapy & Brachy-therapy Techniques in Malignant and Non-Malignant Diseases	3	-	-	3	30	70	100
5	BRT351	Radiotherapy Planning and Quality Control (Practical)	-		4	2	50	50	100
6	BRT352	Equipment of Radio Diagnosis(Practical)	-		4	2	50	50	100
7	BRT353	Interventional Radiology & Drugs Used in Diagnostic Radiology (Practical)	-		4	2	50	50	100
Group 2									
1	BRT306	Computed Tomography Techniques and Equipments	3	-	-	3	30	70	100
2	BRT307	Magnetic Resonance Imaging Techniques and Equipments	3	-	-	3	30	70	100
3	BRT308	Techniques & Equipments of Interventional Radiology & Nuclear Medicine Technology	3	-	-	3	30	70	100
4	BRT309	Radiation Protection & Management of Radiology Department	3	-	-	3	30	70	100
5	BRT355	Computed Tomography Techniques and Equipments (Practical)	-	-	4	2	50	50	100
6	BRT356	Magnetic Resonance Imaging Techniques and Equipments (Practical)	-	-	4	2	50	50	100
7	BRT357	Techniques & Equipments of Interventional Radiology & Nuclear Medicine Technology (Practical)	-	-	4	2	50	50	100
Group 3 (Compulsory for all students)									
8	BRT305	Orientation in Clinical Sciences	3	-	-	3	30	70	100
9	BRT354	Hospital Postings	-	-	10	5	50	50	100
Total			**15**		**22**	**26**	**350**	**550**	**900**

Question Paper Structure

1. The question paper shall consist of eight questions. First question shall be of short answer type and be compulsory. It shall contain 8 parts, covering entire syllabus and the student shall be required to answer any five of them (weightage 4 marks each).
2. Out of the remaining seven questions, student shall be required to attempt any five. The weightage of Question No. 2 to 8 shall be 10 marks each.

YEAR I
Human Anatomy

Course Code: BRT101 **L-3, T-0, P-0, C-3**

Course Contents:

1. Introduction

Human body as a whole: Definition of anatomy and its divisions, Terms of location, positions and planes, Cell and its organelles, Epithelium-definition, classification, describe with examples, function, Glands- classification, describe serous & mucous glands with examples, Basic tissues – classification with examples.

2. Locomotion and Support

Cartilage – types with example & histology, ***Bone*** – Classification, names of bone cells, parts of long bone, microscopy of compact bone, names of bones, vertebral column, inter vertebral disc, fontanelles of fetal skull, ***Joints*** – Classification of joints with examples, synovial joint (in detail for radiology), ***Muscular system***- Classification of muscular tissue & histology, Names of muscles of the body.

3. Cardiovascular System

Heart-size, location, chambers, exterior & interior, Blood supply of heart, Systemic & pulmonary circulation, Branches of aorta, common carotid artery, subclavian artery, axillary artery, brachial, artery, superficial palmar arch, femoral artery, internal iliac artery, Peripheral pulse, Inferior venacava, portal vein, portosystemic anastomosis, Great saphenous vein, Dural venous sinuses, Lymphatic system-cisterna chyli & thoracic duct, Histology of lymphatic tissues, Names of regional lymphatics, axillary and inguinal lymph nodes in brief.

4. Gastro-intestinal System

Parts of GIT, Oral cavity (lip, tongue (with histology), tonsil, dentition, pharynx, salivary glands Waldeyer's ring), Oesophagus, stomach, small and large intestine, liver, gall bladder, pancreas Radiographs of abdomen.

5. Respiratory System

Parts of RS, nose, nasal cavity, larynx, trachea, lungs, bronchopulmonary segments, Histology of trachea, lung and pleura, Names of paranasal air sinuses.

6. Peritoneum: Description in brief

7. Urinary System

Kidney, ureter, urinary bladder, male and female urethra, Histology of kidney, ureter and urinary bladder.

8. Reproductive System

Parts of male reproductive system, testis, vas deferens, epididymis, prostate (gross & histology), Parts of female reproductive system, uterus, fallopian tubes, ovary (gross & histology), Mammary gland-gross.

9. Endocrine Glands

Names of all endocrine glands in detail on pituitary gland, thyroid gland, parathyroid gland, suprarenal glad (gross & histology).

10. Nervous System

Neuron, Classification of NS, Cerebrum, cerebellum, midbrain, pons, medulla oblongata, spinal cord with spinal nerve (gross & histology), Meninges, Ventricles & cerebrospinal fluid, Names of basal nuclei, Blood supply of brain, Cranial nerves, Sympathetic trunk & names of parasympathetic ganglia.

11. Sensory Organs

Skin: Skin-histology, Appendages of skin, ***Eye:*** Parts of eye & lachrymal apparatus, Extra-ocular muscles & nerve supply, ***Ear:*** parts of ear- external, middle and inner ear and contents

12. Embryology

Spermatogenesis & oogenesis, Ovulation, Fertilization, Fetal circulation, Placenta

Reference Books:

1. William Davis, *Understanding Human Anatomy and Physiology*, McGraw Hill
2. Chaurasia, *A Text Book of Anatomy*
3. Ranganathan, T.S., *A Text Book of Human Anatomy*
4. Fattana, *Human Anatomy*, (Description and Applied), Saunder's & C P Prism Publishers, Bangalore
5. Ester. M. Grishcimer, *Physiology & Anatomy with Practical Considerations,* J.P. Lippin Cott. Philadelphia

*** Latest editions of all the suggested books are recommended.**

YEAR I

Human Physiology

Course Code: BRT102 **L-3, T-0, P-0, C-3**

Course Contents:

1. **Cell**

   Definition, Structure and function of Cytoplasmic Organelles, Reproduction Meosis, Mitosis

2. **The important physico-chemical laws applied to physiology**

   Diffusion, Osmosis, Bonding, Filtration, Dialysis, Surface Tension, Adsorption, Colloid

3. **Introduction- composition and function of blood**

   Red blood cells- Erythropoiesis, stages of differentiation function, count physiological Variation. Haemoglobin -Structure, function, concentration physiological variation. Methods of Estimation of Hb, White blood cell- Production, function, life span, count, differential count. Platelets- Origin, normal count, morphology functions. Plasma Proteins- Production, concentration, types, albumin, globulin, fibrinogen, Prothrombin functions. Haemostasis & Blood coagulation. Haemostasis – Definition, normal haemostasis, clotting factors, mechanism of clotting disorders of clotting factors. Blood Bank, Blood groups-A, B, O system, Rh system, **Blood grouping & typing**, Cross-matching, Rh system-Rh factor, Rh in Cross-matching, Blood transfusion – Indication, universal donor and recipient concept. Selection criteria of a blood donor. Transfusion Anticoagulant – Classification, Examples and uses. Anaemia's: Classification – morphological and etiological. Effects of anaemia on body. Blood indices – Colour index, MCH, MCV, MCHC, Erythrocyte Sedimentation Rate (ESR) and Paced cell volume, Normal Values, Definition, determination. Blood Volume – Normal value, determination of blood volume and regulation of blood volume body fluid- pH, normal value, regulation and variation.

