# FACULTY OF ALLIED HEALTH SCIENCES

# SYLLABUS

# FOR

# M.Sc. RADIOLOGY & IMAGING TECHNOLOGY (SEMESTER I-IV)

(Under Choice based Credit System)

**Examinations: 2021 Onwards**

## Department of Allied Health Sciences

## I K GUJRAL PUNJAB TECHNICAL UNIVERSITY KAPURTHALA

Note:

**(i) Subject to change in the syllabi at any time. Please visit the University website time to time.**

# IK Gujral Punjab Technical University

## VISION

To be an institution of excellence in the domain of higher technical education that serves as the fountainhead for nurturing the future leaders of technology and techno- innovation responsible for the techno-economic, social, cultural and environmental prosperity of the people of the State of Punjab, the Nation and the World.

## MISSION

To provide seamless education through the pioneering use of technology, in partnership with industry and society with a view to promote research, discovery and entrepreneurship and

To prepare its students to be responsible citizens of the world and the leaders of technology and techno-innovation of the 21st Century by developing in them the desirable knowledge, skill and attitudes base for the world of work and by instilling in them a culture for seamlessness in all facets of life.

## OBJECTIVES

- To offer globally-relevant, industry-linked, research-focused, technology- enabled seamless education at the graduate, postgraduate and research levels in various areas of engineering & technology and applied sciences keeping in mind that the manpower so spawned is excellent in quality, is relevant to the global technological needs, is motivated to give its best and is committed to the growth of the Nation;
- To foster the creation of new and relevant technologies and to transfer them to industry for effective utilization;
- To participate in the planning and solving of engineering and managerial problems of relevance to global industry and to society at large by conducting basic and applied research in the areas of technologies. To develop and conduct continuing education programmes for practicing engineers and managers with a view to update their fundamental knowledge base and problem-solving capabilities in the various areas of core competence of the University;
- To develop strong collaborative and cooperative links with private and public sector industries and government user departments through various avenues such as undertaking

of consultancy projects, conducting of collaborative applied research projects, manpower development programmes in cutting-edge areas of technology, etc;

- To develop comprehensive linkages with premier academic and research institutions within the country and abroad for mutual benefit;
- To provide leadership in laboratory planning and in the development of instructional resource material in the conventional as well as in the audio- visual, the video and computer-based modes;
- To develop programmes for faculty growth and development both for its own faculty as well as for the faculty of other engineering and technology institutions;
- To anticipate the global technological needs and to plan and prepare to cater to them;
- To interact and participate with the community/society at large with a view to inculcate in them a feel for scientific and technological thought and endeavour; and
- To actively participate in the technological development of the State of Punjab through the undertaking of community development programmes including training and education programmes catering to the needs of the unorganized sector as well as that of the economically and socially weaker sections of society.

## ACADEMIC PHILOSOPHY

The philosophy of the education to be imparted at the University is to awaken the **"deepest potential"** of its students as holistic human beings by nurturing qualities of self-confidence, courage, integrity, maturity, versatility of mind as well as a capacity to face the challenges of tomorrow so as to enable them to serve humanity and its highest values in the best possible way.

# Department of Allied Health Sciences

## VISION

- To impart knowledge of health & medical education & help in making India a centre of Medical Education & Health Care.
- To establish & develop world class self-reliant institute for imparting Medical and other Health Science education at under-graduate & post-graduate levels of the global competence.
- To serve & educate the public, establish guidelines & treatment protocols to be followed by professionals while treating in hospitals.
- To develop and provide professionally qualified health workers for augmenting the nation's human resources through Bio-Medico-Socio-epidemiological scientific research.

## MISSION

- To strive incessantly to achieve the goals of the Institution.
- To impart academic excellence in Allied Health Education.
- To practice medicine ethically in line with the global standard protocols.
- Having a revolutionary impact on students by focusing on deep inter-disciplinary knowledge, getting technical as well as Theoretical concept of Health Sciences, focusing on leadership, communication and interpersonal skills, personal health and well-being.
- Creating best of educational experience by engaging with partners outside the traditional borders of University campus. By engaging in a network of Hospitals & other Healthcare providing facilities to create a job oriented
- Cultivating productive community by attracting and retaining diverse, best talent and such an environment where research, innovation, creativity and entrepreneurship can flourish.
- To give students the best knowledge by the most innovative methods and also provide hospital exposure to work in different fields of Paramedical Sciences.
- To create a well-qualified and highly trained world class Technicians & Assistants who will aid in delivering high-class care & helping in betterment of mankind.

# TITLE OF THE PROGRAM: M.Sc. RADIOLOGY & IMAGING TECHNOLOGY

**YEAR OF IMPLIMENTATION:** New Syllabus will be implemented from July 2021 onwards.

**DURATION:** The course shall be two years, with semester system (4 semesters, with two semesters in a year). The Choice based credit system will be applicable to all the semesters.

**ELGIBILITY FOR ADMISSION:** Candidates with 50% marks (5% relaxation for reserved categories) in Bachelor's Degree in Radiology & Imaging Technology are eligible for admission to this course.

