Sri Guru Ram Das University of Health Sciences, Amritsar
Course Structure for Bachelors in BMRIT (Code- BMRIT.2.4) Session 2024

Course code	Course Title	Course Type	L+T+P	Total Credits /Week	Weightage Theory/ Practical IA+UE
Semester-I					
BMRIT- ANT.201	Anatomy-I	Foundation	3+0+2	5	25+25=50T 50P
BMRIT-PHY.201	Physiology-I	Foundation	3+0+2	5	25+25=50T 50P
BMRIT.201	X-Ray Physics-I	Core	3+0+3	6	50+50=100T 100P
ECO.250	English/Communication skills	Elective	2+0+0	2	NC
		Total Credits	**11+0+7**	**18**	**400**
Semester-II					
BMRIT-ANT.202	Anatomy-I	Foundation	3+0+1	4	25+25=50T 50P
BMRIT-PHY.202	Physiology-II	Foundation	3+0+1	4	25+25=50T 50P
BMRIT.202	X-Ray Physics-II	Core	3+1+4	8	50+50=100T 50P
BMRIT-PAT.201	Pathology	Foundation	2+1+0	3	50+50=100T
COM.250	Computer applications	Elective	2+0+0	2	NC
		Total Credits	**13+2+6**	**21**	**450**
Semester-III					
BMRIT.301	Radiography	Core	3+1+0	4	50+50=100T
BMRIT.302	CT Physics-I	Core	3+1+4	8	50+50=100T 100P
BMRIT.303	Clinical Radiography- I	Core	3+1+4	8	50+50=100T 100P
HVE.350	Human Values & Ethics	Value added course	3+0+0	3	NC
		Total Credits	**12+3+8**	**23**	**500**
Semester-IV(new)					
BMRIT.304	Cross Sectional Anatomy	Foundation	2+0+3	5	20+50=70 10+20=30
BMRIT.305	Modern Radiological Imaging Equipment and Physics	Core	2+0+1	3	20+50=70 10+20=30
BMRIT.306	Interventional Radiology Techniques	Core	2+0+2	4	30+70=100T 30+70=100P
BMRIT.307	Patient Care in Radiology	Core	1+1+2	4	30+70=100T 30+70=100P
BMRIT.350	BMRIT Radiology Clinical Education-I	Core	0+0+4	4	NC
		Total Credits	**7+1+12**	**20**	**300+300=600**
Semester-V					
BMRIT.401	Basics Techniques in CT Technology	Core	4+1+4	9	30+70=100T 30+70=100P
BMRIT.402	Radiation Safety in Diagnostic Radiology	Core	2+1+2	5	30+70=100T 30+70=100P
BMRIT.403	Quality Assurance in Diagnostic Radiology and Regulatory Requirements	Core	1+1+1	3	20+50=70T 10+20=30P

RMB.401	BMRIT Radiology Clinical Education-II	Core	0+0+4	4	NC
		Total Credits	**7+3+11**	**21**	**250/250=500**
Semester-VI					
BMRIT.404	Basics Techniques in MRI Technology	Core	3+1+4	8	30+70=100T 30+70=100P
BMRIT.405	Introduction to Nuclear Medicine Techniques	Core	1+1+1	3	20+50=70T 10+20=30P
BMRIT.406	Ultrasound Techniques	Core	2+1+0	3	30+70=100T
EVS.450	Biostatistics and Research Methodology	Elective	1+1+0	2	NC
BMRIT.450	BMRIT Radiology Clinical Education -III	Core	0+0+5	5	NC
		Total Credits	**12+4+8**	**24**	**200/200=400**
Internship (Six Month) minimum 900 hours (calculated based on 6 hours per day for six month of internship)					
		Grand Total Credits	**68+15+ 43**	**126**	**1425/1425= 2850**

SEMESTER IV

BMRIT.: Cross Sectional Anatomy

Cross sectional anatomy provides the students with Skills that are important to help the technologist in MRI and CT to identify the anatomy being imaged and to communicate effectively with the radiologist and physicians.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Identify cross-sectional anatomy in the sagittal, coronal and axial planes on CT and MR images.
CO2: Describe anatomical structural relationships.
CO3: Recognize normal anatomy and build a personal resource system for future study.
CO4: Locate and identify pertinent cerebral, upper thorax, mid-thorax, and abdominal anatomy.
CO5: On CT and MR images, identify anatomical structures of the body and of the head.
CO6: Distinguish between arterial and venous anatomy of the entire body's vascular system. **CO7:** Classify the various sections of anatomical regions and their associated parts.

