

Study Scheme & Syllabus of
Bachelors of Science (B.Sc.) in
RADIOLOGY IMAGING & TECHNOLOGY

Session 2024 Onwards

By
Board of Studies

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TITLE OF THE PROGRAM: Bachelor of Science (Radiology & Imaging Technology)

DURATION: The course shall be 4 years/8 Semester (Including 1 year or 2 Semesters of Internship). The Choice based credit system will be applicable to all the semesters.

ELIGIBILITY FOR ADMISSION: Candidates who have passed 10+2 examination with medical stream at least 50% marks in aggregate and 55% marks combined in Physics, Chemistry & Biology(45% marks in aggregate and 50% marks combined in Physics, Chemistry & Biology in case of candidate belonging to reserved category) from any recognized board of school education.

OR

Having passed Diploma in Medical Radiology and Imaging Technology or Radiology and Imaging Technology with minimum 50% marks in aggregate (45% marks in case of candidate belonging to reserved category) from any recognized board.

Program Educational Objectives: At the end of the Program, the student will be able to: -	
PEO1	Understand the fundamentals and applications of Radiological Equipments such as MRI Machine, CT Scan Machine, X-ray Machine etc.
PEO2	Perform various Radiological procedures which are necessary for diagnostic purposes.
PEO3	Develop technical knowledge of Radiology so that he/she will be able to assist a Radiologist in every aspect of Radiological Imaging.
PEO4	Pursue a career in Hospital as well as go for further education & research in Radiology & Imaging.

Program Outcomes: At the end of the Program, the student will be able to: -	
PO1	Engage in lifelong learning and adapt to changing professional and societal needs.
PO2	The Candidates can join Private, Military and public health services
PO3	In industry, Imaging technologists are needed for Application and Software development for Medical Imaging equipment.
PO4	Those who choose this stream are going to study about Radiological & Imaging Technology such as MRI, CT scan, USG etc.
PO5	Ability to do various Radiological procedures which are necessary for diagnostic purposes.
PO6	Understanding of fundamentals and applications of Radiological Equipments such as MRI Machine, CT Scan Machine, X-ray Machine etc.
PO7	To explore the foundation science and safety principles in Medical Imaging Technology.
PO8	Enhance knowledge from clinical experience, interactions & discussions and research to improve the quality of training and education in Medical Imaging.
PO9	Explore the subject in depth and develop high degree of expertise to contribute to advancement of knowledge in Medical Imaging.
PO10	Develop technical and presentation skills necessary to become efficient technologists utilizing state-of-the art facilities and equipments.
PO11	To provide with the skills and knowledge to apply for critical appraisal of day to day practice.
PO12	Students will be competent to work in Hospital Radiology Suites, MRI Units and other related sections.
PO13	Students will be skilled in problem solving, critical thinking and will be able to assist the Radiologist in various procedures.
PO14	This course provides medical imaging technologists with an understanding of the physical principles as well as theories involved in diagnostic imaging modalities.
PO15	Students will be able to have all the relevant knowledge of Radiology & Imaging Sciences and will be able to do various procedures required.
PO16	Students will be able to integrate knowledge of various types of Radiological & Imaging procedures along with their in-depth knowledge.

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Program Specific Outcomes: At the end of the Program, the student will be able to: -	
PSO1	Competent to work in Hospital Radiology Suites, MRI Units and other related sections.
PSO2	Develop an understanding of the physical principles as well as theories involved in diagnostic imaging modalities.
PSO3	This Program will create a great source of manpower which can aid in our health sector especially in MRI, CT scan, X-ray & Ultrasonography sections.
PSO4	To explore the foundation science and safety principles in Medical Imaging Technology.

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Semester		First (1 st)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 101-21		Core Theory	Human Anatomy & Physiology-I	3	1	0		40	60	100	4
BRIT 102-21		Core Theory	Basic physics including Radiological Physics	3	1	0		40	60	100	4
BRIT 103-21		Core Theory	Conventional Radiography and Equipment's	3	1	0		40	60	100	4
BRIT 104-21		Core Practical/Lab	Human Anatomy & Physiology-I Practical	0	0	4		60	40	100	2
BRIT 105-21		Core Practical/Lab	Basic physics including Radiological Physics Practical	0	0	4		60	40	100	2
BRIT 106-21		Core Practical/Lab	Conventional Radiography and Equipments Practical	0	0	4		60	40	100	2
BTHU 103-18		Ability Enhancement Compulsory Course-I (AECC)	English	1	0	0		40	60	100	1
BTHU 104-18		Ability Enhancement Compulsory Course-(AECC)	English Practical/Laboratory	0	0	2		30	20	50	1
HVPE 101-18		Ability Enhancement	Human Values, De-	3	0	0		40	60	100	3

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Bachelor of Radiology Imaging & Technology Course for session 2024 Onwards

		t Compulsory Course-II(AECC)	addiction & Traffic Rules								
HVPE 102-18		Ability Enhancement Compulsory Course-(AECC)	Human Values, De-addiction & Traffic Rules (Lab/Seminar)	0	0	1		25	--	25	1

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Semester		Second (2 nd)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 201-21		Core Theory	Human Anatomy & Physiology-II	3	1	0		40	60	100	4
BRIT 202-21		Core Theory	Fundamentals of Medical Imaging modalities	3	1	0		40	60	100	4
BRIT 203-21		Core Theory	Radiation Safety & Protection AERB Guidelines	3	1	0		40	60	100	4
BRIT 204-21		Core Practical/ Lab	Human Anatomy & Physiology-II Practical	0	0	4		60	40	100	2
BRIT 205-21		Core Practical/ Lab	Fundamentals of Medical Imaging modalities Practical	0	0	4		60	40	100	2
BRIT 206-21		Core Practical/ Lab	Radiation Safety & Protection AERB Guidelines Practical	0	0	4		60	40	100	2
EVS 102-18		Ability Enhancement Compulsory Course (AECC)-III	Environmental Studies	2	0	0		40	60	100	2
BMPD 202-18		Core Theory	Mentoring & Professional Development	0	0	1		25	--	25	1

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Examination and Evaluation			
Theory			
Sr. No.	Evaluation Criteria	Weightage in Marks	Remarks
1.	Mid Term / Sessional Tests	24	Internal Evaluation (XXMarks) MSTs, Quizzes, Assignments, Attendance etc., constitute internal evaluation. Average of two mid semester test will be considered for evaluation.
2.	Attendance	06	
3.	Assignments	10	
4.	End Semester Examination	60	External Evaluation
5.	Total	100	Marks May be rounded off to nearest integer

Practical			
Sr. No.	Evaluation Criteria	Weightage in Marks	Remarks
1.	Evaluation of Practical Record / Viva Voce / Attendance / Seminar / Presentation	60	Internal Evaluation
2.	Final Practical Performance + Viva Voce	40	External Evaluation
3.	Total	100	Marks May be rounded off to nearest integer

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Question Paper Pattern for MST:

Roll No:

No. of Pages

I. K. Gujral Punjab Technical University, Jalandhar

Department of Medical & Allied Sciences

Academic Session: -

Mid-Semester Test (I / II / III) (Regular / Reappear): -	Xxxxxxx	Date: -	DD/MM/YYYY
Programme: -	Xxxxxxxxx	Semester: -	XX Semester
Course Code: -	xxxx-xxx-YY	Course: -	Xxxxx
Maximum Marks: -	Xxx	Time: -	xx HH xx MM

* Note: - Section A is Compulsory, Attempt any two questions from Section B and One Question from Section C.

Section: A		Marks	COs
1.		02	
2.		02	
3.		02	
4.		02	
Section: B		Marks	COs
5.			
6.			
7.			
Section: C		Marks	COs
8.			
9.			

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Details of Course Objectives

C01	
C02	
C03	
C04	
C05	

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Semester		First (1 st)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 101-21		Core Theory	Human Anatomy & Physiology-I	3	1	0		40	60	100	4

Pre-requisite: -10+2 with Medical

Course Objective: - *To teach the fundamental concepts of Human Anatomy and Physiology.*

Course Outcomes: - *At the end of the Course, the student will be able to*

The student will be able to

[46 Hours]

- CO1 Explain the gross morphology, structure and functions of various organs of the human body.
- CO2 Knowledge about Cellular & Tissue level organization.
- CO3 Appreciate coordinated working pattern of different organs of each system
- CO4 Knowledge about various organs involved in different systems.
- CO5 Understanding of the Anatomy & function of different body organs & systems.

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	1	1	2	3	3	1	2	3	1
CO2	3	3	3	2	2	1	2	3	2	3	3	2
CO3	3	3	3	2	2	1	2	3	2	3	3	2
CO4	3	3	3	2	2	1	2	3	2	3	3	2
CO5	4	2	4	3	3	2	3	4	3	4	2	3

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Detailed Syllabus:

- Unit 1: -** Introduction to human body: Definition and scope of [12 Hours] (CO1)
anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.
Cellular level of organization: Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine
- Unit 2: -** Tissue level of organization: Classification of tissues, [12 Hours] (CO2)
structure, location and functions of epithelial, muscular and nervous and connective tissues.
Integumentary System : Structures and functions of skin
- Unit3: -** Nervous system: Organization of nervous system, [12 Hours] (CO3)
neuron, neuroglia, classification and properties of nerve fiber, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.
Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid, structure and functions of brain (cerebrum, brain stem and cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity)
- Unit 4: -** Special senses: Structure and functions of eye, ear, [10 Hours] (CO5)
nose and tongue and their disorders.
Endocrine system: Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.

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Suggested Books: -

1. Anatomy and Physiology in Health and Illness- Kathleen J.W. Wilson
2. Text book of Medical Physiology- Arthur C, Guyton and John E
3. Anatomy & Physiology in Health & Wellness- Anne Waugh & Grant
4. BD Chaurasia's Human Anatomy & Human Physiology

Reference Books: -

1. Principles of Anatomy & Physiology- Tortora & Derrickson
2. Essentials of Medical Physiology-K. Sembulingam and P. Sembulingam
3. Anatomy & Physiology- The Unity of Form & Function- Kenneth S. Saladin
4. Fundamentals of Anatomy & Physiology- Ian Peate & Muralitharan Nair

Semester First(1st)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 104-21		Core Practical/Lab	Human Anatomy & Physiology-I Practical	0	0	4	60	40	100	2

List of Experiment

- Task 1. Demonstration of Anatomical Planes.
- Task 2. Identification of different tissues.
- Task 3. Demonstration of Reflex Activity.
- Task 4. Demonstration of Special Senses.

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Lab Outcome:

The student will be able to:

1. Identify different anatomical planes.
2. Differentiate between various types of Tissues.
3. Have an idea of activity of Nervous System.
4. Differentiate between various senses present in the body.

Text and reference Books: -

1. Anatomy & Physiology in Health & Wellness- Anne Waugh & Grant.
2. BD Chaurasia's Human Anatomy & Human Physiology.
3. Fundamentals of Anatomy & Physiology- Ian Peate & Muralitharan Nair.

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Semester		First (1 st)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 102-21		Core Theory	Basic physics including Radiological Physics	3	1	0		40	60	100	4

Pre-requisite: -10+2 with Medical

Course Objective: - *To teach the basic physics especially focusing on the physics related to Radiology.*

Course Outcomes: - *At the end of the Course, the student will be able to*

The student will be able to

[46 Hours]

- CO1 Knowledge about Physics involved in Radiology.
- CO2 Knowledge about Transformers including Principle & Working.
- CO3 Knowledge about Generators including Principle & Working.
- CO4 Knowledge about Rectifiers including Principle & Working.
- CO5 Understanding of X-rays & their production.

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	2	2	3	3	2	4	3	2
CO2	3	3	4	4	2	4	2	4	2	3	3	4
CO3	3	4	3	3	2	3	2	3	4	4	3	3
CO4	3	4	3	4	2	4	3	4	2	3	3	3
CO5	4	2	4	3	3	2	3	4	3	4	2	3

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Detailed Syllabus:

Unit 1: - X-rays- Introduction& Uses, [10 Hours] (CO5)
Production of X-rays ,
Properties of X-rays ,
Interactions of X-rays with matter.
Radiation hazards of X-rays & protection.

Unit 2: - Transformers: Principles of transformer, [12 Hours] (CO2)
Electromagnetic induction, transformer design,
efficiency of transformer, Various types of
transformers and working of step - down and step up
along with its uses.
Transformers: Principles of transformer, Electromagnetic induction, transformer
design, efficiency of transformer, Various types of transformers and working of step -
down and step up along with its uses.