**INTAKE CAPACITY:** 30 (Thirty)

**MEDIUM OF INSTRUCTION:** English.

**PROGRAM EDUCATIONAL OBJECTIVES:**

The Program Educational Objectives are the knowledge skills and attitudes which the students will acquire during post-graduation.

| | |
|---|---|
| PEO1 | Those who choose this stream are going to study about Radiological & Imaging Technology such as MRI, CT Scan, USG etc. |
| PEO2 | Ability to do various Radiological procedures which are necessary for diagnostic purposes. |
| PEO3 | Understand the fundamentals and applications of Radiological Equipments such as MRI Machine, CT Scan Machine, X-ray Machine etc. |
| PEO4 | To explore the foundation science and safety principles in Medical Imaging Technology. |
| PEO5 | Enhance knowledge from clinical experience, interactions & discussions and research to improve the quality of training and education in Medical Imaging. |
| PEO6 | Explore the subject in depth and develop high degree of expertise to contribute to advancement of knowledge in Medical Imaging. |
| PEO7 | Develop teaching and presentation skills necessary to become efficient teachers utilizing state-of-the art facilities and equipments. |
| PEO8 | To provide with the skills and knowledge to apply for critical appraisal of day to day practice. |

**PROGRAM OUTCOMES:** At the end of the program, the student will be able to:

| | |
|---|---|
| PO1 | On completion of the program, Technologists can advance to supervisory position in Diagnostic Centers and hospitals. |
| PO2 | They can also earn key posts in academic institutions including teaching and research. |
| PO3 | In industry, Imaging technologists are needed for Application and Software development for Medical Imaging equipment. |
| PO4 | This Program will build technical knowledge in the student so that he/she will be able to assist an Anesthetist/Surgeon in every aspect of Anaesthesia, Surgery & other related fields. |
| PO5 | Engage in lifelong learning and adapt to changing professional and societal needs. |
| PO6 | The Candidates can join Private, Military and public health services. |

**PROGRAM SPECIFIC OUTCOMES**:

At the end of the program,

| | |
|---|---|
| PSO1 | Students will be competent to work in Hospital Radiology Suites, MRI Units and other related sections. |
| PSO2 | Students will be skilled in problem solving, critical thinking and will be able to assist the Radiologist in various procedures. |
| PSO3 | This course provides medical imaging technologists with an understanding of the physical principles as well as theories involved in diagnostic imaging modalities. |
| PSO4 | Students will be able to have all the relevant knowledge of Radiology & Imaging Sciences and will be able to do various procedures required. |
| PSO5 | 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. |
| PSO6 | Students will be able to explore new areas of research in Radiology and can also go for research as well. |
| PSO7 | Students will be able to integrate knowledge of various types of Radiological & Imaging procedures along with their in-depth knowledge. |

**SCHEME OF THE PROGRAM:**

| Semester-I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sr No** | **Code** | **Theory Papers** | **Hours** | **L-T-P** | **Credits** | **Marks Distribution** | | **Marks** |
| | | | | | | Internal | External | |
| 1. | MRIT 101-21 | RADIOGRAPHIC PROCEDURES & PRINCIPLES OF RADIOGRAPHIC EXPOSURE | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 2. | MRIT 102-21 | MODERN IMAGING TECHNIQUES INCLUDING FUSION & HYBRID IMAGING TECHNOLOGIES | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 3. | MRIT 103-21 | ADVANCED PHYSICS OF RADIOLOGY & IMAGING | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 4. | MRIT 104-21 | INSTRUMENTATION OF CONVENTIONAL X-RAY & SPECIALIZED RADIOLOGY EQUIPMENTS | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 5 | MRIT 105-21 | RADIOGRAPHIC PROCEDURES & PRINCIPLES OF RADIOGRAPHIC EXPOSURE LAB | 30 | 0-0-3 | 2 | 50 | 25 | 75 |
| 6. | MRIT 106-21 | MODERN IMAGING TECHNIQUES INCLUDING FUSION & HYBRID IMAGING TECHNOLOGIES LAB | 30 | 0-0-3 | 2 | 50 | 25 | 75 |
| 7. | MRIT 107-21 | ADVANCED PHYSICS OF RADIOLOGY & IMAGING LAB | 30 | 0-0-3 | 2 | 50 | 25 | 75 |
| 8. | MRIT 108-21 | INSTRUMENTATION OF CONVENTIONAL X-RAY & SPECIALIZED RADIOLOGY EQUIPMENTS LAB | 30 | 0-0-3 | 2 | 50 | 25 | 75 |
| | | **Total** | **25 (Theory 19, Practical 6)** | | | **300** | **425** | **725** |

| Semester-II | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sr. No** | **Code** | **Theory Papers** | **Hours** | **L-T-P** | **Credits** | **Marks Distribution** | | **Marks** |
| | | | | | | Internal | External | |
| 1. | MRIT 201-21 | MODERN RADIOLOGICAL & IMAGING EQUIPMENTS | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 2. | MRIT 202-21 | CARE OF PATIENT IN DIAGNOSTIC RADIOLOGY | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 3. | MRIT 203-21 | ADVANCED TECHNIQUES & INSTRUMENTATION OF ULTRASONOGRAPHY | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 4. | MRIT 204-21 | ADVANCED TECHNIQUES & INSTRUMENTATION OF COMPUTED TOMOGRAPHY | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 5. | **MRIT** 205-21 | MODERN RADIOLOGICAL & IMAGING EQUIPMENTS LAB | 30 | 0-0-3 | 2 | 50 | 25 | 75 |
| 6. | MRIT 206-21 | CARE OF PATIENT IN DIAGNOSTIC RADIOLOGY LAB | 30 | 0-0-3 | 2 | 50 | 25 | 75 |
| 7. | MRIT 207-21 | ADVANCED TECHNIQUES & INSTRUMENTATION OF ULTRASONOGRAPHY LAB | 30 | 0-0-3 | 2 | 50 | 25 | 75 |
| 8. | MRIT 208-21 | ADVANCED TECHNIQUES & INSTRUMENTATION OF COMPUTED TOMOGRAPHY LAB | 30 | 0-0-3 | 2 | 50 | 25 | 75 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | **Total** | **24 (Theory 16, Practical 8)** | **320** | **380** | **700** |