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**CIE**	**ESE**	**CIE**	**ESE**	**100**
2	**--**	**6**	**5**	**--**	**--**	**50**	**50**	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours
I	**Introduction to Sectional Anatomy & Terminology-** Sectional planes, Anatomical relationships/terminology Anatomy of the upper thorax-Surface anatomy relationships, Bony structures and muscles, Blood vessels. Divisions of the mid-thorax, heart and great vessels-Lungs, heart and great vessels, Esophagus	**12**
II	**CT/MRI Images of the Thorax -** Normal and abnormal imaging **Anatomy of the Abdomen-** Major organs and their accessories, Abdominal blood vessels **CT/MR Images of Abdomen –** Normal and pathologic anatomy of the Pelvis- Bony structures and associated muscles, Digestive and urinary systems **Reproductive Organs -** Normal and abnormal imaging	**12**
III	**CT/MR Images of the Male/Female Pelvis- Normal and pathologic** **Neuro Anatomy-**Scan planes **Brain –**Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves **Spine-** Vertebra and disc, Spinal cord and meninges **Neck-**Arterial/venous systems, Muscles, Glands and pharynx	**12**
Total		**36**

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	**Introduction to Sectional Anatomy & Terminology-** Sectional planes, Anatomical relationships/terminology Anatomy of the upper thorax-Surface anatomy relationships, Bony structures and muscles, Blood vessels. Divisions of the mid-thorax, heart and great vessels-Lungs, heart and great vessels, Esophagus	36
2.	**CT/MRI Images of the Thorax -** Normal and abnormal imaging **Anatomy of the Abdomen-** Major organs and their accessories, Abdominal blood vessels **CT/MR Images of Abdomen –** Normal and pathologic anatomy of the Pelvis- Bony structures and associated muscles, Digestive and urinary systems **Reproductive Organs -** Normal and abnormal imaging	36
3.	**CT/MR Images of the Male/Female Pelvis- Normal and pathologic** **Neuro Anatomy-**Scan planes **Brain –**Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves **Spine-** Vertebra and disc, Spinal cord and meninges **Neck-**Arterial/venous systems, Muscles, Glands and pharynx	36
	Total	108

Evaluation System-Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two practical tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
	Total	***50***	***50%***	***50***
2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	Total	***50***	***50%***	***50***
	Total CIE marks			***30***

End Semester Evaluation (ESE)
There shall be practical examination for 100 marks in the subject.

Distribution of marks for ESE practical exams:

ESE		CIE		**Grand total**
Practical	Viva		Sub Total	
30	20	50	100	100

SUGGESTED LEARNING RESOURCES

S. No.	**Title of Book**	**Author**	**Publication**
1	Cross Sectional Anatomy CT & MR	G Bhavin Jhankaria	Jaypee Brothers Medical Publishers;
2	Step by step Cross-sectional Anatomy	D Karthikeyan	Jaypee brother medical publishers
3	Atlas of Cross Sectional Anatomy and Radiological Imaging	Dr David J. Jackowe	Anshan Ltd
4	Fundamentals of Sectional Anatomy: An Imaging Approach	Denise L. Lazo	Cengage Learning

Subject: Modern Radiological Imaging Equipment and Physics
Subject Code: BMRIT - 020
RATIONALE
Modern radiological Imaging Equipment and Physics provides the students knowledge about the modern x-ray equipment and working principle. Modern imaging techniques – including X-rays, ultrasound, CT scans and MRI – can show structures inside your body in great detail. Radiologic Physics

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**CIE**	**ESE**	**ESE**	**CIE**	**100**
2	**1**	**2**	**3**	**50**	**50**	**--**	**--**	

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours
I	Modern x-ray tube. Digital Mammography and Tomosynthesis, Stitch radiography, Dual energy x-ray absorptionometry (DEXA) scan.	**9**
II	Computed radiography: its principle, physics & equipment. Digital Radiography: its principle, physics & equipment. Flat panel digital fluoroscopy and radiography system, Direct and indirect digital radiography and fluoroscopy systems. Digital radiography and Computed radiography its advantages, disadvantages and applications. Digital Portable and mobile x-ray units.	**9**
III	Modern dental equipments. Cone beam dental CT.	**9**
IV	Picture archiving and communication system (PACS), RIS and HIS.	**9**
Total		**36**

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Modern x-ray tube. Digital Mammography and Tomosynthesis, Stich radiography, Dual energy x-ray absorptionometry (DEXA) scan.	**9**
2.	Computed radiography: its principle, physics & equipment. Digital Radiography: its principle, physics & equipment. Flat panel digital fluoroscopy and radiography system, Direct and indirect digital radiography and fluoroscopy systems. Digital radiography and Computed radiography its advantages, disadvantages and applications. Digital Portable and mobile x-ray units.	**9**
3.	Modern dental equipments. Cone beam dental CT.	**9**
4.	Picture archiving and communication system (PACS), RIS and HIS.	**9**
	Total	**36**

Evaluation System
Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
	Total	***25***	***25%***	**25**
2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	Total	***25***	***25%***	***25***
	Total CIE marks			***50***

SUGGESTED PRACTICALS/DEMONSTRATION

Unit	
1.	Modern x-ray tube. Digital Mammography and Tomosynthesis, Stich radiography, Dual energy x-ray absorptionometry (DEXA) scan.
2.	Computed radiography: its principle, physics & equipment. Digital Radiography: its principle, physics & equipment. Flat panel digital fluoroscopy and radiography system, Direct and indirect digital radiography and fluoroscopy systems. Digital radiography and Computed radiography its advantages, disadvantages and applications. Digital Portable and mobile x-ray units.
3.	Modern dental equipments. Cone beam dental CT.
4.	Picture archiving and communication system (PACS), RIS and HIS.
	Total Marks (including optional questions)