Unit3: - Generators: Types of generators, 3 phase, 6 and 12 [12 Hours] (CO3)
pulse circuits, falling load generators, Advantages of
the 3-phase over single phase, Radiographic
advantages of 3 phase X-Ray generators over single
phase, 12 pulse circuit.
Generators: Types of generators, 3 phase, 6 and 12 pulse circuits, falling load
generators, Advantages of the 3-phase over single phase, Radiographic advantages of
3 phase X-Ray generators over single phase, 12 pulse circuit.

Unit 4: - Rectifiers: Introduction, principle of rectification, half [12 Hours] (CO4)
wave and full wave rectification ,energy bands in
solids, the semiconductor, p-type and n-type
semiconductors, p-n junction, p-n junction diode, p-n
junction diode as rectifier (half- wave and full-wave
rectifier).
Rectifiers: Introduction, principle of rectification, half wave and full wave rectification
,energy bands in solids, the semiconductor, p-type and n-type semiconductors, p-n
junction, p-n junction diode, p-n junction diode as rectifier (half- wave and full-wave
rectifier).

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Suggested Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. The Physics of Radiology and Imaging- K THAYALAN
3. The Essential Physics of Medical Imaging- Bushberg
4. Review of Radiologic Physics- Walter Huda

Reference Books: -

1. Radiology Review: Radiologic Physics, 1e
2. A Textbook of Radiology Physics- Jaypee Digital
3. Diagnostic Radiology Physics- A Handbook for Teachers
4. The Essential Physics of Medical Imaging- Bushberg

Semester First(1st)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 105-21		Core Practical/Lab	Basic Physics including Radiology Physics Practical	0	0	4	60	40	100	2

List of Experiment

- Task 1. A.C. and D.C. power supply with examples, single phase and poly phase power supply, switches, fuses
- Task 2. Heating effect of current, Ammeter, voltmeter, Galvanometer.
- Task 3. TLD badges and their uses and relative merits.
- Task 4. Rectifiers: Introduction, energy bands in solids, the semiconductor, p-type and n-type semiconductors, density of charge carriers and conductivity, p-n junction, p-n junction diode.

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Lab Outcome:

The student will be able to:

1. Know about AC & DC power supply & Physics behind those.
2. Know about current & devices used to measure it.
3. Know about Rectifiers & energy bands.
4. Know about semiconductors & types of Semi-conductors.

Text and reference Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. The Physics of Radiology and Imaging- K THAYALAN
3. The Essential Physics of Medical Imaging- Bushberg

Semester		First (1 st)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 103-21		Core Theory	Conventional Radiography and Equipments	3	1	0		40	60	100	4

Pre-requisite: -10+2 with Medical

Course Objective: - *To learn about the conventional Radiology & Equipments used in it.*

Course Outcomes: - *At the end of the Course, the student will be able to*

The student will be able to

[46 Hours]

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- CO1 Knowledge about X-ray machine & X-ray Tubes.
 CO2 Knowledge about Cassettes used in X-ray.
 CO3 Knowledge about Filters & Intensifying screens used in X-ray.
 CO4 Understanding scattered radiation & its control method.
 CO5 Knowledge about Grid & its uses and functions in X-rays.

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	3	2	3	3	2	3	3	3
CO2	2	4	2	2	4	3	3	4	3	3	4	4
CO3	2	3	2	2	3	3	4	3	3	4	3	3
CO4	2	4	3	3	4	3	4	4	3	4	3	4
CO5	3	2	3	3	4	4	2	4	4	2	4	3

Detailed Syllabus:

Unit 1: - X-ray tubes: x-ray tube, construction working and limitations, stationary anode x - ray tube; construction, working, methods of cooling the anode, rotating anode x - ray tube: construction, speed of anode rotation, angle of anode inclination, anode heel effect [12 Hours] (CO1)

Unit 2: - Cassettes: Structure and function, Types, Design features and consideration with loading/unloading, Care and maintenance (cleaning) [10 Hours] (CO2)

Unit 3: - Intensifying Screen & Filters: Structure and functions, common phosphors used for determination of relative speeds, types, screen mounting, care and maintenance of film screen contact. [12 Hours] (CO3)

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Unit 4: - Control of scattered radiation: Beam limiting devices: cones, diaphragms, light beam collimator, beam centering device, methods to verify beam centering and field alignment, Grid: Purpose and function, grid ratio, grid cut-off effect on radiation exposure, use of grid, structure and materials. [12 Hours] (CO4,CO5)
Types: stationary, parallel, focused, cross-hatch Moving grids.
Purpose/advantages/disadvantages

Suggested Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. Learning Radiology- William Herring
3. Textbook of Radiology & Imaging- David Sutton
4. Radiologic Science for Technologists- Stewart C. Bushong

Reference Books: -

1. Introduction to Radiologic Technology- William J. Callaway
2. Core radiology- A Visual Approach- Ellen X-Sun
3. Handbook of Interventional Radiologic Procedures- Krishna Kandarpa
4. The Essential Physics of Medical Imaging- Bushberg

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Semester First(1st)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 106-21		Core Practical/Lab	Conventional Radiography and Equipments Practical	0	0	4	60	40	100	2

List of Experiment

- Task 1. X-ray tube, its features & Parts.
- Task 2. Image intensifier, its features, spot film.
- Task 3. Grids, its features & types.
- Task 4. Maintenance of X-ray equipment and accessories

Lab Outcome:

The student will be able to:

1. Knowledge about X-ray machine & X-ray Tubes.
2. Know about Image intensifier, its features, spot film.
3. Know about Grids&its use.
4. Know about Maintenance of X-ray Equipment& accessories.

Text and reference Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. Learning Radiology- William Herring
3. Textbook of Radiology & Imaging- David Sutton

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Semester		First (1 st)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BTHU 103-18		Ability Enhancement Compulsory Course-I (AECC)	English	1	0	0		40	60	100	1

Pre-requisite: -10+2 with Medical

Course Objective: - *To learn about the effective English communication skills.*

Course Outcomes: - *At the end of the Course, the student will be able to*

The student will be able to

[30 Hours]

- CO1 Knowledge about theory & types of communication.
- CO2 Knowledge about English language for verbal conversations.
- CO3 Knowledge about barriers & strategies used in Communication.
- CO4 Idea about reading & understanding of English Language.
- CO5 Knowledge about Documenting, Note taking, note writing etc.

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Detailed Syllabus:

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- Unit 1:** - Theory of Communication [4 Hours] (CO1)
Types and modes of Communication
- Unit 2:** - Language of Communication Verbal and Non-verbal [6 Hours] (CO2)
(Spoken & verbal), Personal, Social and Business Barriers and Strategies, Intra-personal, Inter-personal and Group communication.
- Unit3:** - Reading and Understanding Close Reading, [10 Hours] (CO3)
Comprehension, Summary Paraphrasing, Analysis and Interpretation, Translation(from Hindi/Punjabi to English and vice-versa), Literary/Knowledge Texts
- Unit 4:** - Documenting, Report Writing, Making Notes, Letter [12 Hours] (CO4,CO5)
Writing.

Suggested Books: -

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 20213.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas.

Reference Books: -

1. On Writing Well. William Zinsser. Harper Resource Book. 2001
2. Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
3. Common European Framework of Reference for Languages: Learning, Teaching, Assessment
4. Face2face: Elementary & Pre-Intermediate Teacher's Book

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Semester First(1st)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BTHU 104-18		Ability Enhancement Compulsory Course-I (AECC)	English	0	0	2	30	20	50	1

List of Experiment

- Task 1. Listening Comprehension
- Task 2. Self-Introduction, Group Discussion and Role Play
- Task 3. Conversations and Dialogues
- Task 4. Formal Presentations, Effective Communication/ Mis-communication Public Speaking.

Lab Outcome:

The student will be able to:

1. Knowledge about Formal Presentations & public speaking.
2. Knowledge about English language for verbal conversations.
3. Knowledge about barriers & strategies used in Communication.
4. Idea about reading & understanding of English Language.

Text and reference Books: -

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 20213.

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Semester		First (1 st)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
HVPE 101-18		Ability Enhancement Compulsory Course-II(AECC)	Human Values, De-addiction & Traffic Rules	3	0	0		40	60	100	3

Pre-requisite: -10+2 with Medical

Course Objective: - *To develop a sense of social responsibility, traffic rules and about menace of drugs.*

Course Outcomes: - *At the end of the Course, the student will be able to*

The student will be able to

[28 Hours]

- CO1 Understanding about Value Education.
- CO2 Understanding Harmony in the Human Being.
- CO3 Understanding Harmony in family & society.
- CO4 Understanding Harmony in Nature & Existence.
- CO5 Knowledge about Traffic Rules & Drug De-addiction.

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

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Detailed Syllabus:

- Unit 1:** Course Introduction – Need, Basic Guidelines, Content and Process [6 Hours]
for Value Education Understanding the need, basic guidelines, (CO1)
- content and process for Value Education Self Exploration–what is it?
– its content and process; ‘Natural Acceptance’ and Experiential
Validation-as the mechanism for self-exploration Continuous
Happiness and Prosperity- A look at basic Human Aspirations Right
understanding, Relationship and Physical Facilities- the basic
requirements for 19ulfilment of aspirations of every human being
with their correct priority Understanding Happiness and Prosperity
correctly- A critical appraisal of the current scenario Method to 19ulfil
the above human aspirations: understanding and living in harmony
at various levels
Course Introduction – Need, Basic Guidelines, Content and Process for Value
Education Understanding the need, basic guidelines, content and process for
Value Education Self Exploration–what is it? – its content and process; ‘Natural
Acceptance’ and Experiential Validation-as the mechanism for self-exploration
Continuous Happiness and Prosperity- A look at basic Human Aspirations Right
understanding, Relationship and Physical Facilities- the basic requirements for
19ulfilment of aspirations of every human being with their correct priority
Understanding Happiness and Prosperity correctly- A critical appraisal of the
current scenario Method to 19ulfil the above human aspirations: understanding
and living in harmony at various levels
- Unit 2:** - Understanding Harmony in the Human Being – Harmony in [6 Hours]
Myself! Understanding human being as a co-existence of the (CO2)
sentient ‘I’ and the material ‘Body’ Understanding the needs of
Self (‘I’) and ‘Body’ – Sukh and Suvidha Understanding the Body
as an instrument of ‘I’ (I being the doer, seer and enjoyer)
Understanding the characteristics and activities of ‘I’ and harmony
in ‘I’ Understanding the harmony of I with the Body: Sanyam and
Swasthya; correct appraisal of Physical needs, meaning of
Prosperity in detail Programs to ensure Sanyam and Swasthya
Practice Exercises and Case Studies will be taken up in Practice
Sessions.
- Unit3:** - Understanding Harmony in the Family and Society- Harmony in [10
HumanHuman Relationship Understanding harmony in the Family- Hours]
the basic unit of human interaction Understanding values in (CO3)
human-human relationship; meaning of Nyaya and program for
its 19ulfilment to ensure Ubhay-tripti; Trust (Vishwas) and
Respect (Samman) as the foundational values of relationship
Understanding the meaning of Vishwas; Difference between

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intention and competence Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals 6 20 Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family! Practice Exercises and Case Studies will be taken up in Practice Sessions
Understanding Harmony in the Nature and Existence – Whole existence as Co-existence Understanding the harmony in the Nature Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space Holistic perception of harmony at all levels of existence Practice Exercises and Case Studies will be taken up in Practice Sessions

Unit 4: - Implications of the above Holistic Understanding of Harmony on Professional Natural acceptance of human values Definitiveness of Ethical Human Conduct Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order Competence in professional ethics: Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems Strategy for transition from the present state to Universal Human Order: At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations [6 Hours] (CO4,CO5)

Suggested Books: -

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Value Education
2. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA.
3. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.

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4. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.

Reference Books: -

1. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
2. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.
3. A.N. Tripathy, 2003, Human Values, New Age International Publishers.
4. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.

Semester First(1st)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
HVPE 101-18		Ability Enhancement Compulsory Course-II(AECC)	Human Values, De-addiction & Traffic Rules (LAB/SEMINAR)	0	0	2	30	20	50	1

List of Experiment

- Task 1. Seminar on Drug De-addiction.
- Task 2. Seminar on Traffic Rules.
- Task 3. Seminar on Human Values.
- Task 4. Seminar on Harmony & its importance.

Lab Outcome:

The student will be able to:

5. Knowledge about Human Values.

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6. Understanding Harmony in family & society.
7. Understanding Harmony in Nature & Existence.
8. Knowledge about Traffic Rules & Drug De-addiction.

Text and reference Books: -

4. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
5. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books
6. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

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Semester		Second (2 nd)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT201-21		Core Theory	Human Anatomy & Physiology-II	3	1	0		40	60	100	4

Pre-requisite: -10+2 with Medical

Course Objective: - *To teach the fundamental concepts of Human Anatomy and Physiology.*

Course Outcomes: - *At the end of the Course, the student will be able to*

The student will be able to

[45 Hours]

CO1 Explain the Alimentary Canal & its functions.