4. **Fundamentals of different Organ Systems:**
   - Cardiovascular System
   - Respiratory System
   - Excretory System
   - Reproductive System
   - Endocrine System
   - Lymphatic System

Reference Books:

1. Guyton, Arthur, *Text Book of Physiology*, Prism Publishers
2. Chatterjee, C C, *Human Physiology*, Medical Allied Agency
3. A.K Jain, *Human Physiology*

YEAR I

Fundamental of Medical Imaging & Radiotherapy

Course Code: BRT103 **L-3, T-0, P-0, C-3**

Course Contents:

The X-Ray machine

1. X-ray Production, Emission & Interactions with Matter
2. Radiographic Film, latent Image, Intensifying Screens, Grids
3. Radiographic Exposure, Film Developing & Processing, Radiographic Quality
4. Physical Principles of Diagnostic Ultrasound Plezoelectric Effect.
5. Acoustic Intensity, Reflection, Impedance & Absorption
6. Ultra Sound Transducer, Beam, Operational Modes & Biological Effects.
7. Compound Tomography Principles of Operation System Components & Image Reconstruction.
8. Physical Principles of Magnetic Resonance Imaging: Basic concept, System Components, Biological Hazards, Advantage over CT

Reference Books:

1. Garkal, *Radiology for Poisoning and Applied Anatomy*.
2. Krishnamurthy, *Medical Radiographic Technique and Dark Room Practice*
3. Rehani, *Diagnostic Imaging and Quality Assurance*
4. Chesney and Chesney, *Radiographic Imaging*

*** Latest editions of all the suggested books are recommended.**

YEAR I

Medical Biochemistry

Course Code: BRT104 **L-3, T-0, P-0, C-3**

Course Contents:

1. **Specimen Collection**

   Pre-analytical variables, Collection of blood, Collection of CSF & other fluids, Urine collection. Use of preservatives, Anticoagulants

2. **Introduction to Laboratory Apparatus**

   Pipettes- different types (Graduated, volumetric, Pasteur, Automatic etc.), Calibration of glass pipettes, Burettes, Beakers, Petri dishes, depression plates. Flasks - different types) Volumetric, round bottomed, Erlenmeyer conical etc.). Funnels – different types (Conical, Buchner etc.) Bottles: Reagent bottles – graduated and common, Wash bottles – different types, Specimen bottles etc.

   Measuring cylinders, Porcelain dish, Tubes – Test tubes, centrifuge tubes, test tube draining rack Tripod stand, Wire gauze, Bunsen burner. Cuvettes, significance of cuvettes in colorimeter, cuvettes for visible and UV range, Cuvette holders Racks – Bottle, Test tube, Pipette, Desiccators, Stop watch, rimers, scissors, Dispensers – reagent and sample.

   Any other apparatus which is important and may have been missed should also be covered

3. **Maintenance of Lab Glassware and Apparatus**

   Glass and plastic ware in Laboratory, use of glass: significance of boro silicate glassware and cleaning of glassware, different cleaning solutions of glassware and cleaning of plastic ware, different cleaning solutions.

4. **Instruments (Theory and demonstration)**

   Water bath: Use, care and maintenance, Oven & Incubators: Use, care and maintenance. Water Distillation plant and water deionizers. Use, care and maintenance, Refrigerators, cold box, deep freezers – use, care and maintenance. Reflux condenser: Use, care and maintenance. Centrifuges (Theory and demonstration) *Diagrams to be drawn*

   Definition, Principle, Svedberg unit, centrifugal force, centrifugal field rpm, ref. Conversion of G to rpm and vice versa. Different types of centrifuges, Use care and maintenance of a centrifuge. Laboratory balances [Theory & Practical) Diagrams to be drawn. Manual balances: Single pan, double pan, trip balance, Direct read out electrical balances. Use care and maintenance. Guideline to be followed and precautions to be taken while weighing. Weighing different types of chemicals, liquids. Hygroscopic compounds etc. Colorimeter and spectrophotometer (Theory and Practical) *Diagrams to be drawn*. Principle, Parts diagram. Use, care and maintenance of pH meter and electrodes, Guidelines to be followed and precautions to be taken while using pH meter

5. **Conventional and SI Units**
   Preparation of normal solutions e.g., In Na_2CO_3, O In Oxalic acid, 0.1N HCl, 0.1N H_2S0_4, 0.66 N H_2S0_4 etc. Percent solutions. Preparation of different solutions – v/v w/v (solids, liquids and acids). Conversion of a percent solution into a molar solution.

6. Dilutions

Diluting solutions: e.g. Preparation of 0.1N NaCl from 1N NaCl from 2N HCl etc., Preparing working standard from stock standard, Body fluid dilutions, Reagent dilution techniques, calculating the dilution of a solution, body fluid reagent etc., Saturated and supersaturated solutions.

Standard solutions: Technique for preparation of standard solutions e.g. Glucose, urea, etc.,

Significance of volumetric flask in preparing standard solutions. Volumetric flasks of different sizes, Preparation of standard solutions of deliquescent compounds ($CaCl_2$, potassium carbonate, sodium hydroxide etc.,) Preparation of standards using conventional and SI units.

Acids, bases, salts and indicators: Acids and Bases – Definition, physical and chemical properties with examples. Arrhenius concept of acids and bases, Lowery – Bronsted theory of acids and bases classification of acids and bases. Difference between bases and alkali, acidity and basicity, monoprotonic and polyprotonic acids and bases. Concepts of acid base reaction, hydrogen ion concentration, Ionisation of water, buffer, pH value of a solution, preparation of buffer solutions using pH meter.

Salts – Definition, classification, water of crystallization – definition and different types, deliquescent and hygroscopic salts.

Acid-base indicators: (Theory and Practical) Definition, concept, mechanism of dissociation of an indicator, colour change of an indicator in acidic and basic conditions, use if standard buffer solution and indicators for pH determinations, preparation and its application, list of commonly used indicators, and their pH range, suitable pH indicators used in different titrations, universal indicators.

Quality control: Accuracy, Precision, Specificity, Sensitivity. Limits of error allowable in laboratory, Percentage error, Normal values and Interpretations, pH Regulation, Disturbance in acid Base Balance, Metabolic acidosis & alkalosis, Respiratory acidosis & alkalosis, Respiratory alkalosis, Basic Principles and estimation of Blood Gases and pH, Basic principles and estimation of Electrolytes, Nutritional importance of lipids, carbohydrates, proteins and Vitamins.

Reference Books:

1. Varley, *Clinical Chemistry*
2. Teitz, *Clinical Chemistry*
3. Kaplan, *Clinical Chemistry*
4. Ramakrishna S, Prasanna KG, Rajna, *Text Book of Medical Biochemistry*, Orient Longman
5. Vasudevan DM & Sreekumari S, *Text Book of Biochemistry for Medical Students*.
6. Das, Debajyothi, Biochemistry, Academic, Publishers, Calcutta.
7. Chatterjee, *A Text book of Medical Biochemistry*
8. U. Satyanarayan, *Medical Biochemistry*

*** Latest editions of all the suggested books are recommended.**

YEAR I

Community Healthcare

Course Code: BRT105 **L-3, T-0, P-0, C-3**

Course Contents:

1. Definition of Health, Determinants of Health, Health Indicators of India, Health Team Concept.
   a. National Health Policy
   b. National Health Programmers (Briefly Objectives and Scope)
   c. Population of India and Family welfare programme in India.
2. Family:
   a. The family, meaning and definitions
   b. Functions of types of family
   c. Changing family patterns
   d. Influence of family on Individuals Health, family and nutrition, the effects of sickness in the family and psychosomatic disease and their Importance to physiotherapy.
3. Community:
   a. Rural community: Meaning and features – Health hazards to rural communities, health hazards to tribal community.
   b. Urban community – Meaning and features – Health hazards of urbanities
4. Culture and Health Disorders
   a. Social Change:
   b. Meaning of social changes
   c. Factors of social changes
   d. Human adaptation and social changes
   e. Social changes and stress
   f. Social changes and deviance
   g. Social changes and health programme
   h. The role of social planning in the Improvement of health and rehabilitation
5. Social Problems of disabled:
   a. Consequences of the following social problems in relation to sickness and disability
   b. Population explosion.