| **Semester-III** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sr. No** | **Code** | **Theory Papers** | **Hours** | **L-T-P** | **Credits** | **Marks Distribution** | | **Marks** |
| | | | | | | Internal | External | |
| 1. | MRIT 301-21 | ADVANCED TECHNIQUES & INSTRUMENTATION OF MRI | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 2. | MRIT 302-21 | INTERVENTIONAL RADIOLOGY TECHNIQUES | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 3. | MRIT 303-21 | NUCLEAR MEDICINE IMAGING TECHNIQUES | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 4. | MRIT 304-21 | QUALITY CONTROL IN RADIOLOGY AND RADIATION SAFETY | 45 | 4-0-0 | 4 | 30 | 70 | 100 |
| 5 | MRIT 305-21 | ADVANCED TECHNIQUES & INSTRUMENTATION OF MRI LAB | 30 | 0-0-3 | 2 | 50 | 25 | 75 |
| 6. | **MRIT** 306-21 | INTERVENTIONAL RADIOLOGY TECHNIQUES LAB | 30 | 0-0-3 | 2 | 50 | 25 | 75 |
| 7. | MRIT 307-21 | NUCLEAR MEDICINE IMAGING TECHNIQUES LAB | 30 | 0-0-3 | 2 | 50 | 25 | 75 |
| + | | **Total** | **22 (Theory 16, Practical 6)** | | | **270** | **355** | **625** |

| **Semester-IV** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sr. No** | **Code** | **Theory Papers** | **Hours** | **L-T-P** | **Credits** | **Marks Distribution** | | **Marks** |
| | | | | | | Thesis | Viva | |
| 1. | | INTERNSHIP* | 6 Month | 0-0-30 | 15 | - | - | - |
| 2. | | DISSERTATION/THESIS SUBMISSION** | | - | - | 50 | 50 | 100 |
| | | **Total** | **15 (Theory 0, Practical 15)** | | | | | **100** |

** Dissertation work will be held in fourth semester. In fourth semester, students will go to Hospitals for Internship and along with that, they will prepare their respective thesis and submit it after completing their Internship. There will be a Presentation/Viva before a panel of teachers from the department after submission of thesis.

## EXAMINATION AND EVALUATION

| **THEORY** | | | | |
|---|---|---|---|---|
| S.No. | | Weightage in Marks | | Remarks |
| 1 | Mid-Semester Examination | 20 | 15 | MSTs, Quizzes, assignments, attendance, etc. Constitute internal evaluation. Average of two mid-semester exams will be considered for evaluation |
| 2 | Attendance | 5 | 5 | |
| 3 | Assignments | 5 | 5 | |
| 4 | End-Semester Examination | 70 | 50 | Conduct and checking of the answer sheets will be at the department level in case of university teaching department of Autonomous institutions. For affiliated colleges examination will be conducted at the university level |
| | **Total** | **100** | **75** | |
| **PRACTICAL** | | | | |
| 1 | Daily evaluation of practical performance/ record/ viva voce | 30 | | Internal Evaluation |
| 2 | Attendance | 5 | | |
| 3 | Internal Practical Examination | 15 | | |
| 4 | Final Practical Examination | 25 | | External Evaluation |
| | **Total** | **75** | | |

## PATTERN OF END-SEMESTER EXAMINATION

I. **Part A** will be One Compulsory question consisting of short answer type questions [Q No. 1(a-j)] covering whole syllabus. There will be no choice in this question. It will be of 20 marks comprising of **10 questions of 2 marks each**.

II. **Part B** will be comprising of eight questions [2-9]. Student will have to attempt any six questions from this part. It will be of 30 marks with **6 questions of 5 marks each**.

III. **Part C** will be comprising of two compulsory questions with internal choice in both these questions [10-11]. It will be of 20 marks with **2 questions of 10 marks each**.

## 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.

# SEMESTER-I

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 101-21** | | | |
| **Subject Title:** | **RADIOGRAPHIC PROCEDURES & PRINCIPLES OF RADIOGRAPHIC EXPOSURE** | | | |
| **Contact Hours:** | **L:4** | **T:0** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about various radiographic procedures & principles of radiographic exposure. | | | |

**Details of the Course**

| Unit | Contents | Contact Hours |
|---|---|---|
| I | Basic review of all Radiographic Techniques,<br>Contrast Media- Application, types, safety aspects, mode & volume of administration, administration techniques.<br>Anatomy and physiology of Digestive System & associated pathology, Plain Radiography, Barium Swallow, Barium Meal, Plain radiography of Genito-urinary system, Intravenous Urogram, Micturating Cystourethrogram, Ascending Urethrogram (ASU), Hysterosalpingography (HSG), Fallopian Tube Recanalisation. | 12 |
| II | Chest radiography.<br>Mammography- Indications, contraindications and techniques ICRP guidelines, BIRADS. Radiographic projections of Skull, Vertebral Column, Upper Limb, Lower Limb, Pelvis. Pelvimetry, ERCP/ PTBD, T – tube cholangiography, Intraoral, Extraoral and Occlusal views in Dental Radiography, Sialography , Dacrocystography, Sinography, Fistulography. | 12 |