CO2 Knowledge about Urinary System & its Functions.

CO3 Knowledge about cardiovascular System & its Functions

CO4 Knowledge about Reproductive System & its functions.

CO5 Understanding of Body fluids & their uses.

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	4	4	2	3	3	1	2	3	1
CO2	3	3	3	2	2	3	2	3	2	4	4	2
CO3	3	3	3	2	2	3	2	3	2	3	3	2
CO4	3	3	3	2	4	4	2	3	2	3	3	2

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CO5	4	2	4	3	3	2	3	4	3	4	2	3
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Detailed Syllabus:

Unit 1: - Alimentary system: mechanism and physiology of digestion [12 Hours]
and absorption structure & function (Mouth, Tongue, Teeth, (CO1)
Oesophagus, Pharynx, Stomach, Intestine, Rectum, Anus;
Digestive glands; physiology of digestion of carbohydrates,
lipids& proteins, structure and function of liver.

Urinary system: Main parts, Structure & function of kidney, structure of nephron,
physiology of excretion & urine formation, urine, additional excretory organs.

Unit 2: - Circulatory system: Composition and functions of blood, [12 Hours]
anatomy and physiology of Heart, circulation of blood, cardiac (CO2)
cycle and conducting system of Heart, the blood pressure,
arteries and veins

Respiratory system-Organs of respiration and their histology, Respiration
(definition and mechanism), Gas exchange in the lungs, Regulation of respiration,
Basal metabolic rate.

Unit3: - Reproductive system-Male and female reproductive system, [11 Hours]
Histology of gonads, the ovarian cycle and ovulation, (CO3)
Fertilization, spermatogenesis.

Lymphatic system- Introduction, Structure and function, Lymph nodes, Spleen,
Thymus gland, Tonsils

Unit 4: - Body fluids and their significance: Important terms, types [10 Hours]
of body fluid, total body water, avenues by which water leaves (CO5)
and enters body, general principles for fluid balance, cardinal
principle, how body fluids maintain Homeostasis, Electrolytes &
ions Function of electrolytes, how electrolyte imbalance leads
to fluid imbalance

Body fluids and their significance: Important terms, types of body fluid, total
body water, avenues by which water leaves and enters body, general principles for
fluid balance, cardinal principle, how body fluids maintain Homeostasis, Electrolytes &
ions Function of electrolytes, how electrolyte imbalance leads to fluid imbalance

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Suggested Books: -

1. Anatomy and Physiology in Health and Illness- Kathleen J.W. Wilson
2. Text book of Medical Physiology- Arthur C, Guyton and John E
3. Anatomy & Physiology in Health & Wellness- Anne Waugh & Grant
4. BD Chaurasia's Human Anatomy & Human Physiology

Reference Books: -

1. Principles of Anatomy & Physiology- Tortora & Derrickson
2. Essentials of Medical Physiology-K. Sembulingam and P. Sembulingam
3. Anatomy & Physiology- The Unity of Form & Function- Kenneth S. Saladin
4. Fundamentals of Anatomy & Physiology- Ian Peate& Muralitharan Nair

Semester Second(2nd)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 204-21		Core Practical/ Lab	Human Anatomy & Physiology-II Practical	0	0	4	60	40	100	2

List of Experiment

- Task 1. Estimation of blood pressure.
- Task 2. Estimation of Respiratory Rate.

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Task 3. Calculation of Pulse & Heart rate.

Task 4. Estimation of Blood cells & different counts.

Lab Outcome:

The student will be able to:

1. Measure Blood Pressure.
2. Differentiate between Pulse & Heart Rate.
3. Estimation of respiratory rate.
4. Differentiate between various types of cells found in blood.

Text and reference Books: -

4. Anatomy & Physiology in Health & Wellness- Anne Waugh & Grant.
5. BD Chaurasia's Human Anatomy & Human Physiology.
6. Fundamentals of Anatomy & Physiology- Ian Peate & Muralitharan Nair.

Semester		Second (2 nd)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 202-21		Core Theory	Fundamentals of Medical Imaging modalities	3	1	0		40	60	100	4

Pre-requisite: -10+2 with Medical

Course Objective: - *To learn about the Fundamental Radio-Medical Imaging.*

Course Outcomes: - *At the end of the Course, the student will be able to*

The student will be able to

[46 Hours]

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- CO1 Knowledge about Computed Tomography.
 CO2 Knowledge about Magnetic Resonance Imaging.
 CO3 Knowledge about Ultrasound Imaging.
 CO4 Understanding of Advanced imaging modalities.
 CO5 Knowledge about MR Instrumentation & management.

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	3	2	3	3	2	3	3	3
CO2	2	4	2	2	4	3	3	4	3	3	4	4
CO3	2	3	2	2	3	3	4	3	3	4	3	3
CO4	2	4	3	3	4	3	4	4	3	4	3	4
CO5	3	2	3	3	4	4	2	4	4	2	4	3

Detailed Syllabus:

Unit 1: - Basic Computed Tomography- Basic principles of [10 Hours] (CO1)
 CT, generations of CT, CT instrumentation, image formation in CT, CT image reconstruction, Hounsfield unit, CT image quality, CT image display

Unit 2: - Advanced Computed Tomography - Helical CT scan: [12 Hours] (CO2)
 Slip ring technology, advantages, multi detector array helical CT, cone – beam geometry, reconstruction of helical CT images.
 Post processing techniques: MPR, MIP, Min IP, 3D rendering: SSD and VR, CT Dose, patient preparation, Imaging techniques and protocols for various parts of body, CT contrast enhanced protocols .

Unit3: - Advanced technique & instrumentation of MRI [12 Hours] (CO2)
 Basic Principle: Spin – precession – relaxation time– T1 weighted image – T2 weighted image – proton density image.

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Pulse sequence: Spin echo pulse sequence – turbo spin echo pulse sequence - Gradient echo sequence – Turbo gradient echo pulse sequence - Inversion recovery sequence – STIR sequence – SPIR sequence – FLAIR sequence – Echo planar imaging – Advanced pulse sequences.

MR Instrumentation: Types of magnets – RF transmitter – RF receiver – Gradient coils – shim coils – RF shielding – computers.

Unit 4: - Production of ultrasound: Piezoelectricity, Medical ultrasound transducer: Principle, construction and working, characteristics of US beam. [12 Hours] (CO4)

Ultrasound display modes: A, B, M ,ultrasound artifacts, ultrasound recording devices, ultrasound artifacts, biological effects and safety.

Suggested Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. BASICS OF MRI- CATHERINE
3. Textbook of Radiology & Imaging- David Sutton
4. Radiologic Science for Technologists- Stewart C. Bushong

Reference Books: -

1. Introduction to Radiologic Technology- William J. Callaway
2. Core radiology- A Visual Approach- Ellen X-Sun
3. Handbook of Interventional Radiologic Procedures- Krishna Kandarpa
4. The Essential Physics of Medical Imaging- Bushberg

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Semester Second(2nd)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 205-21		Core Practical/ Lab	Fundamentals of Medical Imaging modalities Practical	0	0	4	60	40	100	2

List of Experiment

- Task 1. Types of magnets used in MRI.
- Task 2. Transducer Construction.
- Task 3. Working of CT Scan machine.
- Task 4. Working of USG.

Lab Outcome:

The student will be able to:

1. Knowledge about Magnets.
2. Know about Transducers.
3. Know about Computed Tomography.
4. Know about Ultrasound Imaging.

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Text and reference Books: -

- 1 Radiology For Residents and Technicians- S K Bhargawa
- 2 Learning Radiology- William Herring
- 3 Textbook of Radiology & Imaging- David Sutton

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Semester		Second (2 nd)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 203-21		Core Theory	Radiation Safety & Protection AERB Guidelines	3	1	0		40	60	100	4

Pre-requisite: -10+2 with Medical

Course Objective: - *To learn about Radiations & Protection from radiation.*

Course Outcomes: - *At the end of the Course, the student will be able to*

The student will be able to

[44 Hours]

CO1 Knowledge about Radiations in Radiology suite.

CO2 Knowledge about Radiation Protection.

CO3 Knowledge about measurement of Radiation.

CO4 Understanding of Biological effects of Radiation.

CO5 Knowledge about Radiation Regulatory Bodies.

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	3	2	3	3	2	3	3	3
CO2	2	4	2	2	4	3	3	4	3	3	4	4
CO3	2	3	2	2	3	3	4	3	3	4	3	3
CO4	2	4	3	3	4	3	4	4	3	4	3	4
CO5	3	2	3	3	4	4	2	4	4	2	4	3

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Detailed Syllabus:

- Unit 1: - Introduction to Radiation protection-** Need for [12 Hours]
protection, Aim of radiation protection. (CO1,CO2)
Limits for radiation exposure: Concept of ALARA, maximum permissible dose, exposure in pregnancy, children.
Occupational Exposure Limits - Dose limits to public
- Unit 2: -** Radiation measuring instruments: survey meters, area [12 Hours] (CO3)
monitor, personnel dosimeters, film badge, thermo luminescent dosimeter, pocket dosimeter.
Radiation Quantities and Units: Radiation, Radioactivity, Sources of radiation - natural radioactive sources, cosmic rays, terrestrial radiation, manmade radiation sources. Kerma, Exposure, Absorbed dose, Equivalent Dose, Weighting Factors, Effective Dose.
- Unit3: - Biological Effects of radiation:** Direct & Indirect [10 Hours] (CO4)
actions of radiation ,concept of detriment ,Deterministic & stochastic effect of radiation ,somatic and genetic effects, chronic exposure-LD50 - factors affecting radio sensitivity.
- Unit 4: -** Regulatory Bodies & regulatory Requirements: [10 Hours] (CO5)
International Commission on Radiation Protection (ICRP) / National Regularity body (AERB - Atomic Energy Regulatory Board) - Responsibilities, organization & Safety Standard.

Suggested Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. BASICS OF MRI- CATHERINE
3. Textbook of Radiology & Imaging- David Sutton
4. Radiologic Science for Technologists- Stewart C. Bushong

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Reference Books: -

1. Introduction to Radiologic Technology- William J. Callaway
2. Core radiology- A Visual Approach- Ellen X-Sun
3. Handbook of Interventional Radiologic Procedures- Krishna Kandarpa
4. The Essential Physics of Medical Imaging- Bushberg

Semester Second(2nd)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 206-21		Core Practical/ Lab	Radiation Safety & Protection AERB Guidelines Practical	0	0	4	60	40	100	2

List of Experiment

- Task 1. Types of Radiations.
- Task 2. Radiation Protection.
- Task 3. Radiation Measurement.
- Task 4. Effects of Radiation.

Lab Outcome:

The student will be able to:

1. Knowledge about Radiation.
2. Know about Radiation Protection.
3. Know about Radiation Measurement.

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4. Know about effects of Radiation.

Text and reference Books: -

4. Radiology For Residents and Technicians- S K Bhargawa
5. Learning Radiology- William Herring
6. Textbook of Radiology & Imaging- David Sutton

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Semester		Second (2 nd)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
EVS 102-18		Ability Enhancement Compulsory Course (AECC)-III	Environmental Studies	2	0	0		40	60	100	2

Pre-requisite: -10+2 with Medical

Course Objective: - *To learn about Environment & related terms.*

Course Outcomes: - *At the end of the Course, the student will be able to*

The student will be able to

[36 Hours]

- CO1 Knowledge about Environment & Ecosystem.
- CO2 Knowledge about Renewable & Non-Renewable Resources.
- CO3 Knowledge about Environmental Factors & Hazards.
- CO4 Idea about Sanctuaries, Parks & other areas of Ecosystem.
- CO5 Knowledge about Human impact on Environment.