Reference Books:

1. K.Perks ,*Textbook of Preventive Social Medicine*
2. Sunder Lal ,Adarsh, Pandey

*** Latest editions of all the suggested books are recommended.**

YEAR I
Foundation English

Course Code: BRT106

(Common with BML106/ BPT107/COT105)	L	T	P	C
	2	2	0	3

Unit I

Functional Grammar: Patterns & Parts of speech Subject, Predicate, Noun, Pronoun, Adjective, Adverb, Verb, Verb phrases, Conjunction, Interjection. Articles, Preposition, Tenses: functions, Synthesis, Transformation, Spotting errors and correction of sentences. **(12 Hours)**

Unit II

Vocabulary: Word formation, Prefix, Suffix, compound words, conversion, Synonyms, Antonyms, Homophones and Homonyms, How to look up a dictionary, The Language of Doctor and Patient, General description and Medical description, Medical abbreviations, Terminology used in Medical Lab Technology etc. **(12 Hours)**

Unit III

Communication: Meaning & importance of communication, elements of human communication, Barriers to effective communication, channels of communication, Language as a tool of communication, 7C's of Communication, Tips for effective communication. **(12 Hours)**

Unit IV

Requisites of Sentence writing: Fragmented sentences, a good sentence, expletives, garbled sentences, rambling sentences, loaded sentences, Parallel Comparison, Series, Squinting construction, Loose & periodic sentences, Dangling participles, ellipsis. **(12 Hours)**

Unit V

Requisites of Paragraph writing: Structure of Paragraph, Coherence & Unity, Development of paragraph, Inductive order, Deductive order, spatial order, Linear, chronological orders, expository writing, and Argumentative writing, Factual description of objects, process, experiments. **(12 Hours)**

Recommended Books:

1. Wren & Martin, *High School English Grammar & Composition* – S. Chand & Co. Delhi.
2. Lewis Norman, *Word Power Made Easy* – W.R. Goyal Publication & Distributors, Delhi.
3. Raman Meenakshi & Sharma Sangeeta, *Technical Communication-Principles & Practice* – O.U.P. New Delhi. 2007.
4. Medical Lab Technology Terminology.

NOTE:

This syllabus has been designed to improve the oral and written communication skills of students. The faculty members should put emphasis on practical (oral) activities for generating students' interest in language learning.

*** Latest editions of all the suggested books are recommended.**

YEAR I
Basics of Computers

Course Code: BRT107 **L-2, T-0, P-0, C-2**

Course Contents:

1. Input and Output units: Their functional characteristics, main memory, cache memory read only memory, overview of storage devices – floppy disk, hard disk, compact disk, tape.
   Computer Networks and Communication: Network types, network topologies.
2. Internet - Evolution , Protocols, Interface Concepts, Internet Vs Intranet, Growth of Internet, ISP.SSS Connectivity – Dial-up, Leased line, VSAT etc. URLs, Domain names, Portals.

   E-MAIL- Concepts, POP and WEB based E-mail, merits, address, Basics of Sending & Receiving, E-mail Protocols, Mailing List, Free E-mail services.
3. Electronic Payment Systems: Introduction, Types of Electronic Payment Systems, Digital Token-Based, Electronic Payment Systems, Smart Card and Electronic Payment Systems, Credit Card-Based Electronic Payment Systems, Risk and Electronic Payment Systems.
4. Html – Concepts of Hypertext, Versions of HTML, Elements of HTML syntax, Head & Body Sections, Building HTML documents, Inserting texts, Images, Hyperlinks, Backgrounds and Color Controls, Different HTML tags, Table layout and presentation, Use of font size & Attributes, List types and its tags, Use of Frames and Forms in web pages. Overview of MS Front Page, Macromedia Dream weaver, and other popular HTML editors, designing web sites using MS Front Page (using at least Front Page 2000)

Reference Books:

1. Sanders, D.H., *Computers Today*, McGraw Hill.
2. Trainer, T.N., Computers, McGraw Hill.
3. Joseph, P.T., S.J., *E- Commerce an Indian Perspective,* Prentice Hall of India.

*** Latest editions of all the suggested books are recommended.**

YEAR I

Basics Radiation Physics

Course Code: BRT108 **L-4, T-0, P-0, C-4**

Course Contents:

Fundamental of Physics

1. Matter & energy
2. Radiation & spectra
3. Electricity and Magnetism
4. Atoms & nuclei
5. Radioactivity

X-rays

1. Production
2. Properties
3. Measurement
4. Interaction of X-rays- Gamma rays and electron radiation with matter and principles of differential absorption in biological materials.

Reference Books:

1. K.Thalayan, *Basic of Radiological Physics*
2. K.Thalayan, *Textbook of Radiological Safety*
3. Rehani, *Advance Medical Physics*

* **Latest editions of all the suggested books are recommended.**

YEAR I
Human Anatomy (Practical)

Course Code: BRT151 **L-0, T-0, P-2, C-1**

Course Contents:

1. Histology of types of epithelium, Histology of serous, mucous & mixed salivary gland
2. Histology of the 3 types of cartilage, Demo of all bones showing parts, radiographs of normal bones & joints, Histology of compact bone (TS & LS), Demonstration of all muscles of the body, Histology of skeletal (TS & LS), smooth & cardiac muscle
3. Demonstration of heart and vessels in the body, Histology of large artery, medium sized artery & vein, large vein, Microscopic appearance of large artery, medium sized artery & vein, large vein, pericardium, Histology of lymph node, spleen, tonsil & thymus, Normal chest radiograph showing heart shadows, Normal angiograms
4. Demonstration of parts of respiratory system, Normal radiographs of chest, Histology of lung and trachea
5. Demonstration of reflections
6. Demonstration of parts of urinary system, Histology of kidney, ureter, urinary bladder, Radiographs of abdomen-IVP, retrograde cystogram
7. Demonstration of section of male and female pelvis with organs in situ, Histology of testis, vas-deferens, epididymis, prostate, uterus, fallopian tubes, ovary, Radiographs of pelvis – hystero salpingogram
8. Demonstration of the glands, Histology of pituitary, thyroid, parathyroid, suprarenal glands
9. Histology of peripheral nerve & optic nerve, Demonstration of all plexuses and nerves in the body, Demonstration of all part of brain, Histology of cerebrum, cerebellum and spinal cord
10. Histology of thin and thick skin, Demonstration and histology of eyeball, Histology of cornea & retina

Reference Books:

1. William Davis, *Understanding Human Anatomy and Physiology*, McGraw Hill
2. Chaursia's, *Practical of Human Anatomy*

*** Latest editions of all the suggested books are recommended.**

YEAR I

Human Physiology (Practical)

Course Code: BRT152 **L-0, T-0, P-2, C-1**

Course Contents:

1. Haemoglobinometry
2. White Blood Cell Count
3 Red Blood Count
4. Determination of Blood Groups
5. Leishman's staining and Differential WBC count
6. Determination of packed cell Volume
7. Erythrocyte sedimentation rate [ESR]
8. Calculation of blood indices
9. Determination of Clotting Time, Bleeding Time
10. Blood pressure Recording
11. Auscultation for Heart Sounds
12. Artificial Respiration
13. Determination of vital capacity

