

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

Batch 2021 Onwards

By  
Board of Studies

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<b>Program Educational Objectives:</b> 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.

<b>Program Outcomes:</b> 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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<b>Program Specific Outcomes:</b> 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 2021 Onwards**

<b>Semester</b>		<b>Third (3<sup>rd</sup>)</b>									
<b>Course Code</b>	<b>Group</b>	<b>Course Type</b>	<b>Course Name / Title</b>	<b>Load Allocation</b>				<b>Marks Distribution</b>		<b>Total Marks</b>	<b>Credit</b>
				<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Studio (If Applicable)</b>	<b>Internal</b>	<b>External</b>		
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 2021 Onwards**

<b>Semester</b>		<b>Fourth (4<sup>th</sup>)</b>									
<b>Course Code</b>	<b>Group</b>	<b>Course Type</b>	<b>Course Name / Title</b>	<b>Load Allocation</b>				<b>Marks Distribution</b>		<b>Total Marks</b>	<b>Credit</b>
				<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Studio (If Applicable)</b>	<b>Internal</b>	<b>External</b>		
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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<b>Examination and Evaluation</b>			
<b>Theory</b>			
<b>Sr. No.</b>	<b>Evaluation Criteria</b>	<b>Weightage in Marks</b>	<b>Remarks</b>
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.	<b>Total</b>	<b>100</b>	Marks May be rounded off to nearest integer

<b>Practical</b>			
<b>Sr. No.</b>	<b>Evaluation Criteria</b>	<b>Weightage in Marks</b>	<b>Remarks</b>
1.	Evaluation of Practical Record / Viva Voce / Attendance / Seminar / Presentation	60	Internal Evaluation
2.	Final Practical Performance + Viva Voce	40	External Evaluation
3.	<b>Total</b>	<b>100</b>	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): -	<b>Xxxxxxxx</b>	Date: -	<b>DD/MM/YYYY</b>
Programme: -	<b>Xxxxxxxxxx</b>	Semester: -	<b>XX Semester</b>
Course Code: -	<b>xxxx-xxx-YY</b>	Course: -	<b>Xxxxxx</b>
Maximum Marks: -	<b>Xxx</b>	Time: -	<b>xx HH xx MM</b>

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

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

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**Details of Course Objectives**

CO1	
CO2	
CO3	
CO4	
CO5	

Semester		Third (3 <sup>rd</sup> )									
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(3<sup>rd</sup> )**

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 <sup>rd</sup> )									
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,  
Hysterosalpingography,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(3<sup>rd</sup> )**

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 <sup>rd</sup> )									
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(3<sup>rd</sup> )**

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 <sup>rd</sup> )									
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 <sup>th</sup> )									
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(4<sup>th</sup>)

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 <sup>th</sup> )									
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(4<sup>th</sup>)

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 <sup>th</sup> )									
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:

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- 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(4<sup>th</sup>)

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 <sup>th</sup> )									
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(4<sup>th</sup>)**

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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