Detailed Syllabus:

Unit 1: - Introduction to Environmental Studies Multidisciplinary nature of Environmental Studies: Scope & Importance Need for Public Awareness [4 Hours] (CO1)

Ecosystems Concept of an Ecosystem: Structure & functions of an ecosystem (Producers, Consumers & Decomposers) Energy Flow in an ecosystem: Food Chain, Food web and Ecological Pyramids Characteristic features, structure & functions of following Ecosystems: • Forest Ecosystem • Aquatic Ecosystem (Ponds, Lakes, River & Ocean)

Unit 2: - Natural Resources Renewable & Non-renewable resources Forest Resources: Their uses, functions & values (Biodiversity) [8 Hours] (CO2)

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conservation, role in climate change, medicines) & threats (Overexploitation, Deforestation, Timber extraction, Agriculture Pressure), Forest Conservation Act Water Resources: Their uses (Agriculture, Domestic & Industrial), functions & values, Overexploitation and Pollution of Ground & Surface water resources (Case study of Punjab), Water Conservation, Rainwater Harvesting, Land Resources: Land as a resource; Land degradation, soil erosion and desertification. Energy Resources: Renewable & non-renewable energy resources, use of alternate energy resources (Solar, Wind, Biomass, Thermal), Urban problems related to Energy

- Unit3: -** Biodiversity & its conservation Types of Biodiversity: Species, Genetic & Ecosystem India as a mega biodiversity nation, Biodiversity hot spots and biogeographic regions of India Examples of Endangered & Endemic species of India, Red data book Environmental Pollution & Social Issues Types, Causes, Effects & Control of Air, Water, Soil & Noise Pollution Nuclear hazards and accidents & Health risks Global Climate Change: Global warming, Ozone depletion, Acid rain, Melting of Glaciers & Ice caps, Rising sea levels Environmental disasters: Earthquakes, Floods, Cyclones, Landslides [8 Hours] (CO3)
- Unit 4: -** Field Work Visit to a National Park, Biosphere Reserve, Wildlife Sanctuary Documentation & preparation of a Biodiversity (flora & fauna) register of campus/river/forest Visit to a local polluted site : Urban/Rural/Industrial/Agricultural Identification & Photography Ofresident or migratory birds, insects (butterflies) Public hearing on environmental issues in a village [16 Hours] (CO4,CO5)

Suggested Books: -

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.Global Ethics and Environment, London, Routledge

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4. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.

Reference Books: -

1. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
2. McCully, P. 1996. Rivers no more: the environmental effects of dams(pp. 29--- 64). Zed Books.
3. Odum, E.P., Odum, H.T. & Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2021. Environmental and Pollution Science. Academic Press.

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Semester		Second (2 nd)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BMPD 202-18		Core Theory	Mentoring & Professional Development	0	0	1		25	--	25	1

Pre-requisite: -10+2 with Medical

Course Objective: - *To learn about Mentoring & Professional Development.*

Course Outcomes: - *At the end of the Course, the student will be able to Have a professional growth in them.*[25 Hours]

Detailed Syllabus:

Unit 1: - PART A: CLASSROOM ACTIVITIES: [15 Hours]

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises
- 7* A part of above six points practicals on Fundamentals of Computers are also added as per Annexure-I

Unit 2: - PART B: OUTDOOR ACTIVITIES: [10 Hours]

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc. (CO2)

Evaluation shall be based on rubrics for Part – A & B

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

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Study Scheme & Syllabus of
Bachelors of Science (B.Sc.) in
RADIOLOGY IMAGING & TECHNOLOGY

Session 2024 Onwards

By
Board of Studies

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Program Educational Objectives: At the end of the Program, the student will be able to: -	
PEO1	Understand the fundamentals and applications of Radiological Equipments such as MRI Machine, CT Scan Machine, X-ray Machine etc.
PEO2	Perform various Radiological procedures which are necessary for diagnostic purposes.
PEO3	Develop technical knowledge of Radiology so that he/she will be able to assist a Radiologist in every aspect of Radiological Imaging.
PEO4	Pursue a career in Hospital as well as go for further education & research in Radiology & Imaging.

Program Outcomes: At the end of the Program, the student will be able to: -	
PO1	Engage in lifelong learning and adapt to changing professional and societal needs.
PO2	The Candidates can join Private, Military and public health services
PO3	In industry, Imaging technologists are needed for Application and Software development for Medical Imaging equipment.
PO4	Those who choose this stream are going to study about Radiological & Imaging Technology such as MRI, CT scan, USG etc.
PO5	Ability to do various Radiological procedures which are necessary for diagnostic purposes.
PO6	Understanding of fundamentals and applications of Radiological Equipments such as MRI Machine, CT Scan Machine, X-ray Machine etc.
PO7	To explore the foundation science and safety principles in Medical Imaging Technology.
PO8	Enhance knowledge from clinical experience, interactions & discussions and research to improve the quality of training and education in Medical Imaging.
PO9	Explore the subject in depth and develop high degree of expertise to contribute to advancement of knowledge in Medical Imaging.
PO10	Develop technical and presentation skills necessary to become efficient technologists utilizing state-of-the art facilities and equipments.
PO11	To provide with the skills and knowledge to apply for critical appraisal of day to day practice.
PO12	Students will be competent to work in Hospital Radiology Suites, MRI Units and other related sections.
PO13	Students will be skilled in problem solving, critical thinking and will be able to assist the Radiologist in various procedures.
PO14	This course provides medical imaging technologists with an understanding of the physical principles as well as theories involved in diagnostic imaging modalities.
PO15	Students will be able to have all the relevant knowledge of Radiology & Imaging Sciences and will be able to do various procedures required.
PO16	Students will be able to integrate knowledge of various types of Radiological & Imaging procedures along with their in-depth knowledge.

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Program Specific Outcomes: At the end of the Program, the student will be able to: -	
PSO1	Competent to work in Hospital Radiology Suites, MRI Units and other related sections.
PSO2	Develop an understanding of the physical principles as well as theories involved in diagnostic imaging modalities.
PSO3	This Program will create a great source of manpower which can aid in our health sector especially in MRI, CT scan, X-ray & Ultrasonography sections.
PSO4	To explore the foundation science and safety principles in Medical Imaging Technology.

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Bachelor of Radiology Imaging & Technology Course for session 2024 Onwards

Semester		Third (3 rd)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 301-21		Core Theory	Equipments of modern imaging technology	3	1	0		40	60	100	4
BRIT 302-21		Core Theory	Contrast and Special Radiographic Procedures	3	1	0		40	60	100	4
BRIT 303-21		Core Theory	Clinical Radiography Positioning	3	1	0		40	60	100	4
BRIT 304-21		Core Practical/Lab	Equipments of modern imaging technology Practical	0	0	4		60	40	100	2
BRIT 305-21		Core Practical/Lab	Contrast and Special Radiographic Procedures Practical	0	0	4		60	40	100	2
BRIT 306-21		Core Practical/Lab	Clinical Radiography Positioning Practical	0	0	4		60	40	100	2
BRIT 307-21		Ability Enhancement Compulsory Course (AECC)-IV	Introduction to Quality & Patient Safety	2	1	0		40	60	100	3

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Bachelor of Radiology Imaging & Technology Course for session 2024 Onwards

Semester		Fourth (4th)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 401-21		Core Theory	Physics of newer imaging modalities	3	1	0		40	60	100	4
BRIT 402-21		Core Theory	Interventional Radiological Techniques	3	1	0		40	60	100	4
BRIT 403-21		Core Theory	Advance Techniques and Instrumentation of MRI	3	1	0		40	60	100	4
BRIT 404-21		Core Practical/Lab	Physics of newer imaging modalities Practical	0	0	4		60	40	100	2
BRIT 405-21		Core Practical/Lab	Interventional Radiological Techniques Practical	0	0	4		60	40	100	2
BRIT 406-21		Core Practical/Lab	Advance Techniques and Instrumentation of MRI Practical	0	0	4		60	40	100	2
BRIT 407-21		Ability Enhancement Compulsory Course (AECC)-V	Basic in Computers and Information Science	2	1	0		40	60	100	3
BRIT 408-21		Ability Enhancement Compulsory Course (AECC)-V	Basic in Computers and Information Science (Practical)	0	0	2		60	40	100	1

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Examination and Evaluation			
Theory			
Sr. No.	Evaluation Criteria	Weightage in Marks	Remarks
1.	Mid Term / Sessional Tests	24	Internal Evaluation (XXMarks) MSTs, Quizzes, Assignments, Attendance etc., constitute internal evaluation. Average of two mid semester test will be considered for evaluation.
2.	Attendance	06	
3.	Assignments	10	
4.	End Semester Examination	60	External Evaluation
5.	Total	100	Marks May be rounded off to nearest integer

Practical			
Sr. No.	Evaluation Criteria	Weightage in Marks	Remarks
1.	Evaluation of Practical Record / Viva Voce / Attendance / Seminar / Presentation	60	Internal Evaluation
2.	Final Practical Performance + Viva Voce	40	External Evaluation
3.	Total	100	Marks May be rounded off to nearest integer

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Question Paper Pattern for MST:

Roll No:

No. of Pages

I. K. Gujral Punjab Technical University, Jalandhar

Department of Medical & Allied Sciences

Academic Session: -

Mid-Semester Test (I / II / III) (Regular / Reappear): -	Xxxxxxxx	Date: -	DD/MM/YYYY
Programme: -	Xxxxxxxxxx	Semester: -	XX Semester
Course Code: -	xxxx-xxx-YY	Course: -	Xxxxxx
Maximum Marks: -	Xxx	Time: -	xx HH xx MM

* Note: - Section A is Compulsory, Attempt any two questions from Section B and One Question from Section C.

Section: A		Marks	COs
1.		02	
2.		02	
3.		02	
4.		02	
Section: B		Marks	COs
5.			
6.			
7.			
Section: C		Marks	COs
8.			
9.			

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Details of Course Objectives

CO1	
CO2	
CO3	
CO4	
CO5	

Semester		Third (3 rd)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 301-21		Core Theory	Equipments of modern imaging technology	3	1	0		40	60	100	4

Pre-requisite: -10+2 with Medical

Course Objective: -*To learn about Equipments used in Modern Imaging.*

Course Outcomes: -*At the end of the Course, the student will be able to*

The student will be able to [50 Hours]

- CO1 Knowledge about CR & Digital Radiography.
- CO2 Knowledge about Mammography & USG.
- CO3 Knowledge about CT basic Physics & CT artifacts.
- CO4 Understanding of MRI basic Principles & imaging methods.
- CO5 Knowledge about Modern advanced imaging technology.

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Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	2	3	2	3	3	3	3
CO2	4	3	3	4	4	3	3	3	3	4	4	4
CO3	3	3	4	3	3	3	4	3	4	3	3	3
CO4	4	3	4	3	4	3	4	3	4	4	3	4
CO5	4	4	2	4	4	4	2	4	2	4	4	3

Detailed Syllabus:

Unit 1: - C.R: Principle, Equipment & Imaging ,Digital Radiography: [12 Hours] (CO1)
Principle, Equipment & Imaging

Unit 2: - Mammography: Basic principle, Equipment & Image acquisition [14 Hours] (CO2)
USG - Production of ultrasound: Piezoelectricity, Medical ultrasound transducer: Principle, construction and working, characteristics of US beam ,Basic acoustics - ultrasound terminologies – Interaction of US with matter –Ultrasound display modes

Unit3: - CT - Basic physics – Tomography principle - basics of plain [12 Hours] (CO4)
studies, contrast studies,Hounsfield unit>window level & window width
CT Artifacts- Classification, Types, Causes, , Diagnostic aspects of CT and post Processing Techniques HRCT.

Unit 4: - MRI -basic principle – imaging methods - slice section plain & [12 Hours] (CO5)
contrast studies –coils in use – image contrast - Factors affecting image quality
- HELIUM / SUPERCONDUCTION & 1.5 TESLA,3 TESLA

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Suggested Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. BASICS OF MRI- CATHERINE
3. Textbook of Radiology & Imaging- David Sutton
4. Radiologic Science for Technologists- Stewart C. Bushong

Reference Books: -

1. Introduction to Radiologic Technology- William J. Callaway
2. Core radiology- A Visual Approach- Ellen X-Sun
3. Handbook of Interventional Radiologic Procedures- Krishna Kandarpa
4. The Essential Physics of Medical Imaging- Bushberg

Semester Third(3rd)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 304-21		Core Practical/Lab	Equipments of modern imaging technology Practical	0	0	4	60	40	100	2

List of Experiment

- Task 1. CT – Its Features & Parts.
- Task 2. Image Intensifier & its Features
- Task 3. Grids, its Features & types.
- Task 4. MRI and Imaging methods.

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Lab Outcome:

The student will be able to:

1. Knowledge about CT Scan & its parts.
2. Know about Image Intensifier.
3. Know about Grid & its Features.
4. Know about MRI & imaging methods.

Text and reference Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. Learning Radiology- William Herring
3. Textbook of Radiology & Imaging- David Sutton

Semester		Third (3 rd)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 302-21		Core Theory	Contrast and Special Radiographic Procedures	3	1	0		40	60	100	4

Pre-requisite: -10+2 with Medical

Course Objective: -To learn about Contrast & its uses in Radiology.

Course Outcomes: -At the end of the Course, the student will be able to

The student will be able to [48 Hours]

- CO1 Knowledge about Radiological Contrast media.
- CO2 Know the methods of administration & dosage of contrast.
- CO3 Knowledge about Barium study & its types.
- CO4 Understanding different methods of Cholangiography.

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CO5 Knowledge about various contrast procedures done in Radiology.