SUGGESTED LEARNING RESOURCES

S.No.	**Title of Book**	**Author**	**Publication**
1	Textbook of Radiology: Physics	Amol Sasane, Hariqbal Singh, Roshan Lodha	Jaypee Brothers Medical Publishers
2	The Physics of Radiology and Imaging	THAYALAN K	Jaypee Brothers Medical Publishers
3	Christensen's Physics of Diagnostic Radiology	Thomas S. Curry, James E. Dowdey, Robert E. Murry	Lea & Febiger,U.S
4	Textbook Of Radiology for Residents and Technicians	BHARGAVA S. K (Author	CBS; publishers
5	Concise Text Book on Imaging Modalities & Recent Advances In Diagnostic Radiology	Lalit Agarwal, Dr. K.B. Gehlot	JBD Publications

Subject: Interventional Radiology Techniques

Subject Code: BMRIT -021

RATIONALE

Interventional radiology (IR) helps student MRIT to gain about the basics diagnostics and interventional procedures and to learn procedures in modalities like digital radiography CT and MRI and nuclear medicine and to increase the level of understandings and knowledge required to meet current radiologic procedures and to understand the physical principles of radiography and basic radiography positioning to perform the procedures. it a medical specialty that performs various minimally-invasive procedures using medical imaging guidance, such as x-ray fluoroscopy, computed tomography, magnetic resonance imaging, or ultrasound. IR performs both diagnostic and therapeutic procedures through very small incisions or body orifices

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Know the basic principle and physics of interventional equipment.
CO2: Know the management and positioning of patients while performing interventional radiological procedure.
CO3: Have knowledge about the indications, contraindications, contrast media, radiation dose, exposure timing and radiation safety measures for the different interventional radiological procedure.
CO4: Understand the patient preparation needed before any interventional radiological procedures.
CO5: Have knowledge about the post procedural care and safety.

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**CIE**	**ESE**	**CIE**	**ESE**	**200**
2	**1**	**4**	**4**	**50**	**50**	**50**	**50**	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours
I	Introduction to interventional procedures **DSA:** basic principles and types **Equipment:** Basics of angiographic equipment, single and biplane angiographic equipments, angiographic table, image intensifier, flat panel detectors, recording systems, pulse oximetry, cardiac resuscitation measure-ECG, pressure injector, catheters, needle and other tools, 3D rotational angiography, image processing, patient monitor, CO2 angiography	**6**
II	Interventional procedures: Catheter- classification, types and applications, Guide wire- classification, types and applications, Pressure Injector and Accessories, Percutaneous catheterization, Digital Subtraction Angiography, Catheterization Sites, Asepsis	**9**
III	Arteriography: Head and Neck Arteriography, Pulmonary Arteriography, Coronary Arteriography, Ascending Aortography, Trans Lumbar Aortography, Renal Arteriography, Trans Femoral Arteriography Venography: Peripheral Venography- Lower Limb, Upper Limb, Central Venography, Superior Venacavography, Inferior Venacavography, Pelvic Venography	**9**
IV	**Safety considerations in angiography room**; room design, protective devices, radiation monitoring	**6**
V	**Care and maintenance tests:** General care, functional test **Quality assurance program:** Acceptable limits of variation, corrective action	**6**
Total		**36**

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Basics of angiographic equipments	18
2.	Catheter and guide wires	18
3.	Arteriography and venography procedures	18
4.	Safety considerations in angiography room	18
	Total	72

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	The practice of interventional radiology	Karim valji	
2	Interventional radiology: a survival guide	EBIR Kessel, David, Robertson, Iain	Elsevier Health Sciences
3	Handbook of Interventional Radiologic Procedures	Krishna kandarpa, lindsay machan, janettedurham	Lippincott Williams and Wilkins
4	Interventional Radiology: A Survival Guide	David Kessel , Iain Robertson	sevier Health Sciences
5	A Guide on Special Radiographic Investigations & Techniques	Lalit Agarwal	JBD Publications

Subject: Patient Care in Radiology
Subject Code: BMRIT - 022

RATIONALE

Patient management is based on team work, it is essential that the student should appreciate the technologist's 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.

COURSE OUTCOMES

At the end of the course, students will be able to…

CO1: Understand the responsibility of the imaging technologist and other health care facility.
CO2: Understand the management and care of patient during different procedures and emergency situations.
CO3:Know about different patient transfer techniques and to restrain the uncooperative patients during radiological examination
CO4: Differentiate the types of consent forms
CO5: Know about infection control, infection source and isolation techniques
CO6: Describe sterilization techniques
CO7: Understand the radiation safety and protection

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**CIE**	**ESE**	**CIE**	**ESE**	**200**
1	**1**	**4**	**4**	**50**	**50**	**50**	**50**	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and content	Hours

I	**Introduction to Patient Care:** Responsibilities of Medical Imaging Technologist, Obtaining Consents and history for different radiological examinations, Patient transfer and Restraining techniques, Obtaining vital signs, Ergonomics and body mechanism **Communication:** Patient education, Communication with the patient, Professional role and behavior	**2**
II	**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.	**2**
III	**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.	**3**
IV	**Nursing procedures in Radiology:** Injection- methods and their routes of administration, Clothing of patient, Administering rectal enema. **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.	**3**
V	**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. Universal precautions, hospital acquired infections- HIV, Hepatitis B, C, and MRSA etc. **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 radio imaging department (for study by radio imaging students only)	**3**
VI	**Patient care in following investigations:** GIT, Respiratory system, Cardiovascular system, CNS; Sterilization; Infection control **Departmental procedures:** Department staffing and organizations; 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; organisations; minimizing waiting time; out-patient and follow-up clinics; stock taking and stock keeping.	**2**
VII	**Drugs in the department and Storage:** classification; labelling and checking, regulations regarding dangerous and other drugs; units of measurement, special drugs, anti-depressive, anti- hypertensive etc. crash cart. **Medical ethics and records:** Medico legal implication of MLC cases, Importance of consent, Consent in detail, Precaution while dealing with female patient, Medical records	**3**
	Total	**18**