| | | |
|---|---|---|
| III | X-ray production Interaction of radiation with matter- Compton effect, photoelectric effect, pair production, coherent scattering. Useful range Clinical application.<br><br>The Photographic process- Introduction Basic review of photographic emulsions, Photographic latent image, Film materials, Spectral sensitivity of film material, Speed and contrast of photographic materials, Intensifying screens and cassettes, Film processing. Sensitometry, Photographic density, Opacity, Transmission, Production of Characteristic curve, Features of Characteristic curve. Comparison of emulsions by their characteristic curve, Application of Characteristic curve. | 11 |
| IV | Radiographic Image, Radiographic Density, Acceptable range, Factors influences density. Radiographic Contrast, Components, Factors influences contrast, Management of Radiographic Image quality. Resolution, Line spread function & Modulation transfer function, Unsharpness in the Radiographic image. Types of Unsharpness, Radiographic mottle, Geometry of the radiographic image, Magnification / Distortion -Types and factors, Micro / Macro radiography. Automatic film processor (AFP), Layout and planning of Darkroom. | 10 |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Knowledge about Basic Radiographic Techniques & Plain Radiography.
**CO2.** Study about special procedures related to various systems of human body.
**CO3.** Understanding about various Phenomenon related to radiology.
**CO4.** Know about Film Materials & Film processing.
**CO5.** Study about Radiographic image, image quality management and other techniques along with its magnification/distortion.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 3 | 2 | 4 |
| CO2 | 3 | 3 | 4 | 4 | 3 | 3 | 4 |
| CO3 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| CO4 | 4 | 3 | 2 | 3 | 3 | 2 | 3 |
| CO5 | 3 | 4 | 3 | 4 | 2 | 2 | 3 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1 | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS AND TECHNICIANS | CBS |
| 2 | Stewart Whitley | Clark's Procedures in Diagnostic Imaging | CRC Press |
| 3 | Thomas Curry, James Dowdey, Robert Jr. | Christensen's Physics of Diagnostic radiology | Wolters Kluwer |
| 4 | Glends Bryan | Diagnostic Radiography | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 105-21** | | | |
| **Subject Title:** | **RADIOGRAPHIC PROCEDURES & PRINCIPLES OF RADIOGRAPHIC EXPOSURE LAB** | | | |
| **Contact Hours:** | **L:0** | **T:0** | **P:3** | **Credits:2** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about introduction of basic anesthetic instruments & anesthetic procedures. | | | |

**Details of the Course**

| Unit | Contents |
|---|---|
| I | 1) Contrast Media<br>2) Plain Radiography<br>3) Intravenous Urogram<br>4) Mammography<br>5) Dental Radiography |
| II | **1.** X-ray production<br>**2.** Film processing<br>**3.** Sensitometry<br>**4.** Radiographic Image<br>**5.** Automatic film processor |

At the end of the course, the student will be able to

**CO1.** Knowledge about Basic Radiographic Techniques & Plain Radiography.
**CO2.** Study about special procedures related to various systems of human body.
**CO3.** Understanding about various Phenomenon related to radiology.
**CO4.** Know about Film Materials & Film processing.
**CO5.** Study about Radiographic image & Automatic Film Processor.

**Course Outcomes and Mapping**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 3 | 2 | 4 |
| CO2 | 3 | 3 | 4 | 4 | 3 | 3 | 4 |
| CO3 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| CO4 | 4 | 3 | 2 | 3 | 3 | 2 | 3 |
| CO5 | 3 | 4 | 3 | 4 | 2 | 2 | 3 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1 | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS AND TECHNICIANS | CBS |
| 2 | Stewart Whitley | Clark's Procedures in Diagnostic Imaging | CRC Press |
| 3 | Thomas Curry, James Dowdey, Robert Jr. | Christensen's Physics of Diagnostic radiology | Wolters Kluwer |
| 4 | Glends Bryan | Diagnostic Radiography | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 102-21** | | | |
| **Subject Title:** | **MODERN IMAGING TECHNIQUES INCLUDING FUSION & HYBRID IMAGING TECHNOLOGIES** | | | |
| **Contact Hours:** | **L:4** | **T:0** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about Modern imaging techniques including Hybrid technology. | | | |

**Details of the Course**

| Unit | Contents | Contact Hours |
|---|---|---|
| I | **Interventional Radiography: Basic angiography and DSA:**<br>a. History, technique, patient care<br>b. Percutaneous catherization, catheterization sites, Asepsis<br>c. Guidewire, catheters, pressure injectors, accessories<br>d. Use of digital subtraction- single plane and bi-plane<br>All forms of diagnostic procedures including angiography, angioplasty, biliary examination, renal evaluation and drainage procedure.<br>Myelography, Cerebral studies, Ventriculography,<br>Arthrography: Shoulder, Hip, Knee, Elbow. | 10 |
| II | **Angiography:**<br>a. Carotid Angiography (4 Vessel angiography).<br>b. Thoracic and Arch Aortography.<br>c. Selective studies: Renal, SMA, Coeliac axis.<br>d. Vertebral angiography.<br>e. Femoral arteriography.<br>f. Angiocardiography.<br>**Venography:**<br>a. Peripheral venography.<br>b. Cerebral venography.<br>c. Inferior and superior venocavography.<br>d. Relevant visceral phlebography.<br>**e.** Cardiac catheterization procedures: PTCA, BMV, CAG, Pacemaker, Electrophysiology. | 12 |