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	2	3	2	3	3	3	3
CO2	4	3	3	4	4	3	3	3	3	4	4	4
CO3	3	3	4	3	3	3	4	3	4	3	3	3
CO4	4	3	4	3	4	3	4	3	4	4	3	4
CO5	4	4	2	4	4	4	2	4	2	4	4	3

Detailed Syllabus:

Unit 1: - Radiological contrast media – classification -need for [14 Hours] (CO1)
radiological contrast media - methods of administration-dosage-
reactions to contrast media- role of radiographer in management
of patient with contrast reaction

For all contrast investigations-patient preparation, positioning, patient care during the study-
post procedural patient care-types of contrast media used and dosagealternative contrast used-
side effects and its identification-treatment of complication during the procedure - pathological
conditions- indications and contraindications- injection procedure –techniques for radiographic
projections - radiographic appearances– radiation protection.

Unit 2: - Sialogram ,Barium studies- different types – Barium swallow [12 Hours] (CO2)
Barium meal study of upper GIT, Barium meal follow through,
Barium enema, small bowel enema, distal colography,
defaecography.

Unit3: - Percutaneous Transhepatic Cholangiogram, ERCP, T-Tube [10 Hours] (CO4)
cholangiography, per-operative cholangiography.

Unit 4: - IVP-rapid sequence-infusion pyelography-high dose urography, [12 Hours] (CO5)
Cystogram, Anterior Urethrogram RGU, MCU, RCP ,
Angiography, Diagnostic & therapeutic, venography,
Lymphangiogram ,Orthography, Discography ,Myelogram,
Hysterosalphingography,Sinography ,Fistulogram, Ductogram

Suggested Books: -

1. Radiology For Residents and Technicians- S K Bhargawa

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2. BASICS OF MRI- CATHERINE
3. Textbook of Radiology & Imaging- David Sutton
4. Radiologic Science for Technologists- Stewart C. Bushong

Reference Books: -

1. Introduction to Radiologic Technology- William J. Callaway
2. Core radiology- A Visual Approach- Ellen X-Sun
3. Handbook of Interventional Radiologic Procedures- Krishna Kandarpa
4. The Essential Physics of Medical Imaging- Bushberg

Semester Third(3rd)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 305-21		Core Practical/Lab	Contrast and Special Radiographic Procedures Practical	0	0	4	60	40	100	2

List of Experiment

- Task 1. Administration & dosage of contrast media.
- Task 2. Barium study methods.
- Task 3. Cholangiography methods.
- Task 4. Various studies done by using contrast.

Lab Outcome:

The student will be able to:

1. Knowledge about Contrast media.
2. Know about Barium study methods.
3. Know about Cholangiography methods.

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4. Know about procedures done with contrast.

Text and reference Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. Learning Radiology- William Herring
3. Textbook of Radiology & Imaging- David Sutton

Semester		Third (3 rd)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 303-21		Core Theory	Clinical Radiography Positioning	3	1	0		40	60	100	4

Pre-requisite: -10+2 with Medical

Course Objective: -*To learn about Positioning used in radiology.*

Course Outcomes: -*At the end of the Course, the student will be able to*

[50 Hours]

- CO1 Knowledge about Extremity Radiography.
- CO2 Know the methods of Spine Radiography.
- CO3 Knowledge about Skull Radiography.
- CO4 Understanding different methods Chest Radiography.
- CO5 Knowledge about soft tissue Radiography

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

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CO1	3	2	3	3	3	2	3	2	3	3	3	3
CO2	4	3	3	4	4	3	3	3	3	4	4	4
CO3	3	3	4	3	3	3	4	3	4	3	3	3
CO4	4	3	4	3	4	3	4	3	4	4	3	4
CO5	4	4	2	4	4	4	2	4	2	4	4	3

Detailed Syllabus:

Unit 1: - Extremities Radiography – Hand- Finger –MCP- Wrist joint- [12 Hours] (CO1)
Forearm -Elbow joint – humerus - shoulder joint. Foot – Toes-
Tarsal bones -Ankle joint - Knee joint – patella – tibia- femur –
Hip joint – pelvis -sacroiliac joint. Fractures of upper limb &
lower limb

Unit 2: - Spine Radiography -Vertebral column – Atlanta occipital [12 Hours]
articulation- cervical spine- dorsal spine - lumbar spine – sacrum - (CO2)
vertebral canal- vertebral foramen. Spondylosis, Spondylitis,
spondylolisthesis, Fractures of Vertebra.

Unit3: - Skull Radiography – general, sella – temporal bone – mastoid – optic [12 Hours]
foramen – Internal auditory canal – Superior and inferior orbital (CO3)
fissure – base of skull – facial bones – petrous apex – Zygomatic
bone, nasal bone, sinuses of skull – mandible – Tempo-mandibular
joint – Paranasal sinuses Radiography.

Unit 4: - Chest Radiography –Basic views (PA & AP) - inspiratory & [14 Hours]
expiratory films special chest views & their significance – larynx- (CO5)
trachea- thoracic inlet -Sternum - Ribs – Heart and great vessels –
mediastinum -Diaphragm – double exposure technique, Basic chest
pathology, Silhouette sign
Abdomen & Pelvic Radiography – all projection – the acute
abdomen investigation.
Soft tissue radiography: Preparations, Instructions, Various
techniques, positioning digital mammography, High and low KV
Technique – radiography – technique for steep range

Suggested Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. Radiography Positioning- CLARK

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3. Textbook of Radiology & Imaging- David Sutton
4. Radiology Of Positioning For Technician- O P SHARMA

Reference Books: -

1. Introduction to Radiologic Technology- William J. Callaway
2. Core radiology- A Visual Approach- Ellen X-Sun
3. Handbook of Interventional Radiologic Procedures- Krishna Kandarpa
4. The Essential Physics of Medical Imaging- Bushberg

Semester Third(3rd)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 306-21		Core Practical/Lab	Clinical Radiography Positioning	0	0	4	60	40	100	2

List of Experiment

- Task 1. Upper limb radiography
- Task 2. Lower limb radiography
- Task 3. Spinal Radiography.
- Task 4. Soft Tissue Radiography.

Lab Outcome:

The student will be able to:

1. Knowledge about Upper limb radiography.
2. Know about Lower limb radiography.
3. Know about Spinal Radiography.
4. Know about Soft Tissue Radiography.

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Text and reference Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. Radiography Positioning- CLARK
3. Radiology Of Positioning For Technician- O P SHARMA

Semester		Third (3 rd)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 307-21		Ability Enhancement Compulsory Course (AECC)-IV	Introduction to Quality & Patient Safety	2	1	0		40	60	100	3

Pre-requisite: -10+2 with Medical

Course Objective: -To learn about Quality Management & Patient safety.

Course Outcomes: -At the end of the Course, the student will be able to

The student will be able to [40 Hours]

- CO1 Knowledge about Quality Management System.
- CO2 Knowledge about Basic Life Support(BLS).
- CO3 Knowledge about Basic Emergency Care.
- CO4 Idea about Biomedical Waste Management.
- CO5 Knowledge about Infection Prevention & Control.

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Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	2	3	2	3	3	3	3
CO2	4	3	3	4	4	3	3	3	3	4	4	4
CO3	3	3	4	3	3	3	4	3	4	3	3	3
CO4	4	3	4	3	4	3	4	3	4	4	3	4
CO5	4	4	2	4	4	4	2	4	2	4	4	3

Detailed Syllabus:

Unit 1: - Quality assurance and Management

[14 Hours]
(CO1)

Introduction, Quality improvement approaches, standards and norms, quality improvement tools, introduction to NABH guidelines.

Basic of Emergency care and Life support skills

Basic life support (BLS) following cardiac arrest, recognition of sudden cardiac arrest and activation of emergency response system, early cardiopulmonary resuscitation (CPR) and rapid defibrillation with an automated external defibrillator (AED)

Unit 2: - Basic emergency care

[12 Hours]
(CO2-CO3)

First aid, choking, rescue breathing methods, ventilation including use of bag valve master (BVMs)

Biomedical Waste Management

Definition, waste minimization, BMW-segregation, collection, transportation, treatment and disposal (Including color coding), Liquid BMW, Radioactive waste, metals/chemicals/drug waste, BMW management and methods of disinfection, use of Personal protective equipment (PPE)

Unit3: - Infection Prevention and Control

[8 Hours]
(CO3)

Sterilization, Disinfection, Effective hand hygiene, use of PPE, Prevention and control of common healthcare associated infections, Guidelines(NABH) and JCI for hospital infection control.

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Unit 4: - Disaster preparedness and management
Fundamentals of emergency management

[6 Hours]
(CO4,CO5)

Suggested Books: -

1. Organizational Quality Management- Pankaj Lochan.
2. Total Quality Management- P N Mukherjee
3. Essentials of Hospital Infection Control- Apurba S Sastry
4. Textbook of Emergency & Trauma Care.

Reference Books: -

1. Organizational Quality Management- Pankaj Lochan.
2. Total Quality Management- P N Mukherjee
3. Essentials of Hospital Infection Control- Apurba S Sastry
4. Textbook of Emergency & Trauma Care.

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Semester		Fourth (4 th)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 401-21		Core Theory	Physics of newer imaging modalities	3	1	0		40	60	100	4

Pre-requisite: -10+2 with Medical

Course Objective: -To learn about Physics of Newer Imaging Equipments.

Course Outcomes: -At the end of the Course, the student will be able to

The student will be able to

[50 Hours]

- CO1 Knowledge about CT-Scan & Physics applied in it
- CO2 Know the Scanning principle, Image Acquisition etc.
- CO3 Knowledge about CT-Scan of Various regions of the body.
- CO4 Understanding the preparation of patient for CT procedures.
- CO5 Knowledge about various CT guided techniques done.

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	2	3	2	3	3	3	3
CO2	4	3	3	2	4	3	3	3	3	4	2	4
CO3	3	3	4	3	3	2	4	3	4	3	3	3
CO4	4	3	4	3	4	3	4	3	4	4	2	4
CO5	4	4	2	4	4	4	2	4	2	4	4	3

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Detailed Syllabus:

- Unit 1: -** Basic principle of CT scan, history of CT-Scan, EMI, advantages and disadvantages, Equipment description, CT image quality, CT image display Advanced Computed Tomography Helical CT scan: Slip ring technology. [12 Hours] (CO1)
- Unit 2: -** Scanning principle, Image acquisition, Image reconstruction, Image manipulation, Image display and documentation, Scanning parameters, post processing techniques: MPR, MIP, Min IP, 3D rendering: SSD and VR. [12 Hours] (CO2)
- Unit3: -** CT scan studies acquisition/ protocols /techniques: CT of head and neck – thorax – abdomen – pelvis – musculo skeletal system – spine – PNS. clinical indications and contraindications – patient preparation – technique – contrast media-types, dose, injection technique; timing, sequence - image display – patient care – utilization of available techniques & image processing facilities to guide the clinician. [14 Hours] (CO4)
- Unit 4: -** CT procedures: patient preparation, Imaging techniques and protocols for- CT Angio mainly Brain, C.T Enteroclysis/ CT IVP/ dual phase CT, CT Guided FNAC / biopsy. [12 Hours] (CO5)

Suggested Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. BASICS OF MRI- CATHERINE
3. Textbook of Radiology & Imaging- David Sutton
4. Radiologic Science for Technologists- Stewart C. Bushong

Reference Books: -

1. Introduction to Radiologic Technology- William J. Callaway
2. Core radiology- A Visual Approach- Ellen X-Sun
3. Handbook of Interventional Radiologic Procedures- Krishna Kandarpa
4. The Essential Physics of Medical Imaging- Bushberg

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Semester Fourth(4th)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 404-21		Core Practical/Lab	Physics of newer imaging modalities Practical	0	0	4	60	40	100	2

List of Experiment

- Task 1. Advanced Computed Tomography.
- Task 2. Post-Processing techniques.
- Task 3. Patient preparation for some special CT-scan procedures.
- Task 4. CT guided FNAC/Biopsy.

Lab Outcome:

The student will be able to:

1. Knowledge about Advanced Computed Tomography.
2. Know about Post-Processing techniques.
3. Know about Patient preparation for some special CT-scan procedures.
4. Know about CT guided FNAC/Biopsy

Text and reference Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. Learning Radiology- William Herring
3. Textbook of Radiology & Imaging- David Sutton

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Semester		Fourth (4 th)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 402-21		Core Theory	Interventional Radiological Techniques	3	1	0		40	60	100	4

Pre-requisite: -10+2 with Medical

Course Objective: -To learn about Interventional techniques used in radiology.

Course Outcomes: -At the end of the Course, the student will be able to

The student will be able to

[46 Hours]

CO1 Knowledge about Interventional Radiology.

CO2 Know the Angiography & its methods.

CO3 Knowledge about Interventional procedures for Nervous system.

CO4 Understanding the Diagnostic procedure Angiography.

CO5 Knowledge about Diagnostic Procedure Venography.