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Introduction to Patient Care and Communication	10
2.	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.	11
3.	Care of the patient	10
4.	Nursing procedures in Radiology and first aid	11
5.	Infection and Principles of asepsis	10
6.	Patient care in following investigations: GIT, Respiratory system, Cardiovascular system, CNS; Sterilization; Infection control.	10
7.	Drugs in the department and Storage and medical ethics and records	10
	Total	72

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Patient care in radiography	Ruth Ann Ehrlich, Dawn M Coakes	Mosby
2	Concise Textbook on Hospital Management & Patient Care in Diagnostic Radiology	N.K.Kardam,, Lalit Agarwal	JBD Publications
3	Patient care in radiography: with an introduction to medical imaging	Ruth Ann Ehrlich and Joan A. daly	St. Louis, Mo. : Mosby Elsevier
4	Introduction To Radiologic And Imaging Sciences And Patient Care	Adler A M	Elsevier
5	Concise Text Book on Hospital Management & Patient Care In Diagnostic Radiology	Lalit Agarwal , Dr. N.K. Kardam	JBD Publications

BMRIT Radiology Clinical Education – I (studentship)

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semesters.
- Provide simulation and skill labs for practising skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/ technologies.
- Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated

Fifth Semester

Subject: Basics Techniques in CT Technology
Subject Code: BMRIT - 023
RATIONALE
Basics techniques in CT Technology provide the students with knowledge of the basic physics of CT. It creates relationship between scan and patient with various CT protocols for better representation of images.

COURSE OUTCOMES
At the end of the course students will be able to...
CO1: Define basic principle and physics of Computed Tomography scan
CO2: Recognize protocols needed for Computed Tomography examination **CO3:** Prepare and positioning for Computed Tomography examination **CO4:** Interpret post processing of raw Computed Tomography images
CO5: Prepare and position the patients for Computed Tomography examination
CO6: Categorize knowledge of improving image quality in Computed Tomography images
CO7: Plan of scanning with various Computed Tomography protocols for better representation of images
CO8: Systematize post processing for Computed Tomography scan
CO9: Management of patient for any post contrast reactions

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**CIE**	**ESE**	**CIE**	**ESE**	**200**
4	**1**	**8**	**9**	**50**	**50**	**50**	**50**	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.
THEORY COMPONENTS
The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours
I	**Introduction and history,** CT principle, CT generations, CT Instrumentation, CT detectors, Axial & Helical CT – Slip ring technology	**15**
II	**Data acquisition, Image pre-processing/reconstruction techniques,** Algorithms for image reconstruction, Image display, Image post-processing techniques, CT artifacts, Image quality	**14**

III	**CT Protocols for different body parts & Dental scan,** CT Protocols for Angiography & Perfusion, CT contrast media and administration, CT guided interventional procedures	**14**
IV	**Multi-detector CT** Isotropic imaging, Cardiac CT, Flash CT, Advanced CT scanners, Dual energy & Dual Source Scanners, CT- fluoroscopy	**15**
V	**Safety consideration,** Documentation in CT, Role of Medical Imaging technologist in CT scan procedures, Quality assurance in CT	**14**
Total		**72**

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		**Hours**
1.	Introduction and history, CT principle, CT generations, CT Instrumentation, CT detectors, Axial & Helical CT – Slip ring technology	30
2.	Image post-processing techniques, CT artifacts	20
3.	CT Protocols for different body parts & Dental scan, CT Protocols for Angiography & Perfusion, CT contrast media and administration, CT guided interventional procedures	54
4.	Multi-detector CT	20
5.	Safety consideration, Documentation in CT, Role of Medical Imaging technologist in CT scan procedures, Quality assurance in CT	20
	Total	**144**

SUGGESTED LEARNING RESOURCES

S. No.	**Title of Book**	**Author**	**Publication**
1	Computed Tomography: Physical Principles, Clinical Applications, and Quality Control	Euclid Seeram RT(R) BSc MSc FCAMRT (Author)	Saunders
2	Computed Tomography for Technologists: A Comprehensive Text	Lois Romans	Lippincott Williams and Wilkins;
3	Computed Tomography: Physics and Technology. A Self Assessment Guide	Euclid Seeram	Wiley-Blackwell
4	The CT Handbook: Optimizing Protocols for Today's Feature-Rich Scanners	Timothy P. Szczykutowicz	Medical Physics Publishing Corporation
5	CT PROTOCOLS	Manjot Kaur, Maajid Mohi Ud Din Malik	JBD Publications

Subject: Radiation Safety in Diagnostic Radiology
Subject Code: BMRIT - 024

RATIONALE

Radiation protection aims to reduce unnecessary radiation exposure with a goal to minimize the harmful effects of ionizing radiation. In the medical field, ionizing radiation has become an inescapable tool used for the diagnosis and treatment of a variety of medical conditions .to study radiation physics relevant to radiation protection to gain information on radiation types and does receive to study the molecular and cellular effects of radiations and to know the radiation quantities units dose limits and regulatory bodies to know about equipment design for radiation protection and to implement patient and personnel radiation protection practices for radiological procedures