Reference Books:

1. Jain, A.K., *Practical Handbook of Human Physiology*
2. Nageshwari, *Practical Workbook of Human Physiology*
3. Gupta, *Medical Physiology Made Easy*

*** Latest editions of all the suggested books are recommended.**

YEAR I

Fundamental of Medical Imaging & Radiotherapy (Practical)

Course Code: BRT153 **L-0, T-0, P-2, C-1**

Course Contents:

Practical/Clinical posting

1. X-ray tubes general features and mobile equipments.
2. Care and maintenance of X-ray equipments and image intensifier
3. To study effects of Kilo Voltage Peak (KVP) and Milli Ampere Second (MAS)
4. T o check the safety of dark room.
5. To check the speed of intensifying screen.
6. To check the developing time test and function.
7. Silver recovery method

Reference Books:

1. Rehani, *Diagnostic Imaging and Quality Assurance*
2. Chesney and Chesney, *Radiographic Imaging*

*** Latest editions of all the suggested books are recommended.**

YEAR I

Medical Biochemistry (Practical)

Course Code: BRT154 **L-0, T-0, P-2, C-1**

Course Contents:

1. Analysis of Normal Urine
2. Liver Function tests
3. Lipid Profile
4. Renal Function test
5. Blood gas and Electrolytes
6. Demonstration of Glucometer with strips

Reference Books:

1. Das, Debajyothi, *Biochemistry,* Academic Publishers, Calcutta.
2. Chatterjee, *A Text book of Medical Biochemistry*
3. Satyanarayan, U., *Medical Biochemistry*

*** Latest editions of all the suggested books are recommended.**

YEAR I

Basics of Computers (Practical)

Course Code: BRT155 **L-0, T-0, P-2, C-1**

Course Contents:

Unit I

Concept in Computer:

Definition of Computer, History of Computer , Generations, Characteristic and Application of Computers, Classification of Computers, Computer Hardware, CPU, Various Types of I/O devices, Peripherals Devices, Storage Devices. Management Introductory concepts in operating system, textual Vs GUI Interface, Introduction to DOS

Unit III

Starting MS WORD, Creating and formatting a document, Changing fonts and point size, Table Creation and operations, Autocorrect, Auto text, spell Check, Word Art, Inserting objects, Page setup, Page Preview, Printing a document, Mail Merge.

Unit III

Starting Excel, Work sheet, cell inserting Data into Rows/ Columns, Alignment, Text wrapping , Sorting data, Auto Sum, Use of functions, referencing formula cells in other formulae , Naming cells, Generating graphs, Worksheet data and charts with WORD, Creating Hyperlink to a WORD document , Page set up, Print Preview, Printing Worksheets.

Unit IV

Starting MS–Power Point,, Creating a presentation using auto content Wizard, Blank Presentation, creating, saving and printing a presentation, Adding a slide to presentation, Navigating through a presentation, slide sorter, slide show, editing slides, Using Clipart, Word art gallery, Adding Transition and Animation effects, setting timings for slide show, preparing note pages, preparing audience handouts, printing presentation documents, MS- Access, Creating tables and database, Internet, Use of Internet (Mailing, Browsing, Surfing).

Text Books:

1. Sinha P. K., *Computer Fundamentals.*
2. Bruck Bill, *The Essentials Office 2000 Book.*

Reference Books:

1. Leon A and Leon M., *Introduction to Computers.*
2. Norton‟ s Peter, *Introduction to Computers.*

*** Latest editions of all the suggested books are recommended.**

YEAR I

Hospital Postings

Course Code: BRT156 **L-0, T-0, P-10, C-5**

Course Contents:

Students shall be deputed to various labs of Radiology department wherein they shall undergo practical training of handling patients, collection and processing of investigation (X Ray, Special procedures, CT Scan, MRI, Ultrasound etc) and equipment.

Identification of patient's particulars based on CR number, Lab Number and transfer of samples from collection to different labs.

Process of performing various tests in different labs

Each student is required to maintain a logbook of the various posting. Student's performance shall be evaluated on continuous basis by the faculty posted in various sections. The faculty shall submit the assessment records of each student posted in his/her section on monthly basis to the HOD. Marks will be awarded out of 50.

II YEAR
Advanced Radiographic Techniques

Course Code: BRT201 **L-4, T-0, P-0, C-4**

Course Contents:

Ultra Sound

1. Principle of Ultra Sound
2. Types of Ultra sound
3. Description of Equipment
4. Indication and clinical Application

CT SCAN

1. Basic principle of CT scan
2. Description of Equipment
3. Conventional CT Scan
4. Indications and Contra Indications

COURSE CONTENTS:

1. Preparation of Patients
2. Contrast Media
3. Indication and Contraindication
4. Clinical application
5. Procedure
6. MR Angiography

Reference Books:

1. Chapman, *Radiological Procedure*
2. Bhushan L Lakkar, *Radiological Procedure*
3. Clark, *Radiological Procedure*
4. Kartikeyan, *Step by Step CT Made Easy*
5. Khurana, *3D &4D Ultrasound: A Textbook and Atlas*

*** Latest editions of all the suggested books are recommended.**

II YEAR

Radiation Physics and Radiation Protection

Course Code: BRT202 **L-4, T-0, P-0, C-4**

Course Contents:

RADIATION PHYSICS

1. Atomic structure as applied to generation of X-rays and radioactivity spectrum of diagnostic imaging and therapy X ray.
2. Effects of variation of tube voltage current, filtration, III waveform and target material on X-ray production lows of radioactivity and decay schemes of different alpha, Beta, gamma ray. Megatron and position emitters as used in medicine especially in radiotherapy.
3. Artificial radionuclide generators employed in medicine in general and radiotherapy sources in particulars.
4. Interaction of radiation with matter attenuation absorption and scattering phenomena.
5. Photoelectric absorption Compton scattering pair-production and annihilation process ionization, effects of geometry of thickness of the absorber. Dependence on the nature and atomic number of the absorber and on radiation quality.
6. Transmission of X-ray through body tissues linear energy transfer.
7. Range of secondary electrons and electron build up relative amount of scatter from homogeneous and homogonous beam defining the passage through a patient.
8. Physical requirements of beam defining devices e.g. cones, diaphragm, collimators etc.
9. Units of radiation measurements specification of quality and half- valve thickness (HIV) and its measurements, filters and filtration.
10. Measurement of radiation and dosimeteric procedures.
11. Radiation detectors and their principles of working.
12. Definition of Bragg-peak , percentage depth dose, peak scatter factor, tissue air-ratio, tissue maximum ratio, scatter air ratio, isodose curves and radiation penumbra of different beams.
13. Wedge filters, wedge angle, hinge angle.
14. Compensator beams flattering filters, scattering foils.
15. Physical properties of phantom materials, bolus and substitutes.
16. Factor used for treatment dose calculations, Daily treatment time and monitor units calculation method physical aspects of electron and neutron therapy.

RADIATION PROTECTION

1. Definition of radiation hazards maximum permissible dose and annual limit of intake (ALI) permissible dose levels on and around sealed source housing and installation principles of radiation protection and MPD of different ICRP rules, stochastic and non-stochastic effects.
2. Importance of 'ALARA' physical principles of design and planning of installation safe work practice in teletherapy and brachytherapy.
3. Shielding materials Radiation survey and personnel monitoring devices film badge, TLD badges pocket dosimeters.

Reference Books:

1. Rehani, *Advance Medical Physics*
2. Faiz M Khan, *Radiation Physics*

3. * Latest editions of all the suggested books are recommended.