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	2	3	2	3	3	3	3
CO2	4	3	3	2	4	3	3	3	3	4	2	4
CO3	3	3	4	3	3	2	4	3	4	3	3	3
CO4	4	3	4	3	4	3	4	3	4	4	2	4
CO5	4	4	2	4	4	4	2	4	2	4	4	3

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Detailed Syllabus:

- Unit 1: -** Interventional Radiography: Basic angiography and DSA: a. [12 Hours] (CO1)
History , technique, patient care b. Percutaneous catheterisation, catheterization sites, Asepsis c. Guidewire, catheters, pressure injectors, accessories d. Use of digital subtraction- single plane and bi-plane.
- Unit 2: -** Diagnostic procedure angiography, angioplasty, biliary [12 Hours] (CO4)
examination, renal evaluation and drainage procedure. Central Nervous System: a. Myelography b. Cerebral studies c. Ventriculography Arthrography: Shoulder, Hip, Knee, Elbow.
- Unit3: -** Diagnostic procedure Angiography: a. Carotid Angiography (4 [12 Hours] (CO4)
Vessel angiography) b. Thoracic and Arch Aortography c. Selective studies: Renal, SMA, Coeliac axis d. Vertebral angiography e. Femoral arteriography f. Angiocardiology
- Unit 4: -** Diagnostic procedure Venography: a. Peripheral venography b. [10 Hours] (CO5)
Cerebral venography c. Inferior and superior venocavography d. Relevant visceral phlebography

Suggested Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. BASICS OF MRI- CATHERINE
3. Textbook of Radiology & Imaging- David Sutton
4. Radiologic Science for Technologists- Stewart C. Bushong

Reference Books: -

1. Introduction to Radiologic Technology- William J. Callaway
2. Core radiology- A Visual Approach- Ellen X-Sun
3. Handbook of Interventional Radiologic Procedures- Krishna Kandarpa
4. The Essential Physics of Medical Imaging- Bushberg

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Semester Fourth(4th)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 405-21		Core Practical/Lab	Interventional Radiological Techniques Practical	0	0	4	60	40	100	2

List of Experiment

- Task 1. Basic Angiography.
- Task 2. Angioplasty.
- Task 3. Carotid & Coronary Angiography.
- Task 4. Venography.

Lab Outcome:

The student will be able to:

1. Knowledge about Basic Angiography.
2. Know about Angioplasty.
3. Know about Carotid & Coronary Angiography.
4. Know about Venography.

Text and reference Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. Learning Radiology- William Herring
3. Textbook of Radiology & Imaging- David Sutton

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Semester		Fourth (4 th)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 403-21		Core Theory	Advance Techniques and Instrumentation of MRI	3	1	0		40	60	100	4

Pre-requisite: -10+2 with Medical

Course Objective: -To learn about Instrumentation & Techniques in MRI.

Course Outcomes: -At the end of the Course, the student will be able to

The student will be able to

[50 Hours]

- CO1 Knowledge about history & Principles of MRI.
- CO2 Know about MR Instrumentation.
- CO3 Knowledge about MR Angiography.
- CO4 Understanding the Advanced techniques & Instrumentation in MRI.
- CO5 Knowledge about MRI Sequences.

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	2	3	2	3	3	3	3
CO2	4	3	3	2	4	3	3	3	3	4	2	4
CO3	3	3	4	3	3	2	4	3	4	3	3	3
CO4	4	3	4	3	4	3	4	3	4	4	2	4
CO5	4	4	2	4	4	4	2	4	2	4	4	3

Detailed Syllabus:

Signature of Convenor (BOS) Signature of Chairman (BOS)

- Unit 1: -** History of MRI, Magnetism, Basic Principle, hardware, Types of Contrast agents used in MRI, Physical and physiological basis of magnetic relaxation, Image contrast and noise, Spin Echo, Inversion Recovery, Gradient Echo. [12 Hours] (CO1)
- Unit 2: -** MR Instrumentation: Types of magnets – RF transmitter – RF receiver – Gradient coils – shim coils – RF shielding – computers. d. Image formation: 2D Fourier transformation method – K-space representation – 3D Fourier imaging – MIP. e. MR contrast media [12 Hours] (CO3)
- Unit3: -** MR Angiography – TOF & PCA – MR Spectroscopy – functional MRI, 3D images- MRS blood flow imaging, diffusion/perfusion scans - strength and limitations of MRI. [12 Hours] (CO4)
- Unit 4: -** Advanced technique & instrumentation of MRI a. Basic Principles: Spin – precession – relaxation time – pulse cycle – T1 weighted image – T2 weighted image – proton density image. b. Pulse sequence: Spin echo pulse sequence – turbo spin echo pulse sequence - Gradient echo sequence – Turbo gradient echo pulse sequence - Inversion recovery sequence – STIR sequence – SPIR sequence – FLAIR sequence – Echo planar imaging – Advanced pulse sequences [14 Hours] (CO5)

Suggested Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. BASICS OF MRI- CATHERINE
3. Textbook of Radiology & Imaging- David Sutton
4. MRI Made Easy- Govind B. Chauhan

Reference Books: -

1. Introduction to Radiologic Technology- William J. Callaway
2. Core radiology- A Visual Approach- Ellen X-Sun
3. Handbook of Interventional Radiologic Procedures- Krishna Kandarpa
4. The Essential Physics of Medical Imaging- Bushberg

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Semester Fourth(4th)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 406-21		Core Practical/Lab	Advance Techniques and Instrumentation of MRI Practical	0	0	4	60	40	100	2

List of Experiment

- Task 1. Physics, scanning principle in MRI.
- Task 2. Image formation in MRI.
- Task 3. Identification of different parts of MR scanner.
- Task 4. Sequencing in MRI.

Lab Outcome:

The student will be able to:

1. Knowledge about Physics, scanning principle in MRI.
2. Know about Image formation in MRI.
3. Know about Identification of different parts of MR scanner.
4. Know about Sequencing in MRI.

Text and reference Books: -

1. Radiology For Residents and Technicians- S K Bhargawa
2. BASICS OF MRI- CATHERINE
3. MRI Made Easy- Govind B. Chauhan

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Semester		Fourth (4 th)									
Course Code	Group	Course Type	Course Name / Title	Load Allocation				Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Studio (If Applicable)	Internal	External		
BRIT 407-21		Ability Enhancement Compulsory Course (AECC)-V	Basic in Computers and Information Science	2	1	0		40	60	100	3

Pre-requisite: -10+2 with Medical

Course Objective: -To learn about Computers &softwares.

Course Outcomes: -At the end of the Course, the student will be able to

The student will be able to

[49 Hours]

- CO1 Know about basics of Computers.
- CO2 Know about processing, memory & storage.
- CO3 Knowledge about windows of computers.
- CO4 Understanding the Microsoft Word & Presentation.
- CO5 Knowledge about Internet & its applications

Mapping of Course Outcomes with the Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	1	2	2	2	2	3	2	2
CO2	2	1	2	1	1	1	1	1	1	2	1	1
CO3	2	1	3	2	2	1	1	1	2	3	1	2
CO4	1	1	2	1	1	1	1	1	2	3	2	1
CO5	3	2	3	2	2	2	2	2	3	3	2	2

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Detailed Syllabus:

- Unit 1: -** Introduction to computer: Introduction, characteristics of [12 Hours] (CO1)
computer, block diagram of computer, generations of computer, computer languages.
Input output devices: Input devices(keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices(monitors, pointers, plotters, screen image projector, voice response systems).
Processor and memory: The Central Processing Unit (CPU), main memory.
- Unit 2: -** Storage Devices: Sequential and direct access devices, magnetic [11 Hours]
tape, magnetic disk, optical disk, mass storage devices. (CO2)
Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).
- Unit3: -** Introduction to MS-Word: introduction, components of a word [12 Hours]
window, creating, opening and inserting files, editing a document (CO3)
file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.
Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.
- Unit 4: -** Introduction to power-point: introduction, creating and [14 Hours]
manipulating presentation, views, formatting and enhancing text, (CO4-CO5)
slide with graphs.
Introduction of Operating System: introduction, operating system concepts, types of operating system.
Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topological (star, ring, bus, mesh, tree, hybrid), components of network.
Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), WWW browsers, use of the internet.
Application of Computers in clinical settings

Suggested Books: -

1. How computer works- Ron White

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2. Internet for seniors in easy steps- Michael Price
3. Computer Basics Absolute Beginner's- Michael Miller
4. The Computer training Handbook- Masie Elliot

Reference Books: -

1. Office 2019 for Dummies by Peter Weverka
2. Modern Operating Systems by Andrew S. Tanenbaum
3. Architecture of Computer Hardware & System Software.
4. Operating System Concepts- Abraham Silberschatz

Semester Fourth(4th)

Course Code	Group	Course Type	Course Name / Title	Load Allocation			Marks Distribution		Total Marks	Credit
				Lecture	Tutorial	Practical	Internal	External		
BRIT 408-21		Core Practical/Lab	Basic in Computers and Information Science Practical	0	0	2	60	40	100	1

List of Experiment

- Task 1. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.
- Task 2. Introduction of Operating System: introduction, operating system concepts, types of operating system.
- Task 3. Computer networks: introduction, types of networks (LAN, MAN, WAN, Internet, Intranet), network topological (star, ring, bus, mesh, tree, hybrid), components of network.
Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), WWW browsers, use of the internet.
- Task 4. Application of Computers in clinical settings.

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Lab Outcome:

The student will be able to:

1. Knowledge about Power-point Presentation.
2. Know about Operating Systems.
3. Know about Computer Networks.
4. Know about Application of Computers in Clinical Settings.

Text and reference Books: -

1. How computer works- Ron White
2. Internet for seniors in easy steps- Michael Price
3. Computer Basics Absolute Beginner's- Michael Miller

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Study Scheme & Syllabus of
**Bachelor of Radiology and Imaging
Technology**

Study Scheme & Syllabus of

(Semester V)

Session 2024 Onwards

By

Board of Studies

**I K GUJRAL PUNJAB TECHNICAL UNIVERSITY
KAPURTHALA**

Syllabus of the Program

The syllabus has been upgraded as per provision of the UGC module and demand of the academic environment. The contents of the syllabus have been duly arranged unit wise and included in such a manner so that due importance is given to requisite intellectual and laboratory skills. The application part of the respective contents has been appropriately emphasized.

5th Semester

Course type	Subject code	Subject Title	Load Allocation			Marks Distribution		Total	Credits
			Lecture L*	Tutorial T*	Practical P	Int.	Ext.		
Core Theory	BRIT – 501-21	Magnetic Resonance Imaging	3	1	-	40	60	100	4
Core Theory	BRIT – 502-21	Nuclear Medicine Technology	3	1	-	40	60	100	4
Core Theory	BRIT – 503-21	Patient Care and Management	3	1	-	40	60	100	4
Core Theory	BRIT – 504-21	Interventional Procedure and Technique	3	1	-	40	60	100	4
Core Practical	BRIT – 551-21	Practical Magnetic Resonance Imaging	-	-	4	60	40	100	2
Core Practical	BRIT – 552-21	Practical Nuclear Medicine	-	-	4	60	40	100	2
Core Practical	BRIT – 553-21	Clinical Posting	-	-	10	60	40	100	5
		Total	12	4	18	340	360	700	25

Magnetic Resonance Imaging

Course Code: BRIT-501-21

L-3T-1 P-4 C-4

Course Outcomes: On completion of the course, the students will be:

CO1. Understanding anatomy, physiology and basic concepts of Magnetic Resonance Imaging.

CO2. Summarizing the essential hardware and execute different parameters in imaging.

CO3. Classifying artifacts in imaging and use of remedy procedure.

CO4. Illustrating the scanning protocols.

CO5. Describing safety procedure for providing clinically safe imaging environment.

- **Course Content:**

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 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-3:

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 MRI parameters & Tradeoffs 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, Tradeoffs, Decision making, Volume imaging.

Unit-4:

MRI Artefacts, Introduction, Phase miss-mapping, Aliasing or wrap around, Chemical shift artefact, Chemical misregistration, Truncation artefact/Gibbs phenomenon, Motion of the patient Magnetic susceptibility artefact, Magic angle artefact, Zipper artefact, shading artefact Cross excitation and cross talk MRI contrast agents

Unit-5:

Flow Phenomena & MRI angiography Introduction, The mechanisms of flow, Time of flight phenomenon, Entry slice phenomenon, Intravoxel Dephasing. Flow phenomena compensation-Gradient moment rephrasing, Pre saturation, Even echo rephrasing, Cardiac MR, & MR Angiography. Clinical Applications, Scanning Protocols and Safety aspects Protocols for whole body imaging, The main magnetic field, Gradient magnetic field, Radiofrequency fields, Projectiles, Implants and prostheses, Pacemakers, Medical emergencies, Patient monitoring, Monitors and devices in MRI Claustrophobia, Quenching, Safety tips, Layout planning.