| | | |
|---|---|---|
| III | **Ultrasonography/ Doppler studies:** 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 display methods –quality image reproducible extend – biopsy procedures, assurance to patients.<br>**CT scan studies acquisition/ protocols /techniques:** CT of head and neck – thorax – abdomen – pelvis – musculo skeletal system – spine – PNS. Anatomy – 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 CT anatomy and pathology of different organ systems. | 11 |
| IV | **MRI imaging –** Head and Neck ,Thorax, Abdomen, Musculoskeletal System imaging - Clinical indications and contraindications- types of common sequences effects of sequence on imaging - Protocols for various studies- slice section- patient preparation positioning of the patient -patient care- calibration - paramagnetic agents and dose, additional techniques and recent advances in MRI - image acquisition-modification of procedures in an unconscious or un co-operative patient - plain studies- contrast studies - special procedures reconstructions- 3D images- MRS blood flow imaging, diffusion/perfusion scans - strength and limitations of MRI- role of radiographer.<br>Techniques of Fusion and hybrid Imaging Technology including PET CT, PET MRI, PET Ultrasound, MRI, CT, Fluoroscopy, Hybrid Imaging as well as Advanced Interventional suite. | 12 |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Know About Various Interventional Radiographic procedures.
**CO2.** To Know About Different Angiographies & Venographies.
**CO3.** Understanding about Ultrasonography & Doppler.
**CO4.** To know about CT Scan & its techniques & protocols.
**CO5.** To Know about MRI Imaging & Techniques of Fusion & Hybrid Imaging.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 3 | 4 | 3 | 3 |
| CO2 | 4 | 4 | 3 | 4 | 3 | 3 | 3 |
| CO3 | 4 | 4 | 3 | 4 | 3 | 3 | 4 |
| CO4 | 4 | 4 | 3 | 4 | 3 | 2 | 4 |
| CO5 | 4 | 4 | 3 | 3 | 4 | 3 | 3 |

**Reference Books**

| S. No. | Author(s) | Title | Publisher |
|---|---|---|---|
| 1. | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS | CBS |
| 2. | CLARK | POSITIONING FOR TECHNICINAS | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 106-21** | | | |
| **Subject Title:** | **MODERN IMAGING TECHNIQUES INCLUDING FUSION & HYBRID IMAGING TECHNOLOGIES LAB** | | | |
| **Contact Hours:** | **L:0** | **T:0** | **P:3** | **Credits:2** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about Modern imaging techniques including Hybrid technology. | | | |

**Details of the Course**

| Unit | Contents |
|---|---|
| I | 1. Angiography & Venography.<br>2. CT Scan<br>3. MRI<br>4. Doppler<br>5. USG |
| II | 1. PET CT<br>2. PET MRI<br>3. Fluoroscopy<br>4. Hybrid Imaging<br>5. Advanced Imaging Suite |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Know About Various Interventional Radiographic procedures.
**CO2.** To Know About different Angiographies & Venographies.
**CO3.** Understanding about Ultrasonography & Doppler.
**CO4.** To know about CT Scan & its techniques & protocols.
**CO5.** To Know about MRI Imaging & Techniques of Fusion & Hybrid Imaging.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 3 | 4 | 3 | 3 |
| CO2 | 4 | 4 | 3 | 4 | 3 | 3 | 3 |
| CO3 | 4 | 4 | 3 | 4 | 3 | 3 | 4 |
| CO4 | 4 | 4 | 3 | 4 | 3 | 2 | 4 |
| CO5 | 4 | 4 | 3 | 3 | 4 | 3 | 3 |

**Reference Books**

| S. No. | Author(s) | Title | Publisher |
|---|---|---|---|
| 1. | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS | CBS |
| 2. | CLARK | POSITIONING FOR TECHNICINAS | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 103-21** | | | |
| **Subject Title:** | **ADVANCED PHYSICS OF RADIOLOGY & IMAGING** | | | |
| **Contact Hours:** | **L:4** | **T:0** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about Advanced physics used in Radiology & Imaging Procedures & Equipments. | | | |

**Details of the Course**

| Unit | Contents | Contact Hours |
|---|---|---|
| I | Physics of Imaging including conventional radiography, computed radiography and flat panel DR imaging.<br>**Computed Tomography**-<br>Basic principles of CT<br>generations of CT,<br>CT instrumentation,<br>image formation in CT,<br>CT image reconstruction,<br>Hounsfield unit,<br>CT image quality, CT- image display. | 10 |
| II | **Advanced Computed Tomography** –<br>Helical CT scan:<br>Slip ring technology, advantages, multi detector array helical CT,<br>cone – beam geometry, reconstruction of helical CT images,<br>CT artifact, CT angiography,<br>CT fluoroscopy, HRCT, post processing techniques:<br>MPR, MIP, Min IP,<br>3D rendering: SSD and VR,<br>CT Dose Index. | 11 |

| | | |
|---|---|---|
| III | **MRI-** Basic Principles: Spin – precession – relaxation time – pulse cycle – T1 weighted image – T2 weighted image – proton density image.<br>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<br>MR Instrumentation: Types of magnets – RF transmitter – RF receiver – Gradient coils – shim coils – RF shielding – computers.<br>Image formation: 2D Fourier transformation method – K-space representation – 3D Fourier imaging – MIP.<br>MR Spectroscopy – functional MRI | 12 |
| IV | **Ultrasonography**<br>Basic Acoustics, Ultrasound terminologies: acoustic pressure, power, intensity, impedance, speed, frequency, dB notation: relative acoustic pressure and relative acoustic intensity. Interaction of US with matter: reflection, transmission, scattering, refraction and absorption, attenuation and attenuation coefficients, US machine controls, US focusing. Production of ultrasound: Piezoelectricity, Medical ultrasound transducer: Principle, construction and working, characteristics of US beam. Ultrasound display modes: A, B, M Real-time ultrasound: Line density and frame rate, Real-time ultrasound transducers: mechanical and electronic arrays, ultrasound artifacts, ultrasound recording devices, and Distance, area & volume measurements. Doppler Ultrasound, Doppler artifacts, vascular sonography | 12 |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Study the detailed physics utilized in Imaging such as CT, MRI, USG etc.
**CO2.** Study about the physics related to Advanced Computed Tomography.
**CO3.** Knowledge about Magnetic Resonance Imaging & its relevant Physics.
**CO4.** Knowledge about Ultrasonography & its relevant Physics.
**CO5.** Study & Knowledge about the machines used in CT Scan, MRI & USG.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 4 | 3 | 2 | 4 | 3 |
| CO2 | 3 | 3 | 4 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 4 | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 4 | 3 | 3 | 2 | 3 |
| CO5 | 4 | 4 | 4 | 4 | 4 | 3 | 4 |