II YEAR
Equipment of Radiotherapy

Course Code: BRT 203 **L-4, T-0, P-0, C-4**

Course Contents:

1. Orthovoltage equipment with special reference to physical design equipment of tube and its accessories and interlocks, gamma ray sources used radiotherapy especially cobalt 60 source its construction and source housing and handling mechanism.
2. Principles of isocentric Tele-isotope machines, megavoltage x-ray and electron beam accelerators and betatron.
3. Salient features of components of Linear Accelerator like tube design, wake guide, target design, beam bending system.
4. Radio-frequency generators like magnetron and klestron.
5. Basic principle of remote after-loading system/machines and sources used.
6. Principles of simulators and vacuum forming machines for making casts.
7. Sterofoam template cutting system introduction to radio-surgery.
8. Equipment and dosimetry equipment.

Reference Books:

1. Krishan, *Step by Step Management of Chemo and Radiotherapy*
2. Lele, *Principle and Practice of Nuclear Medicine and Correlative Medical Imaging*
3. Faiz M Khan , *Textbook of Radiotherapy*

*** Latest editions of all the suggested books are recommended.**

II YEAR

Special Radiographic Technique & Procedures

Course Code: BRT204 **L-4, T-0, P-, C-4**

Course Contents:

1. Special procedure and related Contrast Media
    - Contrast Media
    - Emergency in Radiology Department
    - Excretory System
        a) IVP
        b) RGU
        c) MCU
    - Oral Cholecystography
    - Percutaneous Trans hepatic Cholecystography
    - G.I. Tract
        a) Barium Swallow
        b) Barium Meal Series
        c) Barium Meal Follow Through
        d) Barium Enema
    - Hystero Salpingoraphy
    - Angiography
    - Tomography
2. Radiography of body parts and their poisoning
    - Upper limb
    - Lower limb
    - Abdomen, Head and Neck
3. Guideline for design and location of X-ray equipments
4. Dark Room designing
    - Outline structure of Dark Room
    - Material used
    - Miscellaneous

Reference Books:

1. Clark, *Radiographic Positioning and Special Procedure*
2. Chapman, *Radiological Procedure*
3. Krishnamurthy, *Medical Radiographic Technique & Darkroom Practice*

*** Latest editions of all the suggested books are recommended.**

II YEAR

Orientations in Para Clinical Sciences

Course Code: BRT205 **L-4, T-0, P-0, C-4**

Course Contents:

UNIT-I

PARASITOLOGY

1. Entamoeba Histolytica
2. Leishmania
3. Material Parasites of man
4. Helminthology
5. Taenia Saginata
6. Taenia Soleum
7. Echinococcus granulosus
8. Ascaris Lumbricoides
9. Ancylostoma duodenale
10. Strongylids stercoralis

UNIT-II

MICROBIOLOGY

1. Morphology & Physiology of Bacteria
2. Staphylococcus
3. Streptococcus
4. Mycobacterium tuberculosis
5. Spirochetes
6. Cornybacterium Diptheria

UNIT-III

VIRUS

1. General Properties of Virus
2. Herpes virus
3. Poliovirus
4. Hepatitis virus
5. Oncogenic virus
6. HIV

UNIT-IV

PATHOLOGY

1. Inflammation
2. Neoplasia
3. Osteomyelitis
4. Fractures
5. Osteoporosis
6. Rickets

7. Osteomalacia
8. Tumours of Bone
9. Rhematoid Arthritis
10. Gout
11. Osteoarthritis

UNIT-V

PHARMACOLOGY

1. Pharmacokinetics of Drugs
   a) Absorption
   b) Distribution
   c) Metabolism
   d) Excretion
2. Adverse drug reactions & Management
3. Pharmacology of different dyes used in Radiological procedures

Reference Books:

1. Rabbins & Cotran, *Pathologic Basis & Diseases*
2. Harsh Mohan, *Pathologic Basis & Diseases*
3. Todd & Sanford, *Clinical Diagnosis by Laboratory Method*
4. Ramanik Sood, *Laboratory Technology Methods and Interpretation*
5. Anand Narayan and Panikar, *Textbook of Microbiology*
6. Baweja, *Medical Microbiology*
7. Arora, *Medical Lab Technology*

*** Latest editions of all the suggested books are recommended.**

YEAR II
English Communication

Course Code: BRT206
(Common with BML207/ BPT207)

L	T	P	C
2	2	0	3

Unit I

Technical Paper writing: Definition and purpose, essentials of a good technical paper/Article, Scientific Article writing, Difference between Technical Paper, Article and Scientific Article, elements, Steps in writing Technical paper & Scientific Article, Methods of writing technical paper & Scientific article. **(12 Hours)**

Unit II

Office Management: Types of Correspondence- different types of official correspondence, Demi Official letters, Government letters, Memos and notes. Receipt and Dispatch of mail, Filing System, Classification of Mails, Managing Computer & E-mail. **(12 Hours)**

Unit III

Presentation skills: Importance of Presentation Skills, Capturing Data, Voice & Picture Integration, Guidelines to make Presentation Interesting, Body Language, Voice Modulation, Audience Awareness, Presentation Plan, Visual Aids, Forms of Layout, Style of Presentation.

(12 Hours)

Unit IV

Writing skills: Precis writing, Report writing (with special stress on scientific/technical report, preparing field/observation report). Letter writing/application writing (Social, business letter, applying for a job, for higher studies, Preparing curriculum vitae, subscribing to a journal, letters to the Editor), Essay writing. **(12 Hours)**

Unit V

Corporate behavior & Oral communication: Corporate behavior, Corporate expectation, Office etiquettes, Telephonic conversation & etiquette. Principles of effective oral communication, features, Vitals of communication, communicating with concern & empathy, interpersonal communication, Persuasive communication. **(12 Hours)**

Recommended Books:

1. Newstron John W., *Organizational Behaviour: Human Behaviour at work* – Tata McGraw Hill.
2. Mishra Sunita & Muraliksishra C., *Communication Skills for Engineers* – Pearson Education, New Delhi.
3. Raman Meenakshi & Sharma Sangeeta, *Technical Communication-Principles & Practice* – O.U.P. New Delhi. 2007.

NOTE:

This syllabus has been designed to improve the oral and written communication skills of students. The faculty members should put emphasis on practical (oral) activities for generating students' interest in language learning.

*** Latest editions of all the suggested books are recommended.**

YEAR II
Advanced Radiographic Techniques (Practical)

Course Code: BRT251 **L-0, T-0, P-2, C-1**

Course Contents:
Based on Theory

Reference Books:

1. Chapman, *Radiological Procedure*
2. Bhushan L Lakkar, *Radiological Procedure*
3. Clark, *Radiological Procedure*
4. Kartikeyan, *Step by Step CT Made Easy*
5. Khurana, 3D&4D *Ultrasound: A Textbook and Atlas*

*** Latest editions of all the suggested books are recommended.**

YEAR II

Special Radiographic Technique & Procedures (Practical)

Course Code: BRT252 **L-0, T-0, P-2, C-1**

Course Contents:

1. Radiography in various positions for all the special radiological procedures, using contrast media as per syllabus.
2. Positioning and treatment of various cases patients by using:
   a) Prescribed filters and wedges
   b) Protection of various organs

Reference Books:

1. Clark, *Radiographic Positioning and Special Procedure*
2. Chapman, *Radiological Procedure*
3. Krishnamurthy, *Medical Radiographic Technique & Darkroom Practice*

*** Latest editions of all the suggested books are recommended.**

YEAR II
Hospital Postings

Course Code: BRT253 **L-0, T-0, P-10, C-5**

Course Contents:

Students shall be deputed to various labs of Radiology department wherein they shall undergo practical training of handling patients, collection and processing of investigation (X Ray, Special procedures, CT Scan, MRI, Ultrasound etc) and equipment.