Text Books:

1. Textbook of MRI from picture to proton- 2nd Edition
2. MRI in Practice, Cathrene- 4th Edition

Reference Books:

1. MRI Parameters and Positioning, Emil Reif, Torsten B Moller- Latest Edition
2. MRI Basic Principle and Application, Mark A Brown- Latest Edition.

Nuclear Medicine Technology

Course Code: BRIT-502-21

L-3 T-1 P-4 C-4

- **Course Outcomes: On completion of the course, the students will be :**
- CO1. Remembering the terms dealing with Radioactivity and its measuring quantities.
- CO2. Understanding the principle for production of Radio nuclides, such as generators and reactors.
- CO3. Applying the use of Radiopharmaceutical for diagnosis and therapy.
- CO4. Analyzing and recognizing the site and route of administration of radiopharmaceuticals in hospitals and diagnostic centers.
- CO5. Analyzing the applied physics of nuclear medicine such as PET and SPECT.

- **Course Content:**

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:

Basic introduction to production of Radio nuclides, Reactor produced radionuclide, Reactor principles, accelerator produced radionuclide, Radionuclide generators, disposal of radioactive materials.

Unit-3:

Basic information about 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, , Nuclear medicine emergency technology, Procedures for handling spills.

Unit-4: Basic Knowledge about equipments of NMT, Gamma camera, PET, SPECT (working principle)

- **Text Books:**

1. Physics in Nuclear Medicine-Simon R Cherry, James A Sorenson- 4th Edition.

- **Reference Books:**

2. Physics in Nuclear Medicine-Simon R Cherry, James A Sorenson- 4th Edition

Patient Care and Management

Course Code: BRT-S-503-21

L-3 T-1 P-0 C-4

Course Outcomes: On completion of the course, the students will be :

CO1. Understanding the effective verbal/nonverbal communication skills with patients and healthcare staff.

CO2. Discussing and demonstrating the patient care and assessment tools.

CO3. Demonstrating the professional code of ethics and comply with the profession's scope of practice.

CO4. Discussing and evaluating the practices which lead to prevention of nosocomial infections.

CO5. Applying appropriate radiation protection practice while performing radiologic procedures on children and adults.

• **Course Content:**

Unit-1:

Patient care and Assessment Taking history, Assessing current physical status, Skin temperature, color, consciousness, Breathing, Obtaining Vital signs, Electronic Patient Monitoring.

Unit-2:

Responsibilities of the Imaging Technologist- Medication administration, routes of administration, List of frequently used medications Patient transfer technique & Restraint technique- Preparation for transfer, wheelchair transfer, stretcher transfer, immobilization techniques

Unit-3:

Handling the emergencies in Radiology Reaction to contrast media, Oxygen administration and suction, Respiratory emergencies, Cardiac emergencies,

Trauma, Shock Patient care during Investigation- G.I. Tract, Biliary tract, Respiratory tract, Gynecology, Cardiovascular, Lymphatic system, C.N.S. etc.

Unit-4:

Infection Control in hospital including hospital acquired infections, brief description of microorganisms having their role in radiology and imaging technology. Basic immunity, biomedical waste management, sterilization & disinfectant techniques.

Unit-5:

Patient Education & Communication; Patient procedural communication, Explanation of Radiation Safety / protection, Interacting with terminally ill patient, Informed Consent.

Text Books:

1. Textbook of Patient care in Radiography, Ruth Ann Ebralich- 8th Edition.

Reference Books:

2. Textbook of Patient care in Radiography, Ruth Ann Ebralich- 8th Edition.

Interventional Procedure and Techniques

Course Code: BRT-S-504-21

L-3 T-1 P-0 C-4

- **Course Outcomes: On completion of the course, the students will be:**
- CO1. Understanding the basic concepts, theories, techniques & equipment's for different interventional radiological procedures.
- CO2. Using the emergency drugs, and preparing the patient before & post procedure care in any interventional radiological examination
- CO3. Interpreting& applying provisions for radiation safety and protection as prescribed by various national & international regulatory bodies.
- CO4. Applying the factors affecting the image quality.

Unit-1:

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-2:

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 & guide wires, seldinger technique.

Unit-3:

Digital subtraction angiography, types, instrumentation.

Unit-4:

Sterile techniques, radiation protection, laying up a sterile trolley. Radiation protection for staff and patient, protective devices, monitors.

Unit-5:

Vascular & nonvascular cardiac interventional procedures.

Text Books:

1. Handbook of Interventional Radiologic Procedures, Lippincott Williams and Wilkins Series- Latest Edition.

Reference Books:

1. Vascular and Interventional Radiology, Karim Valzi (RSNA Publications)
2. Vascular and Interventional Radiography: A comprehensive text and examination, Jonathan Schwartz

Practical-Magnetic Resonance Imaging

Course Code: BRIT-551-21

L-0 T-0 P-4 C-2

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

Text Books:

1. Textbook of MRI from picture to proton- 2nd Edition
2. MRI in Practice, Cathrene- 4th Edition

Reference Books:

1. MRI Parameters and Positioning, Emil Reif, Torsten B Moller- Latest Edition
2. MRI Basic Principle and Application, Mark A Brown- Latest Edition

Practical-Nuclear Medicine Technology

Course Code: BRIT-552 -21

L-0 T-0 P-4 C-2

Course Content:

1. Demonstration of handling & transport of Radio-nuclides.
2. Equipment's of NMT.
3. Various post processing techniques and evaluation of image quality and clinical findings.
4. Post procedural care of the patient.

Text Books:

Physics in Nuclear Medicine-Simon R Cherry, James A Sorenson- 4th Edition

Reference Books:

Physics in Nuclear Medicine-Simon R Cherry, James A Sorenson- 4th Edition

Clinical Posting

Course Code: BRIT-553-21

L-0 T-0 P-10 C-5

Course Content:

Based on the clinical exposure from hospital

Study Scheme & Syllabus of

Bachelor of Radiology and Imaging Technology

(Semester VI)

Session 2024 Onwards

By

Board of Studies

I K GUJRAL PUNJAB TECHNICAL UNIVERSITY KAPURTHALA

Syllabus of the Program

The syllabus has been upgraded as per provision of the UGC module and demand of the academic environment. The contents of the syllabus have been duly arranged unit wise and included in such a manner so that due importance is given to requisite intellectual and laboratory skills. The application part of the respective contents has been appropriately emphasized.

6th Semester

Course type	Subject code	Subject Title	Load Allocation			Marks Distribution		Total	Credits
			Lecture	Tutorial	Practical	Int.	Ext.		
			L*	T*	P				
Core Theory	BRIT-601-21	Research Methodology and Biostatistics	3	1	-	40	60	100	4
Core Theory	BRIT-602-21	Orientation in Clinical Sciences	3	1	-	40	60	100	4
Core Theory	BRIT-603-21	Advanced Radiological Modalities	3	1	-	40	60	100	4
Core Theory	BRIT-604-21	Hospital Management	3	1	-	40	60	100	4
Core Practical	BRIT-651-21	Advanced Radiological Modalities	-	-	4	60	40	100	2
Core Practical	BRIT-652-21	Practical Clinical Posting	-	-	10	60	40	100	5
Core Practical	BRIT-653-21	Practical-Seminars, Journal Clubs and Procedures	-	-	10	60	40	100	5
		Total	12	4	24	340	360	700	28

Bachelor of Radiology and Imaging Technology for Session 2024 and onwards

Course Code: BRIT-601-21	BRIT-SEMESTER-VI	L-3 T-1 P-0 C-3
		Research Methodology and Biostatistics
Course Outcomes:	On completion of the course, the students will be:	
CO1.	Understanding Biostatistics & methodology of research.	
CO2.	Assessing and designing of research.	
CO3.	Analyzing the Clinical audit and data	
Course Content:		
Unit-1:	Introduction to research methods Identifying research problem Ethical issues in research Research design	8 Hours
Unit-2:	Basic Concepts of Biostatistics Types of Data Research tools and Data collection methods, sampling methods, Developing a research proposal	12 Hours
Unit-3:	Elementary Statistics: The mean, median, mode, standard deviation, variance, covariance of data. Representation of data- discrete data, continuous data, histogram, polygons, frequency curves. Mean, Median, Quartiles, Percentile, Skewness, Standard deviation, Variance, Box and whisker diagrams (box plots), Scatter diagrams, Introduction to statistical sampling from a population, Random Sampling.	10 Hours
Unit-4:	Hypothesis Testing: Concept of Null and Alternate Hypothesis, Chi-square test (Goodness of fit and association of attributes). Fischer test, Student t-test, One way ANOVA	6 Hours
TextBooks:	1. Mahajan BK: <i>Methods in Biostatistics for medical students and researchworkers</i> , 6th edition Jaypee, 1997 2. Kothari CR: <i>Research methodology–Methods and techniques</i> , Wiley eastern Ltd	

Bachelor of Radiology and Imaging Technology for Session 2024 and onwards

Course Code: BRIT-602-21	<u>DISCIPLINESPECIFICSELECTIVECOURSE(DSEC)-1</u> BRIT-SEMESTER-VI	L-3 T-1 P-0 C-4
	Orientation in Clinical Sciences	
Course Outcomes:	On completion of the course, the students will be:	
CO1.	Understanding the Concept of clinical aspects	
CO2.	Conditions related to cardiology, surgery, nephrology, orthopaedic, gastrology, neurology and general medicine for the diagnosis.	
CO3.	Understanding and applying emergency situation in radiology department	
CO4.		
Course Content:		
Unit-1:	Respiratory & cardiac diseases: Pericarditis, Valvular diseases, Rheumatic Heart Disease, Heart failure , Chronic Bronchitis, Emphysema, Brochitis, Pneumonia, Tuberculosis, Pleural effusion, Empyema, Spontaneous Phenumo thorax. Gastro intestinal diseases: Aclasiacardia, Peptic ulcer, Intestinal obstruction, Crohn’s disease, Ulcerative colitis, Pancreatitis, Portal Hypertension, Ascitis, Cirrhosis	12Hours
Unit-2:	Orthopaedics – Fracture – Type, mechanism, Healing, Delayed Union, Non- complication – Injuries of the shoulder girdle, Dislocation of shoulder – Fracture of Humerus, Elbow Forearm – Fracture of Distal Radius & ulna – Injuries of the carpal – Dislocation of Hip – Femur, Tibia, Ankle, Calcaneum – Acute & chronic osteo arthritis – Rhematoid arthritis –Pathological representation on x-ray images	6Hours
Unit-3:	Surgery – Cholelithiasis – Peritonitis – Supraphrenic Abscess – Appendicitis – Benign Hypertrophy of prostate – Sinusitis	10Hours
Unit-4:	Obstetrics – Diagnosis of Pregnancy – Normal Labour	8Hours
<u>TextBooks:</u>	<i>1.All Text books related to advance Medical Imaging.</i>	

Bachelor of Radiology and Imaging Technology for Session 2024 and onwards

ReferenceBooks:	<i>RSNA(Journals from Radiological Society of North America)</i> <i>AJR (American Journal of Radiology)</i>	
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Bachelor of Radiology and Imaging Technology for Session 2024 and onwards

Course Code: BRIT-603-21	DISCIPLINESPECIFIC ELECTIVE COURSE (DSEC)-1	L-3 T-1 P-0 C-4
	BRIT-SEMESTER-VI	
	ADVANCE RADIOLOGICAL MODALITIES	
Course Outcomes:	On completion of the course, the students will be:	
CO1.	The objective is to learn about advancements in Radiology.	
CO2.	Knowledge to allocate the patients to various modalities according to their pathological condition.	
CO3.	To know about different studies.	
CO4.	Knowledge to allocate the patients to various modalities according to their pathological condition.	
Course Content:		
Unit-1:	Mammo tomogram-Sonomammography-future Developments, exposure factors- Conventional & Digital studies- quality and advantage- diagnosis and screening- Characteristics of benign and malignant lesions – patient care.- radiation dose- recent advances in mammography-mammo tomogram & Sonomammography procedures- advantages & limitations.	12Hours
Unit-2:	Ultrasonography/ Doppler systems: Techniques of sonography-selection- Preparations - instructions and positioning of patient for TAS, TVS, TRUS, neck USG and extremities- patient care and maintenance protocols-clinical applications , USG contrasts.	12Hours
Unit-3:	CT scan CT of head and neck, thorax , abdomen ,pelvis, musculo skeletal system spine, Anatomy clinical indications and contraindications, patient preparation technique, contrast media types, dose, injection technique; timing,sequence patient care	12Hours