**Reference Books**

| S. No. | Author(s) | Title | Publisher |
|---|---|---|---|
| 1 | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS AND TECHNICIANS | CBS |
| 2 | CLARK | POSITIONING FOR TECHNICINAS | |
| 3 | CHAMPMAN | SPECIAL INVESTIGATION | |
| 4 | THALIYAN | MRI MADE EASY | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 107-21** | | | |
| **Subject Title:** | **ADVANCED PHYSICS OF RADIOLOGY & IMAGING LAB** | | | |
| **Contact Hours:** | **L:0** | **T:0** | **P:3** | **Credits:2** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about Advanced physics used in Radiology & Imaging Procedures & Equipments. | | | |

**Details of the Course**

| Unit | Contents |
|---|---|
| I | 1. Knowledge of Physics used in X-rays.<br>2. Working of X-ray Machine.<br>3. Knowledge of Physics used in CT Scan.<br>4. Working of CT Scan Machine. |
| II | 1. Knowledge of Physics used in MRI.<br>2. Working of MRI Machine.<br>3. Knowledge of Physics used in USG<br>4. Working of USG Machine |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to
**CO1.** Study the detailed physics utilized in Imaging such as CT, MRI, USG etc.
**CO2.** Study about the physics related to Advanced Computed Tomography.
**CO3.** Knowledge about Magnetic Resonance Imaging & its relevant Physics.
**CO4.** Knowledge about Ultrasonography & its relevant Physics.
**CO5.** Study & Knowledge about the machines used in CT Scan, MRI & USG.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 4 | 3 | 2 | 4 | 3 |
| CO2 | 3 | 3 | 4 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 4 | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 4 | 3 | 3 | 2 | 3 |
| CO5 | 4 | 4 | 4 | 4 | 4 | 3 | 4 |

**Reference Books**


| S. No. | Author(s) | Title | Publisher |
|---|---|---|---|
| 1 | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS AND TECHNICIANS | CBS |
| 2 | CLARK | POSITIONING FOR TECHNICINAS | |
| 3 | CHAMPMAN | SPECIAL INVESTIGATION | |
| 4 | THALIYAN | MRI MADE EASY | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 104-21** | | | |
| **Subject Title:** | **INSTRUMENTATION OF CONVENTIONAL X-RAY & SPECIALIZED RADIOLOGY EQUIPMENTS** | | | |
| **Contact Hours:** | **L:4** | **T:0** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about the Instruments used in Conventional X-ray & other Specialized Radiology Equipments. | | | |

**Details of the Course**

| Unit | Contents | Contact Hours |
|---|---|---|
| I | Generation of electrical energy, AC/DC, Polyphase supply, Distribution of electrical energy, uses of electrical energy, Current loads & power loss, Uses of electricity in Hospitals, Safety rules for Radiographers.<br>X ray Circuit components, High tension transformers, Main Voltage Compensation, High tension switches, Stabilizers and UPS.<br>Fuses, Switches, Earthing, High tension cables, construction & design.<br>Rectification, Types of Rectifiers, X-ray circuits, Filament circuits, High voltage circuits. Tube rating, Types of Generators, Capacitor discharge generator, Battery Powered generator, Medium frequency & High frequency generator. | 12 |
| II | Switches, Circuit breakers, Primary & Secondary switches, Exposure switching and its application. Interlocking Circuits, Regulating and safety devices, Magnetic relay, Thermal relay switches, Interlock in Tube Circuit and overload interlocks.<br>Exposure timers, Timing systems, Electronic timer, Ionization timer, Photo timer, Synchronous timer and impulse timer.<br>Devices improving radiographic quality- Cone, Cylinder, Collimator, Grid, Filter. Portable X-Ray Equipments, Mobile X-Ray Equipments, Capacitor Discharge Mobile Equipment, Cordless Mobile Equipments, X-Ray Equipments for the Operating Theatre, Mobile Image Intensifier units. | 12 |

| | | |
|---|---|---|
| III | Fluoroscopy Equipments, Construction & Working principles of Image Intensifier, Viewing the Intensified image, Recording the intensified Image, Digital fluoroscopy, Panel type image intensifier.<br>Fluoroscopic / Radiographic Tables, General features of fluoroscopic / radiographic table, The serial changer, Remote control table, The spot film devices. Tomographic Equipment, Principles of tomography, Various types of tomographic movement, Equipment for linear tomography | 11 |
| IV | Equipment for Cranial and Dental radiography, The skull table, General Dental X-ray equipment, Pantomography equipment, Equipment for Cranial & skeletal radiography, Equipment for mammography.<br>Care, Maintenance and tests, General care, Functional tests, Quality assurance program,<br>Acceptable limits of variation, Corrective action | 10 |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Know About Electrical Supply & requirements for Radiology Equipments.
**CO2.** To Know about fuses, switches, earthing & generators etc. used in Radiology.
**CO3.** Understanding the methods of Improving radiographic quality.
**CO4.** To know about various types of mobile & portable X-ray equipments.
**CO5.** To Know about Fluoroscopy & other procedures along with care of equipments.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 2 | 2 | 1 | 2 |
| CO2 | 3 | 2 | 4 | 2 | 2 | 1 | 2 |
| CO3 | 3 | 4 | 4 | 3 | 4 | 3 | 3 |
| CO4 | 4 | 3 | 2 | 4 | 4 | 2 | 3 |
| CO5 | 4 | 4 | 3 | 4 | 4 | 3 | 4 |