Identification of patient's particulars based on CR number, Lab Number and transfer of samples from collection to different labs.

Process of performing various tests in different labs

Each student is required to maintain a logbook of the various posting. Student's performance shall be evaluated on continuous basis by the faculty posted in various sections. The faculty shall submit the assessment records of each student posted in his/her section on monthly basis to the HOD. Marks will be awarded out of 50.

*** Latest editions of all the suggested books are recommended.**

III YEAR

Radiotherapy Planning and Quality Control

Course Code: BRT301 **L-3, T-0, P-0, C-3**

Course Contents:

1. Definition of treatment planning.
2. Planning procedure in general with special emphasis on turnout localization and target volume measurement by conventional radiographic method and simulator imaging.
3. Role of special contrast medium base radiotherapy.
4. CT/MRI/Ultrasound/ radionuclide imaging methods physical and clinical requirements of field selection of treatment in Teletherapy, role of portal films in treatment planning. Choice of central axis percentage depth dose data and isodose curve form a spectrum of radiotherapy beams used treatment.
5. Requirement and practice of organ shielding single multiple fields, and rotational field therapy, planning procedures.
6. Computerized treatment planning system choice of dose, time and fraction.
7. Safety of critical organs in planning methods, Role of treatment shell immobilization devices and laser in patients set up and positioning
8. Acceptance tests on therapy simulator telescope megavoltage X-ray and electron bean machines.
9. Contribution of technologist in radiation calibration of quality control assurance in execution of radiation treatment.

Reference Books:

1. Mohanti, *A Textbook of Radiation Oncology*
2. K.Thalayan , *Textbook of Radiological Safety*
3. Faiz M Khan, *Textbook of Radiotherapy and Treatment Planning*

*** Latest editions of all the suggested books are recommended.**

III YEAR

Equipments of Radio Diagnosis

Course Code: BRT302 **L-3, T-0, P-0, C-3**

COURSE CONTENTS:

1. Equipments and description
2. Color Doppler, Flow Imaging
3. Indication
4. Clinical Application

CT SCAN

COURSE CONTENTS:

1. Advancement in CT
2. Spiral CT
3. Preparation opt Patient
4. Contrast Media
5. Indication and Contraindication
6. Technical Aspects of various procedures in CT

NUCLEAR MEDICINE & PET SCAN

COURSE CONTENTS:

1. Nuclear medicines, PET scan and Mammography
   a) Definition
   b) Characteristic of Radio Nuclide
   c) Commonly used Radio Nuclides
   d) Description of Equipment

Reference Books:

1. Lele, *Principle and Practice of Nuclear Medicine and Correlative Medical Imaging*
2. Satish K Bhargava, *CT Imaging*
3. Singh Hariqbal, *Atlas of Human Anatomy on CT Imaging*

*** Latest editions of all the suggested books are recommended.**

III YEAR

Interventional Radiology & Drugs Used in Diagnostic Radiology

Course Code: BRT303 **L-3, T-0, P-0, C-3**

Course Contents:

1) Interventional Radiology

1) Definition of Interventional Radiology
2) Indication for various Interventional procedures
3) Clinical Application : Disease diagnosis, Severity interpretation, Case follow up
4) Name of different type of procedure

2) Equipment used in various interventional procedures

C-arm equipment: Instrumentation and working procedure
Catheters: Classification, Catheters used for different studies, Balloon angioplasty catheters, Sterilization of catheters, Guide wires

3) Angiography (Cerebral, Peripheral, Visceral)

a) Anatomy of blood vessels
b) Definition, Indication and Contraindication
c) Patient preparation and Contraindication
d) Direct needle puncture
e) Catheter angiography

4) ANAESTHESIA AND EMERGENCY DRUGS USED IN DIAGNOSTIC RADIOLOGY

1) Facilities regarding general Anaesthesia in the X-ray Department.
2) Anaesthetic Problems associated with specific technique
   a)Vascular Studies
   b) Carotid Angiography
   c) Venography

5) Sterile Techniques in angiography procedures

References:

1- *Dondelinger R. F. ,Textbook of Interventional Radiology*
2- *Chapman, Radiological Procedures*
3- *Douglas W., Applied Angiography for Radiographers*

*** Latest editions of all the suggested books are recommended.**

III YEAR

Radiotherapy & Brachytherapy Techniques in Malignant and Non-Malignant Diseases

Course Code: BRT304 **L-3, T-0, P-0, C-3**

Course Contents:

1. Orthovoltage techniques in skin tumours, and cancers of the breast Advantages and disadvantages of orthovoltage in radiotherapy.
2. Tele isotope cobalt therapy techniques in skin and deep sealed tumours parallel opposed fields and small beam directed therapy and wedge field techniques in head and neck tumours especially cancers of larynx treatment techniques for cancer of maxillary antrum and pituitary tumours.
3. Treatment techniques in cancer of breast by telecobalt and low energy megavoltage X-rays and electron beam.
4. Tele and brachy-therapy techniques of treatment of different stages of carcinoma cervix uteri with special emphasis on HDR and LDR brachytherapy.
5. Three field techniques in cancer of esophagus and bladder.
6. Radiotherapy technique in medulo blastoma. Whole body and hemi body radiation techniques.
7. Treatment techniques of malignant and non malignant conditions in ovarian and kidney tumours.
8. Radiation treatment techniques of lymphomas with special emphasis on mantle field irradiation radiotherapy techniques in head and neck cancer.

Salient features of computers in radiotherapy and its application.

1. Introduction to computer, Hardware and software component.
2. Input and output data systems computerized treatment planning systems in tale, brachytherapy and documentations.

Radiological protection

1. Dose limits of occupational workers & Publics.
2. Principle & Method of Protection.
3. Monitoring devices.

Reference Books:

1. Mohanti, *A Textbook of Radiation Oncology*
2. K.Thalayan, *Textbook of Radiological Safety*
3. Faiz M Khan, *Textbook of Radiotherapy and Treatment Planning*
4. Ballinger, *Textbook of Radiation Oncology*

*** Latest editions of all the suggested books are recommended.**

III YEAR

Orientation in Clinical Sciences

Course Code: BRT305 **L-3, T-0, P-0, C-3**

Course Contents:

UNIT-I

MEDICINE

1. Pericarditis
2. Valvular diseases
3. Rheumatic Heart Disease
4. Heart failure
5. Chronic Bronchitis
6. Emphysema
7. Brochitis
8. Pneumonia
9. Tuberculosis
10. Pleura effusion
11. Empyema
12. Spontaneous Phenumo thorax

UNIT-II

1. Aclasia cardia
2. Peptic ulcer
3. Intestinal obstruction
4. Crohn's disease
5. Ulcerative colitis
6. Pancreatitis
7. Portal Hypertension
8. Ascitis
9. Cirrhosis
10. Cholecystitis

UNIT-III

UTI

1. Glomerulo nephritis
2. Nephrotic Syndrome
3. Urinary calculi
4. Polycystic Kidney disease
5. Cerebral Vascular Disorders
6. Meningitis
7. Encephalitis