COURSE OUTCOMES

At the end of the course, students will be able to learn:
CO1: Aim and need of radiation protection
CO2: Introduction to Radiation units and quantities
CO3: Understanding of various Radiation protection regulations and the dose limits CO4: Radiation protection to patients, occupational workers and general public in Diagnostic Radiology
CO5: Layout of Radiology department
CO6: Use of protective devices and awareness of radiation with radiation signages
CO7: Dose reduction measures with technical protective considerations during radiology CO8: Different radiation measuring devices
CO9: Effects of radiation on biological tissue

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**CIE**	**ESE**	**CIE**	**ESE**	**200**
2	**1**	**4**	**5**	**50**	**50**	**50**	**50**	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours
I	Radiation Quantities and Units: Radiation- Radioactivity- Sources of radiation - natural radioactive sources -cosmic rays terrestrial radiation - - man made radiation sources. Units of radiation - Quality factor - Flux- Fluence-Kerma-Exposure- Absorbed dose- Equivalent Dose- Weighting Factors-Effective Dose - Occupational Exposure Limits - Dose limits to public.	**7**

II	Biological Effects of radiation: Ionization, excitation and free radical formation, hydrolysis of water, action of radiation on cell-Chromosomal aberration and its application for the biological dosimetry- Effects of whole body and acute irradiation, dose fractionation, effects of ionizing radiation on each of major organ system including fetus -Somatic effects and hereditary effects- stochastic and deterministic effects-Acute exposure and chronic exposure-LD50 - factors affecting radio sensitivity. Biological effects of non-ionizing radiation like ultrasound, lasers, IR, UV and magnetic fields.	**8**
III	Radiation detection and Measurements: Ionization of gases- Fluorescence and Phosphorescence -Effects on photographic emulsion. Ionization Chambers – proportional counters- G.M counters- scintillation detectors – liquid semiconductor detectors – Gamma ray spectrometer. Measuring systems – free air ionization chamber – thimble ion chamber – condenser chamber – Secondary standard dosimeters – film dosimeter – chemical dosimeter- Thermoluminescent Dosimeter. -Pocket dosimeter-Radiation survey meter- wide range survey meter -zone monitor-contamination monitor -their principle function and uses. Advantages & disadvantages of various detectors &its appropriateness of different detectors for different type of radiation measurement. Dose and Dosimetry, CT Dose Index (CTDI, etc.), Multiple Scan Average Dose (MSAD), Dose Length Product (DLP), Dose Profile, Effective Dose, Phantom Measurement Methods, Dose for Different Application Protocols, Technique Optimization. Dose area product in fluoroscopy and angiography systems, AGD in mammography Artificial Intelligence in Radiation Safety	**7**
IV	Radiation protection: Radiation protection of self and patient- Principles of radiation protection, time - distance and shielding, shielding - calculation and radiation survey –ALARA- personnel dosimeters (TLD and film batches) - occupational exposure.	**7**
V	Radiation Hazard evaluation and control: Philosophy of Radiation protection, effects of time, Distance & Shielding. Calculation of Work load, weekly calculated dose to radiation worker & General public Good work practice in Diagnostic Radiology. Planning consideration for radiology, including Use factor, occupancy factors, and different shielding material.	7
	Total	36

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Radiation Quantities and Units	15
2.	Biological Effects of radiation	15
3.	Radiation detection and Measurements Survey meter and personal dosimeter Artificial Intelligence in Radiation Safety	15
4.	Radiation protection; Principles of radiation protection; ALARA	15
5.	Radiation Hazard evaluation and control	12
		72

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Radiation Protection In Diagnostic X-Ray Imaging	Euclid Seeram, Patrick C. Brennan	Jones and Bartlett Publishers
2	Development of Radiation Protection in Diagnostic Radiology	Stewart C. Bushong	CRC Press Inc.,U.S.
3	Textbook of adiological Safety	Thayalan K	Jaypee Brothers Medical Publishers
4	Radiation Protection in Medical Radiography	Statkiewicz Sherer	Elsevier Health - US;
5	Basics of Radiation, Hazards and Prevention In Diagnostic Radiology	Prashant Kumar Jha	JBD Publications

Subject: Quality Assurance in Diagnostic Radiology and Regulatory Requirements
Subject Code: BMRIT -025
RATIONALE

Quality assurance testing includes the monitoring, evaluation and maintenance of equipment for optimal performance and stability. It is essential that radiological technologists recognize, record and report, according to policy, when a significant increase or underexposure in radiation exposure occurs.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Aim and need of radiation protection
CO2: Introduction to quality assurance
CO3: Understanding of regulatory requirements
CO4: Follow radiation protection regulations and apply practically