**Reference Books**

| S. No. | Author(s) | Title | Publisher |
|---|---|---|---|
| 1. | Noreen Chesney & Muriel Chesney | X-ray Equipments for Radiographers | |
| 2. | Thomas Curry, James Dowdey, Robert Jr. | Christensen's Physics of Diagnostic radiology | Wolters Kluwer |
| 3. | Bhargava.S.K | Text book of Radiology for Technicians | |
| 4. | Thompson Thomas | Practical approach to Modern X.ray equipment | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 107-21** | | | |
| **Subject Title:** | **INSTRUMENTATION OF CONVENTIONAL X-RAY & SPECIALIZED RADIOLOGY EQUIPMENTS LAB** | | | |
| **Contact Hours:** | **L:0** | **T:0** | **P:3** | **Credits:2** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about the Instruments used in Conventional X-ray & other Specialized Radiology Equipments. | | | |

**Details of the Course**

| Unit | Contents |
|---|---|
| I | 1. Safety Rules of Radiographers.<br>2. AC/DC Current & uses of Electricity in Radiology.<br>3. X-ray Circuit components<br>4. Fuses, Switches, High tension Cables in Radiology. |
| II | 5. Regulating & Safety devices.<br>6. Devices improving Radiographic Quality.<br>7. Fluoroscopic/Radiographic Table<br>8. Care & Maintenance of Radiology equipments. |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Know About Electrical Supply & requirements for Radiology Equipments.
**CO2.** To Know about the safety rules for Radiographers.
**CO3.** Understanding the methods of Improving radiographic quality.
**CO4.** To know about various components of X-ray Circuit.
**CO5.** To Know about Fluoroscopy & other procedures along with care of equipments

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 2 | 2 | 1 | 2 |
| CO2 | 3 | 2 | 4 | 2 | 2 | 1 | 2 |
| CO3 | 3 | 4 | 4 | 3 | 4 | 3 | 3 |
| CO4 | 4 | 3 | 2 | 4 | 4 | 2 | 3 |
| CO5 | 4 | 4 | 3 | 4 | 4 | 3 | 4 |

**Reference Book**

| S. No. | Author(s) | Title | Publisher |
|---|---|---|---|
| 1. | Noreen Chesney & Muriel Chesney | X-ray Equipments for Radiographers | |
| 2. | Thomas Curry, James Dowdey, Robert Jr. | Christensen's Physics of Diagnostic radiology | Wolters Kluwer |
| 3. | Bhargava.S.K | Text book of Radiology for Technicians | |
| 4. | Thompson Thomas | Practical approach to Modern X.ray equipment | |

# SEMESTER-II

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 201-21** | | | |
| **Subject Title:** | **MODERN RADIOLOGICAL & IMAGING EQUIPMENTS** | | | |
| **Contact Hours:** | **L:4** | **T:0** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | This subject will overview the upcoming modern imaging equipments, their history functioning and physical concepts. This will lead to understanding of modernization in radiology department. | | | |

**Details of the Course**

| Unit | Contents | Contact Hours |
|---|---|---|
| I | High Frequency X-Ray Generators and their types and applications. Modern x-ray tubes-their types and advancements. Special radiological equipment: Computed radiography: its principle, physics & equipment. Digital Radiography, Direct and indirect digital radiography Digital Fluoroscopy, Digital Mammography; including cones compression devices Stereotactic Biopsy system including Prone Table Biopsy system. Image Receptors: Flat Panel Detectors, Image Processing Workstation and Imaging Cameras. | 10 |
| II | **Tomography:** Body section radiography, basic principle and equipment, multi section tomography, various types of topographic movements, Tomosynthesis, Stitch radiography, Dual energy x-ray absorptiometry (DEXA) scan. Vascular Imaging Equipment: Introduction, historical developments DSA Equipment- Principle, applications and definition of terms, Single Plane, Biplane, Hybrid DSA Lab- digital subtraction techniques. Scatter radiation its formation and control: beam centering devices, collimators, cone diaphragms and grids. Fluoroscopy and IITV systems including cine radiography with various recording devices. | 11 |

| | | |
|---|---|---|
| III | **Computed Tomography** -Principle, data acquisition concepts, image reconstruction, instrumentations, image manipulation Historical developments - Various generations, spiral/helical, single slice/multi-slice CT, Electron beam CT, mobile CT, Advances in volume scanning, continuous, sub-second scanning. Real time CT fluoroscopy, interventional guidance tool, 3D CT, CT angiography. Virtual reality imaging, including image quality and quality control in CT Scanners.<br>Ultrasonography: Basic principle of U.S., various types of transducers, mechanism of image formation, various advancements including Doppler, Elastography, HIFU, ABVS and image artifacts. | 12 |
| IV | **MRI:** Basic principle of MRI, complete imaging equipment and various requirements, T1 and T2 Relaxation behaviors of tissues, T1, T2 and proton density images, spatial localization of images. Types of imaging sequences (spin echo, fast spin echo, flash, inversion recovery, gradient echo etc. MR spectroscopy, principle and techniques, Contrast Agents in MRI, Image quality, Image artifacts and its compensators, NMR hazard and safety. Advances in MRI. Radionuclide scanning including rectilinear scanner, gamma camera, PET, SPECT, their principles, working, applications and advancements. Care and maintenance of radiological equipments. | 12 |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Knowledge about Modern equipments in X-ray.
**CO2.** Study about Digital Radiography such as Fluoroscopy, Mammography etc.
**CO3.** Know about Tomography & DEXA Scan.
**CO4.** Know about Computed Tomography & its principles & Procedure.
**CO5.** Study about Magnetic Resonance Imaging & its Principles & Procedure.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 4 | 3 | 4 |
| CO2 | 4 | 3 | 2 | 4 | 3 | 2 | 4 |
| CO3 | 4 | 3 | 3 | 4 | 2 | 2 | 4 |
| CO4 | 4 | 3 | 4 | 4 | 3 | 2 | 4 |
| CO5 | 4 | 3 | 4 | 4 | 3 | 2 | 4 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1 | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS AND TECHNICIANS | CBS |
| 2 | | ESSENTIAL OF RADIOLOGY | |
| 3 | THALIYAN | MRI MADE EASY | |
| 4 | Bhargava.S.K | Text book of Radiology for Technicians | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 205-21** | | | |
| **Subject Title:** | **MODERN RADIOLOGICAL & IMAGING EQUIPMENTS LAB** | | | |
| **Contact Hours:** | **L:0** | **T:0** | **P:3** | **Credits:2** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about General & regional Anesthesia Techniques. | | | |