UNIT-IV
ORTHOPAEDICS

1. Fracture
2. Type Mechanism, Healing, Delayed Union, Non- complication
3. Injuries of the shoulder girdle, Dislocation of shoulder
4. Number of Humerus, Elbow Forearm
5. Number of Distal Radius & ulna
6. Injuries of the carpal
7. Dislocation of Hip
8. Femur, Tibia, Ankle, calcaneum
9. Acute & chronic osteo arthritis
10. Rhematoid arthritis
11. Paget's Disease
12. Ankylosing spondylitis
13. Club foot
14. Bone Tumour-Benign Malignant

UNIT- V

1. Surgery
2. Cholelithiasis
3. Peritonitis
4. Suprahrenic Abscess
5. Appendicitis
6. Benign Hypertrophy prostate
7. Sinusitis

OBSTETRICS

1. Diagnosis of Pregnancy
2. Normal Labour

Reference Books:

1. Krishna Das, *Textbook of Medicine*
2. Kathale, *Essentials of clinical medicine*
3. Gopalan, *Handbook of Orthopaedics*
4. Shenoy, *Essencial of Orthopaedics*

*** Latest editions of all the suggested books are recommended.**

III YEAR

Radiotherapy Planning and Quality Control (Practical)

Course Code: BRT351 **L-0, T-0, P-4, C-2**

Course Contents:

1. Treatment planning of patient
2. Deals with equipments
3. Maintenance of all radiological equipments
4. Safety of critical organs in planning methods, Role of treatment shell immobilization devices and laser in patients set up and positioning.
5. Computerized treatment planning system uses in radiation dose, time and fraction.
6. Uses of special contrast medium in radiotherapy.

Reference Books:

1. Mohanti, *A Textbook of Radiation Oncology*
2. K.Thalayan, *Textbook of Radiological Safety*
3. Faiz M Khan, *Textbook of Radiotherapy and Treatment Planning*

*** Latest editions of all the suggested books are recommended.**

III YEAR

Equipment of Radio Diagnosis
(Practical)

Course Code: BRT352 **L-0, T-0, P-4, C-2**

Course Contents:
1. Application of various procedures in well equipped Hospitals and Diagnostic Centers.
2. Uses and functioning method of ultrasound probe
3. Patient evaluation on different disease and their diagnosis
4. Working method of CT scan and MRI
5. Calculation of radio nuclide isotopes

Reference Books:
1. Lele, *Principle and Practice of Nuclear Medicine and Correlative Medical Imaging*
2. Satish K Bhargava, *CT Imaging*
3. Singh Hariqbal, *Atlas of Human Anatomy on CT Imaging*

*** Latest editions of all the suggested books are recommended.**

III YEAR

Interventional Radiology & Drugs Used in Diagnostic Radiology

(Practical)

Course Code: BRT353 **L-0, T-0, P-4, C-2**

Course Contents:

1. Radiography in various positions for all the special radiological procedures, using contrast media as per syllabus.
2. Positioning and treatment of various caser patients by using
   a) Prescribed filters and wedges
   b) Protecting various organs
   c) Handle all patients in special and general radiography.

Reference Books:

1. Bhushan L lakkar, *Radiological Procedure*
2. Clark, *Radiological Procedure*
3. Khurana, *3D&4D Ultrasound: A Textbook and Atlas*

*** Latest editions of all the suggested books are recommended.**

III YEAR

Hospital Postings

Course Code: BRT354 **L-0, T-0, P-10, C-5**

Course Contents:

Course Contents:

Students shall be deputed to various labs of Radiology department wherein they shall undergo practical training of handling patients, collection and processing of investigation (X Ray, Special procedures, CT Scan, MRI, Ultrasound etc) and equipment.

Identification of patient's particulars based on CR number, Lab Number and transfer of samples from collection to different labs.

Process of performing various tests in different labs

Each student is required to maintain a logbook of the various posting. Student's performance shall be evaluated on continuous basis by the faculty posted in various sections. The faculty shall submit the assessment records of each student posted in his/her section on monthly basis to the HOD. Marks will be awarded out of 50.

III YEAR

Computed Tomography Techniques & Equipments

Course Code: BRT306 **L-3, T-0, P-0, C-3**
[BRT306 amended vide approval dt. 18th, Feb, 2014 of V.C]

Course Contents:

UNIT-I

Introduction to Computed Tomography and Principle of Computed Tomography

History, Advantage and Disadvantages of CT, Basic principle of CT

UNIT-2
Generations of Computed Tomography
1st generation, 2nd generation, 3rd generation, Slip ring technology, 4th generation, Electron beam CT, Dual Source CT, Flat Panel Detector CT
Single and Multi slice Technology

UNIT-3

Instrumentation

CT scanner gantry, Detectors & Data Acquisition System, Generator, Computer and image processing System Image display system, storage, recording and communication system, CT control console, Options and accessories for CT systems

UNIT-4
Image Reconstruction

Basic principle, Reconstruction algorithms, Image reconstruction from projections, Types of data reconstruction

UNIT-5
Image Display and Image Quality
Image formation and representation, Image processing, Pixel and voxel, CT number Window level and window width, Qualities, Resolution, Contrast, Sharpness, Noise properties in CT

UNIT-6
CT Artefacts

Classification, Types, Causes, Remedies

UNIT-7

Diagnostic aspects of CT and post Processing Techniques

HRCT, Isotropic imaging, Patient management, Patient preparation, positioning, Technologist role, Protocols for whole body imaging

Clinical applications of CT, 2D & 3D imaging, MPR, SSD, Volume Rendering

References:

1- *Euclid S., Computed Tomography- Physical Principle, Clinical application & quality control*
2- *stewart C. B., Computed Tomography*

III YEAR
Magnetic Resonance Imaging Techniques & Equipment

Course Code: BRT307 **L-3, T-0, P-0, C-3**

[BRT307 amended vide approval dt. 18th, Feb, 2014 of V.C]

Course Contents:

UNIT-1
Introduction and Basic Principle of Magnetic Resonance Imaging
History of MRI , Electricity & Magnetism, Laws of magnetism,
Atomic structure, Motion within the atom, The Hydrogen nucleus,
Precession, Larmor equation, Resonance, MR signal, Free induction decay signal, Relaxation, T1 recovery, T2 decay, Pulse timing& parameters.

UNIT-2
MRI Hardware
Introduction, Permanent magnets, Electromagnets, Super conducting magnets, Fringe fields, Shim coils, Gradient coils, Radio-frequency coils, the pulse control units, Patient transportation system, Operator interface

UNIT-3
Encoding, Data collection & Image formation
Introduction, Gradients, Slice selection, Frequency encoding, Phase encoding, Scan timing, Sampling, data space, k-space, k-space filling and fast Fourier transformation.