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**CIE**	**ESE**	**CIE**	**ESE**	**100**
1	**1**	**2**	**3**	**--**	**--**	**30**	**70**	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours
I	Objectives of quality Control: Improve the quality of imaging thereby increasing the diagnostic value; to reduce the radiation exposure; Reduction of film wastage and repeat examination; to maintain the various diagnostic and imaging units at their optimal performance. Quality assurance activities: Equipment selection phase; Equipment installation and acceptance phase; Operational phase; Preventive maintenance. Quality assurance programme at the radiological faculty level: Responsibility; Purchase; Specifications; Acceptance; Routine testing; Evaluation of results of routine testing; Quality assurance practical exercise in the X ray generator and tube; Image receptors from processing; Radiographic equipment; Fluoroscopic equipment; Mammographic equipment; Conventional tomography; Computed tomography; Film processing, manual and automatic; Consideration for storage of film and chemicals; Faults tracing; Accuracy of imaging- image distortion for digital imaging devices. LASER printer calibration	**4**

II	**QA in Diagnostic Radiology** filtration Contact between film and intensifying screen Contrast Verification of Optical and Radiation field congruence Beam alignment Focal spot size Linearity of tube current mA and Timer Applied potential HVT and total tube Resolution Grid alignment QA in mammography QA in CT QA in Digital Radiography	4
III	**Regulatory requirements in Diagnostic Radiology** National Regulatory Body Responsibilities and organization Safety Standards Codes and Guides Care and maintenance of diagnostic equipment: General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually: care in use, special care of mobile equipment	4
IV	Responsibilities of licensees, registrants and employers Enforcement of Regulatory requirements Role of technologist in radiology department Maintenance and care of equipment: Safe operation of equipment; Routine cleaning of equipment and instruments; Cassette, screen maintenance; Maintenance of automatic processor and manual processing units; Routine maintenance of equipments; Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme.	3
V	Care and maintenance of diagnostic equipment: General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually: care in use, special care of mobile equipment.	3

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Quality assurance programme at the radiological faculty level: Responsibility; Purchase; Specifications; Acceptance; Routine testing; Evaluation of results of routine testing; Quality assurance practical exercise in the X ray generator and tube; Image receptors from processing; Radiographic equipment; Fluoroscopic equipment; Mammographic equipment; Conventional tomography; Computed tomography; Film processing, manual and automatic; Consideration for storage of film and chemicals; Faults tracing; Accuracy of imaging- image distortion for digital imaging devices. LASER printer calibration	7
2.	**QA in Diagnostic Radiology** filtration Contact between film and intensifying screen Contrast Verification of Optical and Radiation field congruence Beam alignment Focal spot size Linearity of tube current mA and Timer Applied potential HVT and total tube Resolution Grid alignment QA in mammography QA in CT QA in Digital Radiography	8
3.	Regulatory requirements in Diagnostic Radiology	7
4	Responsibilities of licensees, registrants and employers Enforcement of Regulatory requirements	7
5.	Care and maintenance of diagnostic equipment: General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually: care in use, special care of mobile equipment.	7
	TOTAL	36

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Quality Assurance and Control in Diagnostic Radiology and Imaging	Bhargava	CBS Publishers and Distributors
2	Quality Assurance	Dr. R. Sundhararajan, M.V.Kumudhavalli, Minal T. Harde	Thakur Publications Pvt Ltd
3	Quality Assurance in Diagnostic Radiology	J. McLemore (Author	Imprint unknown
4	An Introduction to Quality Assurance in Radiology	Zafar Neyaz	JBD Publications

BMRIT Radiology Clinical Education – II (studentship)

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semesters.
- Provide simulation and skill labs for practising skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/ technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.

Sixth Semester

Subject: Basics Techniques in MRI Technology Subject Code: BMRIT - 026

RATIONALE

Magnetic Resonance Imaging (MRI) is a non-invasive imaging technology that produces three dimensional detailed anatomical images. It is often used for disease detection, diagnosis, and treatment monitoring. It is based on sophisticated technology that excites and detects the change in the direction of the rotational axis of protons found in the water that makes up living tissue. The student learn to Recognize and planning different protocols and prepare and position patients for MRI examination. To gain knowledge on Management of patients, contrast reactions MRI Safety.

COURSE OUTCOMES

At the end of the course students will be able to...

CO1: Define basic principle and physics of Magnetic Resonance Imaging.
CO2: Recognize protocols needed for Magnetic Resonance Imaging examination.
CO3: Prepare and positioning for Magnetic Resonance Imaging examination.
CO4: Interpret post processing of Magnetic Resonance Imaging images.
CO5: Prepare and position the patients for Magnetic Resonance Imaging examination.
CO6: Categorize knowledge of improving image quality in Magnetic Resonance Imaging .
CO7: Scanning of patient with various Magnetic Resonance Imaging protocols for better representation of images.
CO8: Plan of post processing for Magnetic Resonance Imaging data.
CO9: Management of patient for any post contrast reactions.