Bachelor of Radiology and Imaging Technology for Session 2024 and onwards

Unit-4:	<p>MRI</p> <p>Clinical indications and contraindications- types of common sequences-effects of sequence on imaging –</p> <p>Protocols ,patient preparation-positioning of the patient -patient care, calibration ,dose, recent advances in MRI -plain studies- contrast studies -special procedures- MRS blood flow imaging, diffusion/perfusion scans -, MRCP, strength and limitations of MRI- role of radiographer</p>	12Hours
<u>TextBooks:</u>	<i>1.All Text books related to advance Medical Imaging.</i>	
<u>ReferenceBooks:</u>	<p><i>RSNA(Journals from Radiological Society of North America)</i></p> <p><i>AJR (American Journal of Radiology)</i></p>	

Bachelor of Radiology and Imaging Technology for Session 2024 and onwards

Course Code: BRIT-604-21	<u>DISCIPLINESPECIFICSELECTIVECOURSE(DSEC)-1</u>	L-3 T-1 P-0 C-4
	BRIT-SEMESTER-VI Hospital Management	
Course Outcomes:	On completion of the course, the students will be:	
CO1.	Understanding the concepts of Patients care in hospital.	
CO2.	Understanding & applying provisions for hospital management	
CO3.	Evaluating the factors affecting the hospital services.	
CO4.	Analyzing challenge sand strategies in Hospital administration	
Course Content:		
Unit-1:	Functions of Hospital administration, Modern techniques in Hospital management, Challenges and strategies of Hospital management	12Hours
Unit-2:	Administrative Functions– Planning, Organizing, Staffing, Leading and Controlling Organizational Structure, Motivation and leadership. Designing health care organization.	12Hours
Unit-3:	Medical record, House-keeping services, Laboratory performance. Management of biomedical waste.	12Hours
Unit-4:	Total patient care – indoor and outdoor, Evaluation of hospital services, Quality assurance. Record reviews and medical audit.	12Hours
<u>TextBooks:</u>	<i>All Text books related to advance Medical Imaging.</i>	
<u>ReferenceBooks:</u>	<i>RSNA(Journals from Radiological Society of North America)</i> <i>AJR (American Journal of Radiology)</i>	

Bachelor of Radiology and Imaging Technology for Session 2024 and onwards

Course Code: BRIT-651-21	SKILL ENHANCEMENT COURSE (SEC)-20BRIT-SEMESTER-VI Practical- ADVANCED RADIOLOGICAL MODALITIES	L-0 T-0 P-4 C-2
Course Content:		
1	Scanning protocol, Indication, Patient preparation, image quality: Computed Tomography Magnetic Resonance Imaging	
2	Ultrasonography, Mammography, Digital Radiography Interventional Radiology	
TextBooks:	<ol style="list-style-type: none"> 1. <i>Recent Research topics in Radio imaging (Diagnostic radiology)</i> 2. <i>Focus on advance practices in medical imaging.</i> 3. <i>RSNA(Journals from Radiological Society of North America)</i> 	
Reference Books:	<ol style="list-style-type: none"> 4. <i>AJR (American Journal of Radiology)</i> 5. <i>IJR (Indian journal of Radiology)</i> 6. <i>PubMed(Latest Journals)</i> 	

Bachelor of Radiology and Imaging Technology for Session 2024 and onwards

Course Code: BRIT- 652	SKILL ENHANCEMENT COURSE (SEC)-21BRIT-SEMESTER-VI	L-0
	Practical Clinical Posting	T-0
Course Content:	Based on the Clinical exposure from hospital Total patient care– indoor and outdoor Plain and contrast studies.	P-10 C-5 20 Hours

NOTE:-	<i>Course Outcomes of following Practical's are covered in their respective theory courses.</i>	
Course Code: BRIT-653-21	SKILL ENHANCEMENT COURSE (SEC)- 19BRIT-SEMESTER-VI	
	Practical-Seminars, Journal Clubs and Procedures	
Course Content:		
1	Each student will be assigned topics for presentations as seminars, will explore recent innovations in MRIT for presenting topics during journal clubs and shall be holding group discussions along with in the presence of faculty	
Text Books:	Recent Research to pics in Radio imaging (Diagnostic radiology) Focus on advance practices in medical imaging. RSNA(Journals from Radiological Society of North America)	
Reference Books:	AJR(American Journal of Radiology) IJR(Indian journal of Radiology) PubMed(Latest Journals)	

Bachelor of Science (Radiology and Imaging Technology)

[Semester VII-VIII]

7th Semester

Course Code	Course Title	Marks Distribution			Credits
		Internal	External	Total	
BRIT-701-21	Semester Internship	200	-	200	8

8th Semester

Course Code	Course Title	Marks Distribution			Credits
		Internal	External	Total	
BRIT-801-21	Semester Internship	200	-	200	8

GUIDELINES FOR INTERNSHIP TRAINING PROGRAMME

For

Final year B.Sc. (Radio Imaging Technology)

1. Introduction:

Internship is a phase of training wherein a graduate is expected to conduct actual practice as a radiographer or Radiology technologist and acquire skills under supervision so that he/she may become capable of functioning independently, with fair independence in clinical decision making in low risk cases where as to work under supervision at high risk areas; so that at the end of Internship he/ she is capable to practice Radiography independently.

2. Proceeding of Internship:

Compulsory Internship shall include rotational clinical assignments, administrative skills & a scientific project over a period of One year as per the Rules & Regulations applicable to Internees regarding attendance, attitude, performance & evaluation.

3. OBJECTIVES:

Skills based outcomes and monitor able indicators for Medical Radiology and Imaging Technologist.

1. Should be able to undertake X-Ray, CT scan and MRI procedures independently.
2. Assist in specialized radiological procedures.
3. Able to do the image processing.
4. Should be able to handle all radiological and imaging equipment independently.
5. Should ensure radiation protection and quality assurance
6. Undertake care and maintenance of all radiological and imaging equipment
7. Able to evaluate images for technical quality
8. Able to identify and manage emergency situations.
9. Able to receive and document verbal, written and electronic orders in the patient's medical record.
10. Implements health and safety procedures

11. Demonstrates ability to interpret, apply and disseminate information as a member of the medical imaging team

12. Ensures radiation protection legislation is adhered to

13. Demonstrates knowledge and skills to carry out the daily/weekly Quality Control (QC) checks

4. **INTERNSHIP** – minimum 1440 hours in not less than 180 days evenly spread over TWO Semesters.

The student will have to submit Attendance certificate issued by the Authorized person/ Head of the Hospital/Department where the student is undergoing internship at the end of each semester. (Form-1)

Students have to undertake the rotational postings during which students have to work under supervision of an experienced staff in the following areas:

Postings Duration

S. No.	Posting Area	Duration
1	Conventional radiography/Computed Radiography	2 month
2	Radiographic special procedures including diagnostic and Therapeutic Interventional Procedures	1 month
3	DR and PACS	2 month
4	Ultrasonography / Doppler Imaging	1 month
5	Computed Tomography	3 Months
6	Magnetic Resonance Imaging	3 Months

5. **COMPETENCIES TO BE ACQUIRED DURING INTERNSHIP**

Students must be able to assist independently the following procedures at the end of their postings

5.1. X-RAY- Conventional Radiography (CR), Radiographic Special Procedures, Digital Radiography (DR), Mobile Radiography

- 5.1.1. Basic and special projections Shoulder non-trauma routine and trauma routine
- 5.1.2. Chest - Related radiological anatomy, Basic & special projections
- 5.1.3. Abdomen & KUB - Related radiological anatomy, Basic & special projection
- 5.1.4. Paediatric radiography - Positioning, care and radiation protection while handling babies
- 5.1.5. Pelvic girdle and proximal femur - Related radiological anatomy Basic & special projections
- 5.1.6. Cervical spine, Thoracic spine, Lumbar spine, sacrum and coccyx - Related radiological anatomy Basic & special projections
- 5.1.7. Lower limb and upper limb - Related radiological anatomy Basic & special projections
- 5.1.8. Understand the pharmacology of the contrast media and its administration for various procedures

5.2. Special procedures

- 5.2.1. Gastrointestinal Tract: Barium swallow, Barium meal and follow through, Hypotonic duodenography, small bowel enema, Barium Enema, colostomy
- 5.2.2. Salivary glands: Routine technique, procedure–sialography
- 5.2.3. Biliary system: Intravenous cholangiography, Percutaneous cholangiography, Endoscopic retrograde cholangio-pancreatography (ERCP), Operative cholangiography, post-Operative cholangiography (T - tube Cholangiography)
- 5.2.4. Urinary system: Intravenous urography, Retrograde pyelography, Antegrade pyelography , Cystography and micturating cystourethrography , Urethrography (ascending) ,Renal puncture
- 5.2.5. Female reproductive system: Hysterosalpingography.
- 5.2.6. Sinogram
- 5.2.7. Dacrocystography
- 5.2.8. Mammography - Patient preparation & Different techniques
- 5.2.9. DR-advancements

5.3. Computed Tomography (CT)

- 5.3.1. CT Protocols: Patient preparation, Imaging techniques and protocols for various parts of body, CT contrast enhanced protocols – CT angiography: Selective angiogram head, neck and peripheral
- 5.3.2. CT guided procedures Protocols: Both invasive and non- invasive
- 5.3.3. Advancements: Multi Detector CT, spiral CT scan: Slip ring technology, CBCT geometry, Reconstruction of CT images, 4D CT, HRCT, Post Processing Techniques: MPR, MIP, Min IP, Rendering software's -SSD and VR.

5.4. Ultrasonography, Doppler studies (USG)

- 5.4.1. Techniques: Techniques for imaging different anatomic areas, Patient preparation for various ultrasound imaging
- 5.4.2. Doppler Ultrasound: Doppler Effect, Doppler ultrasound techniques: Continuous Wave Doppler, Pulsed Doppler, Duplex scanning, Doppler spectrum, Color Doppler, Power Doppler, stress and shear wave doppler, B flow imaging

5.5. Magnetic Resonance Imaging (MRI)

5.5.1. MRI Protocols: Patient preparation, Imaging techniques and protocols for various parts of body, Gadolinium contrast enhanced protocols – MR angiography: Selective angiogram head, neck and peripheral

5.5.2. Advanced imaging techniques

5.5.3. Spectroscopy 5.5.4. Diffusion imaging

5.5.5. Perfusion imaging

5.5.6. Functional imaging

5.5.7. Interventional MRI

5 6.6. PACS (Picture Archiving & Communication System)

6. EXIT VIVA

There will be one exit Viva to be conducted at End of training and student has to score SATISFACTORY grade.

7. EVALUATION

- ❖ During the rotational posting, students shall Investigate all kinds of patients & also undertake skills of maintaining administrative records & Maintenance of equipment.
- ❖ The candidate shall maintain a log book (Form-2) & record all the events of the respective posting. He /She shall be closely monitored by the senior staff in charge throughout the posting & the same shall also sign in the Log book on completion of the assignment.

8. START OF INTERNSHIP PROGRAMME

- ❖ The programme will commence within 15 days after the declaration of Final B.Sc result by the University. In special circumstances with the permission of the head of the institute, students can start an internship within 30 days of declaration of results.

9. LEAVE FOR INTERNS

- ❖ An internee shall be entitled for maximum 12 days leave during a One Year period of internship posting.

An internee will not be permitted to avail more than 4 days leave in any department. Period of leave in excess of 4 days in a department will have to be extended in the same department. Under any circumstances this period will not be condoned by any authority.

❖ However if any student wants to attend any state/national/international conference, workshop or seminar then maximally 6 days study leave can be granted to the students with production of the proper documents or certificate. It should not be more than 6 days in any conditions.

10. STIPULATION FOR REPEAT POSTING IN CONCERNED DISCIPLINE:

- i) Unsatisfactory performance.
- ii) Prolonged illness, Medical Certificate must be validated by a by the parent institution
- iii) Prolonged Leave due to any reasons other than illness.
- iv) Failure to submit Log book.
- v) Failure to submit attendance certificate.

11. INTERNSHIP COMPLETION CERTIFICATE

The college/institute will issue Internship completion certificate to student after completion of internship as per format provided in FORM-3.

FORM-1

ATTENDANCE CERTIFICATE

Ref. No _____

Date

This is to certify that Mr.

/Ms./Mrs. _____ has satisfactory
completed _____ months of training in _____ at
_____ (Name of Hospital)

[sign] _____

Authorized person/ Head of the Hospital/Department

[sign] _____

Principal/ Head of the Institute

FORM-3

INTERNSHIP COMPLETION CERTIFICATE

Ref. No _____

Date

This is to certify that

Mr./Ms./Mrs. _____ has satisfactory
completed one year of Compulsory Internship for Bachelor of Science- B.Sc.
(Radio Imaging Technology) at _____ (Name of the
college/institute)

[sign] _____
Department Dean /Principal