UNIT-4
Pulse sequences
Introduction To basic pulse sequences.
Spin echo sequences,
Conventional spin echo, Fast spin echo
Inversion recovery,
STIR, FLAIR
Proton Density Imaging,
Gradient echo pulse sequences
Conventional gradient echo**,** The study state, SSFP**,** Coherent residual transverse magnetization**,** Incoherent residual transverse magnetization**,** Ultra- fast imaging, Advanced imaging techniques, EPI

UNIT-5
MRI parameters & Trade offs
Introduction, Signal To Noise Ratio (SNR) & How to increase SNR, Contrast to Noise Ratio (CNR), Spatial resolution & how to increase the spatial resolution, Scan time & how to reduce time, Trade-offs, Decision making, Volume imaging

UNIT-6
MRI Artefacts
Introduction, Phase miss-mapping, Aliasing or wrap around, Chemical shift artefact, Chemical miss-registration, Truncation artefact/Gibbs phenomenon, Motion of the patient
Magnetic susceptibility artefact, Magic angle artefact, Zipper artefact, shading artefact

Cross excitation and cross talk

UNIT-7

MRI contrast agents

Introduction, Uses and methodology, Review of weighting, Mechanism of action, Dipole-dipole interactions, Magnetic susceptibility, Relaxivity

Gadolinium safety, Feridex safety, Current applications of contrast agents

UNIT-8

Flow Phenomena & MRI angiography

Introduction, The mechanisms of flow, Time of flight phenomenon, Entry slice phenomenon, Intra-voxel dephasing

Flow phenomena compensation

Gradient moment rephrasing, Pre saturation, Even echo rephrasing, MR Angiography

UNIT-9

Clinical Applications, Scanning Protocols and Safety aspects

Protocols for whole body imaging , The main magnetic field, Gradient magnetic field, Radio-frequency fields, Projectiles, Implants and prostheses, Pacemakers, Medical emergencies, Patient monitoring, Monitors and devices in MRI Claustrophobia, Quenching, Safety tips, Layout planning

References:

1- *Stark & Bradley, Fundamentals of MRI*
2- *Catherine W., MRI in Practice*
3- *Stewart C B., MRI Physics & Biological Principle*

III YEAR

Techniques & Equipments of Interventional Radiology & Nuclear Medicine Technology

Course Code: BRT308 **L-3, T-0, P-0, C-3**

[BRT308 amended vide approval dt. 18th, Feb, 2014 of V.C]

Course Contents:

UNIT-1

Introduction to NMT and Radioactive Transformation

Basic atomic and nuclear physics, History of radioactivity, Units & quantities, Isotopes, Isobars, Isomers, , Radioactivity and half life, Exponential decay ,specific activity, Modes of Radioactive decay, parent daughter decay.

UNIT -2

Production of Radio nuclides

Reactor produced radionuclide, Reactor principles; Accelerator produced radionuclide, Radionuclide generators.

UNIT-3

Radio pharmacy &

Handling & Transport of Radio-nuclides

Cold kits, Radio pharmacy used in Nuclear medicine, Radiopharmaceuticals used in various procedures, Safe handling of radioactive materials, Procedures for handling spills

UNIT-4

Equipments of NMT

Gamma camera, PET, SPECT (working principle)

Part-B:-Interventional Radiology

UNIT-5

Introduction to Interventional Radiology, Contrast media & Emergency Drugs

Need for interventional procedures, Informed consent, patient care, patient preparation, Patient monitoring, role of technologist in interventional procedure Types of contrast media, method of administration, contraindication, contrast reaction management, emergency crash cart.

UNIT-6

Angiographic Equipments, Catheters & guide wires

Basics of Angiographic equipments, Single and biplane angiographic equipment, Angiographic Table, Image intensifier, Flat panel detector, electromechanical injectors, Catheters, types of catheters & guidwires , seldinger technique,

UNIT-7

Digital Subtraction Angiography

Types, Instrumentation,

UNIT-8

Sterile Techniques & Radiation Protection

Laying up a sterile trolley, sterile techniques, radiaton protection for staff and patient , protective devices , monitors .

UNIT-9

Sterile Techniques & Radiation Protection

Laying up a sterile trolley, sterile techniques, radiaton protection for staff and patient , protective devices , monitors .

UNIT-10

Interventional Procedures

Cardiac, Vascular, Nonvascular

References:

1- *Cope & Constantin, Current Techniques in Interventional Radiology*
2- *Anthony W., Andreas A., Interventional Radiology - A Practical Guide*
3- *Sorenson, Physics in Nuclear medicine*
4- *Powsner, Physics of Nuclear medicine*

III YEAR

Radiation Protection and Management of Radiology Department

Course Code: BRT309 **L-3, T-0, P-0, C-3**

[BRT309 amended vide approval dt. 18th, Feb, 2014 of V.C]

Course Contents:

UNIT-1
Introduction to Radiation Protection, Units & Quantities

Primary, secondary radiation, need for radiation protection , Exposure, Absorbed dose, absorbed dose equivalent, Effective dose, air KERMA, Radiation weighting factor, Tissue weighting factor, MPD

UNIT-2

Aim & Principle of Radiation Protection

Concept of ALARA, Cardinal Principle, ICRP regulation , Radiation Protection in:

Radiography, CT, Fluoroscopy, Mammography, Ward radiography, radiation shielding.

UNIT-3

Radiation monitoring:

Personnel – Film badge, TLD, OSLD, pocket dosimeter, Area monitoring Devices.

UNIT-4

Radiobiology

Radiolysis of water, Direct & Indirect effects of radiation, Stochastic, Deterministic effects, Somatic, Genetic effects, dose relationship, Antenatal exposure.

UNIT-5

Quality Assurance & Quality control

QA test performed for X -Ray, CT , Mammography , Fluoroscopy units .

UNIT-6

Introduction to Tele radiology & PACS

HIS, RIS ,Work flow, Components, Types, Storage, Advantages and disadvantages

UNIT-7

Radiation Regulation & Planning of Radiology Department

10 day rule, 14 day rule, 28 day rule, structural shielding, work load, use factor, occupancy factor , x ray room lay out, dark room lay out, CT lay out. Fluoroscopy, angiographic room lay out, radiation signage's, Organization of departments

References:

1. *Christensen, Physics of Diagnostic radiology*
2. *Euclid Serum, Radiation Protection*
3. *Thalayin K.,Text book of Radiological Safety*
4. *James E. M., The Physics for Radiation Protection*
5. *ICRP manual*

III YEAR
Computed Tomography Techniques & Equipments
(Practical)

Course Code: BRT- 355

[BRT355 amended vide approval dt. 18th, Feb, 2014 of V.C]

Course Content-

1-Patient preparation, patient positioning, performing all non-contrast and contrast computed tomography procedures.
2-Radiation protection and care of patient during procedures including contrast media management.
3-Various post processing techniques and evaluation of image quality and clinical findings.
4-Post procedural care of the patient.

III YEAR
Magnetic Resonance Imaging Techniques & Equipment
(Practical)

Course Code: BRT-356
[BRT356 amended vide approval dt. 18th, Feb, 2014 of V.C]

Course Content-

1-Patient preparation, patient positioning, performing all non-contrast and contrast MRI procedures.
2-Planning of different scanning planes, parameters and their tradeoffs & patient monitoring during the procedures.
3-Various post processing techniques and evaluation of image quality and clinical findings.
4-Post procedural care of the patient.

III YEAR
Techniques & Equipments of Interventional Radiology & Nuclear Medicine Technology
(Practical)

Course Code: BRT 357
[BRT357 amended vide approval dt. 18th, Feb, 2014 of V.C]

Course Content-

1-Patient preparation, positioning for Various Interventional and nuclear medicine procedures.
2-Radiation protection for patient, occupational workers and public during Various Interventional and nuclear medicine procedures.
3-Basic physics and working principle of Interventional and NMT equipments.
4-Procedure, post processing techniques and evaluation of Image quality and clinical finding.
5-Post procedural care of the patient.

Interventional Procedures

Cardiac, Vascular, Nonvascular

References:

1. *Cope & Constantin, Current Techniques in Interventional Radiology*
2. *Anthony W. & Andreas A. Interventional Radiology - A Practical Guide*
3. *Sorenson, Physics in Nuclear medicine*
4. *Powsner Physics of Nuclear medicine*