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**CIE**	**ESE**	**CIE**	**ESE**	**200**
3	**1**	**8**	**8**	**30**	**70**	**30**	**70**	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	Introduction to MRI; Basic principle; Image weighting and contrast in MRI; Instrumentation of MRI-Magnets- classification, types, advantages, disadvantages, Gradient & Body Coils, RF coils, Shim coils, Ramping, Cryogen, RF shielding	**12**	**15**
II	Encoding and Image formation-Encoding, K-Space; Parameters and Trade-offs; MRI Pulse sequences-Spin Echo pulse sequence, Gradient Echo pulse sequence; Fast imaging sequences	**12**	**15**
III	Flow phenomena; Flow phenomena compensation; Vascular Imaging-Digital Subtraction MRA, TOF-MRA, PC-MRA, Velocity Encoding, MR-Angiogram, MR- Venogram	**10**	**10**
IV	Cardiac Imaging; Whole body MRI Protocols; MRI Artifacts and their compensation; MRI contrast agents-T1 contrast agent, T2 contrast agent	**10**	**15**
V	MRI safety- Implants and pace-makers, Electrical safety, Metallic safety, Instrumental safety, Bio-effects of MRI; Documentation; Quality assurance in MRI	**10**	**15**
Total		**54**	**70**

Sr. No		Hours
1.	Instrumentation of MRI-Magnets- classification, types, advantages, disadvantages, Gradient & Body Coils, RF coils, Shim coils, Ramping, Cryogen, RF shielding	30
2.	MRI Pulse sequences-Spin Echo pulse sequence, Gradient Echo pulse sequence; Fast imaging sequences	30
3.	Flow phenomena; Flow phenomena compensation	24
4.	Whole body MRI Protocols; MRI Artifacts and their compensation	30
5.	MRI safety and Quality assurance in MRI	30
Total		**144**

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Tomography and Magnetic Resonance Imaging of the Whole Body (Vol.1& II) (Saunders).	John R. Haaga, Daniel Boll	Elsevier
2	MRI inPractice	Catherine Westbrook & Caralyn Kaut	Wiley–Blackwell
3	Protocols inMRI	Catherine Westbrook	Wiley-Blackwell
4	An Introduction to the Physics and Function of Magnetic Resonance Imaging	Dominik Weishaupt , Victor D. Koechli , Borut Marincek , J.M. Froehlich	Springer;
5	Concise Textbook of MRI Physics & Protocols	Maajid Mohi Ud Din Malik, Manjot Kaur	JBD Publications

Subject: Introduction to Nuclear Medicine Techniques
Subject Code: BMRIT -027
RATIONALE

It is thebranch of medicine that deals with the use of radioactive substances in research, diagnosis, and treatment disease. In this student will learn about the fundamentals of radioactivity and various interactions of radiation with matter, radiopharmaceuticals, instrumentations measuring radioactivity,

At the end of the course students will be able to…

CO1: Define basic principle and physics of nuclear medicine.

CO2: Apply precautions while handling radiopharmaceuticals.

CO3: Recognizing the artefacts associated with nuclear medicine.

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**CIE**	**ESE**	**CIE**	**ESE**	**100**
1	**1**	**2**	**3**	**50**	**50**	**--**	**--**	

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	History; Isotopes and Radionuclides- Production of Radionuclides, Transport of Radionuclides; Radio Activity- Radio Active transformations, Specific Activity; Radiopharmaceuticals- Preparation, Precautions while handling	**7**	**25**
II	Gamma Camera instrumentation - Collimator- classification and types; Single Photon Emission Computed Tomography (SPECT); Positron Emission Tomography (PET); Advanced techniques in NM - SPECT-CT, PET-CT, PET-MRI	**7**	**25**
III	Safety Considerations & Radiation Dose in Nuclear Medicine; Room layout in nuclear medicine	**4**	**20**
Total		**18**	**70**

Sr.No		Hours
1.	History; Isotopes and Radionuclides- Production of Radionuclides, Transport of Radionuclides; Radio Activity- Radio Active transformations, Specific Activity; Radiopharmaceuticals- Preparation, Precautions while handling	12
2.	Gamma Camera instrumentation - Collimator- classification and types; Single Photon Emission Computed Tomography (SPECT); Positron Emission Tomography (PET); Advanced techniques in NM - SPECT-CT, PET-CT, PET-MRI	12
3.	Safety Considerations & Radiation Dose in Nuclear Medicine; Room layout in nuclear medicine	12
Total		**36**

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Nuclear Medicine Textbook: Methodology and Clinical Applications	DuccioVolterrani , Paola Anna Erba , IgnasiCarrió , H. William Strauss	Springer;
2	Nuclear Medicine Instrumentation	Jennifer Prekeges (Author)	Jones and Bartlett Publishers
3	Nuclear Medicine Physics: The Basics	Ramesh Chandra & Arman Rahmim	Wolters Kluwer
4	Nuclear Medicine Technology: Procedures and Quick Reference	Pete Shackett BA CNMT ARRT(N) (Author)	LWW;
5	A Concise Guide on Basic Radiation Physics, radiotherapy Physics & Nuclear Medicine	Lalit Agarwal, Dr. Arvind Shukla	JBD Publications

Subject: Ultrasound Techniques
Subject Code: BMRIT -028
RATIONALE
Ultrasound techniques provide students knowledge on the basic principles of ultrasonography and how to prepare the patients for the scan and also to identify any artefacts. To learn about the physics behind ultrasound and to gain knowledge regarding various ultrasound procedures equipment used in ultrasound and patient care during ultrasound procedures
COURSE OUTCOMES

At the end of the course students will be able to...
CO001: Describethe Ultrasound properties, interaction of ultrasound with matter

CO002: Describe the transducer and types

CO003: Explain the concepts of image display

CO004: Describe Doppler imaging and ultrasound contrast agents
CO005: Describe the image characteristics and artefacts
CO006: explain the safety considerations in ultrasound and protocols

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**CIE**	**ESE**	**CIE**	**ESE**	**100**
2	**1**	**--**	**3**	**30**	**70**	**--**	**--**	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	**Ultrasound:** Properties of ultrasound, interaction of ultrasound with matter	**6**	**10**
II	**Transducers:** Types of transducers, advances in the design of modern ultrasound transducers	**6**	**15**
III	**Image display:** Display modes, ultrasound instrumentation, controls, image storage, scan converter memory, photographic film, multi format camera,laser imager, colour and video thermal printer, computer storage, pre and post processing techniques	**6**	**10**
IV	**Doppler Imaging:** Doppler principles, continuous wave Doppler and pulsed Doppler, duplex scanning, colour flow imaging, power doppler, harmonic imaging, extended field of view Ultrasound contrast agents	**6**	**15**
V	**Image characteristics and artefacts:** vascular, interventional, intraoperative and ophthalmic ultrasonography, 3D and 4D ultrasound imaging Artificial Intelligence in Ultrasound	**6**	**10**
Vl	**Bio-effects and safety considerations in ultrasound**, ultrasound system performance measurements, ultrasound equipments quality assurance – conventional Doppler system testing and documentation	**6**	**10**
Total		**36**	**70**

Sr. No		Hours
1.	**Ultrasound** interaction of ultrasound with matter	6
2.	Types of transducers, advances in the design of modern ultrasound transducers	6
3.	**Image display:** Display modes, ultrasound instrumentation, controls	6

Sr. No		Hours
4.	**Doppler Imaging:** Doppler principles, continuous wave Doppler and pulsed Doppler, duplex scanning, colour flow imaging, power doppler, harmonic imaging, extended field of view Ultrasound contrast agents	6
5.	**Image characteristics and artefacts**	6
6.	**Bio-effects and safety considerations in ultrasound**, ultrasound system performance measurements, ultrasound equipments quality assurance	6
	Total	**36**

S.No.	Title of Book	Author	Publication
1	Ultrasound physics and technology	Vivien gibbs, davidcole, Antonio sassano	Churchill Livingstone;
2	Manual of Diagnostic Ultrasound	Philip E. S. Palmer (Author)	World Health Organization
3	Physics and Technical Aspects Diagnostic Ultrasound	DINESH K BAGHEL (Author	AITBS PUBLISHERS
4	Diagnostic Ultrasound	Carol M. Rumack (Author), Deborah Levine (Author)	Elsevier;
5	Ultrasound Imaging (1000 Multiple Choice Questions)	Yadav	JBD Publications

Subject: Biostatistics and Research Methodology

Subject Code: BMRIT -029

RATIONALE:

The application of statistical techniques to scientific research in health-related fields, including medicine, biology, and public health, and the development of new tools to study these areas.

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme
L	**T**	**P**	**C**	Institute level exam only: The Institute level examination will be held before the commencement of the University examinations. A Pass in the subject with a minimum of 50 marks (50% of the total 100 marks) is compulsory in order to be eligible for the award of degree. These marks will not be considered for the award of class. Supplementary examination shall be conducted by the Institute for the benefit of unsuccessful candidates. Supplementary examinations will be conducted within six weeks/six months from the date of announcement of results.
1	**1**	**--**	**2**	

Unit	Topic and contents	Hours
I	Introduction: Meaning, Definition, Characteristics of Statistics; Importance of the Study of Statistics. Branches of Statistics; Descriptive and Inferential Statistics; Variables and Their Types. Measurement Scales.	**3**
II	Tabulation of Data: Raw Data, the Array, Frequency Distribution. Basic Principles of Graphical Representation; Types of Diagrams - Histograms, Frequency Polygons, Smooth Frequency Polygon, Commutative Frequency Curve, O give; Normal ProbabilityCurve.	**3**
III	Measure of Central Tendency: Need For Measures of Central Tendency; Definition and Calculation of Mean; Ungrouped and Grouped Meaning, Interpretation and Calculation of Median Ungrouped and Grouped; Meaning	**3**

	and Calculation of Mode; Comparison of the Mean, and Mode; Guidelines for the Use of Various Measures of Central Tendency.	
IV	Measure of Variability: Need For Measure of Dispersion. The Range, the Average Deviation, The Variance and Standard Deviation; Calculation of Variance and Standard Deviation, Ungrouped and Grouped.	**3**
V	Probability and Standard Distributions: Meaning of Probability of Standard Distribution, The Binominal Distribution. The Normal Distribution; Divergence from Normality - Skewness,Kurtosis	**3**
VI	Sampling Techniques: Need For Sampling - Criteria for Good Samples. Application of Sampling in Community, Procedures of Sampling and Sampling Designs Errors. Sampling Variation and Tests of Significance.	**3**
Total		**18**

Suggested Reading

S. No.	Title of Book	Author	Publication
1	Elements of Health Statistics	Rao. N.S	
2	An introduction of Biostatistics	Sunder Rao	
3	Methods in Bio-Statistics	B.K. Mahajan	
4	Elementary Statistics in Medical Workers	Inderbir Singh	
5	An Introduction to. Statistical Methods, Ram Prasad &Sons	Gupta C.B	

Studentship or observer ship must include:

- A minimum of 14 hours per week is considered as studentship in every semester.
- Provide simulation and skill labs for practicing skills specific to the program in the initial years of observer ship/studentship.
- Every semester must have seminars/workshops on new developments/ technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.