**Details of the Course**

| Unit | Contents |
|---|---|
| I | 1. High Frequency X-ray Generator.<br>2. Digital Radiography.<br>3. Procedure of taking Biopsy in Radiology department.<br>4. DEXA Scan |
| II | 1. Computed Tomography Principle.<br>2. Magnetic Resonance Imaging Principle.<br>3. Procedure of CT Scan.<br>4. Procedure of MRI. |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Knowledge about Modern equipments in X-ray.
**CO2.** Study about Digital Radiography such as Fluoroscopy, Mammography etc.
**CO3.** Know about Tomography & DEXA Scan.
**CO4.** Know about Computed Tomography & its principles & Procedure.
**CO5.** Study about Magnetic Resonance Imaging & its Principles & Procedure.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 4 | 3 | 4 |
| CO2 | 4 | 3 | 2 | 4 | 3 | 2 | 4 |
| CO3 | 4 | 3 | 3 | 4 | 2 | 2 | 4 |
| CO4 | 4 | 3 | 4 | 4 | 3 | 2 | 4 |
| CO5 | 4 | 3 | 4 | 4 | 3 | 2 | 4 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1 | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS AND TECHNICIANS | CBS |
| 2 | | ESSENTIAL OF RADIOLOGY | |
| 3 | THALIYAN | MRI MADE EASY | |
| 4 | Bhargava.S.K | Text book of Radiology for Technicians | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 202-21** | | | |
| **Subject Title:** | **CARE OF PATIENT IN DIAGNOSTIC RADIOLOGY** | | | |
| **Contact Hours:** | **L:4** | **T:0** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about various methods of handling a patient & care of patient in Radiology Department. | | | |

**Details of the Course**

| Unit | Contents | Contact Hours |
|---|---|---|
| I | Introduction to Patient Care<br>Responsibilities of the Healthcare facility<br>Responsibilities of the Imaging Technologist<br>General Patient Care<br>Patient transfer technique<br>Restraint techniques<br>Aspects of patient comfort<br>Specific patient conditions<br>Security of patient property | 12 |
| II | Obtaining vital signs<br>Laying up a sterile trolley<br>IV injection administration<br>Nursing procedure in Radiology<br>General abdominal preparation<br>Clothing of the patient<br>Giving an enema<br>Handling the emergencies in Radiology<br>First aid in the X-Ray department | 12 |

| | | |
|---|---|---|
| III | Patient care during Investigation-<br>G.I. Tract, Biliary tract, Respiratory tract, Gynecology, Cardiovascular, Lymphatic system, C.N.S. etc.<br>Infection Control<br>Isolation technique<br>Infection sources –<br>Transmission modes<br>Procedures<br>Psychological considerations | 11 |
| IV | Sterilization & sterile techniques.<br>Patient Education<br>Communication<br>Patient communication problems<br>Explanation of examinations<br>Radiation Safety / Protection<br>Interacting with terminally ill patient<br>Informed Consent | 10 |

**Cou**

At the end of the course, the student will be able to

**CO1.** Introduction to Patient care & responsibilities of Technologist.
**CO2.** Study about Patient transportation techniques & Aseptic Precautions.
**CO3.** Know about basic procedures & first-aid in Radiology department.
**CO4.** Know about patient care during procedures & infection control.
**CO5.** Knowledge about patient education & communication for procedures.

**rse Outcomes and Mapping**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 3 | 2 | 4 | 1 | 2 |
| CO2 | 3 | 3 | 1 | 2 | 3 | 1 | 2 |
| CO3 | 4 | 3 | 2 | 4 | 3 | 2 | 4 |
| CO4 | 4 | 2 | 1 | 2 | 3 | 1 | 2 |
| CO5 | 3 | 1 | 1 | 2 | 2 | 1 | 2 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1. | Chesney & Chesney | Care of patients in Diagnostic Radiology | |
| 2. | Gunn | Care of patients in Diagnostic Radiology | |
| 3. | Torres | Basic Medical Techniques and patient care for Radiologic Technologist | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 206-21** | | | |
| **Subject Title:** | **CARE OF PATIENT IN DIAGNOSTIC RADIOLOGY LAB** | | | |
| **Contact Hours:** | **L:0** | **T:0** | **P:3** | **Credits:2** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about various methods of handling a patient & care of patient in Radiology Department. | | | |

**Details of the Course**

| Unit | Contents |
|---|---|
| I | 1. Introduction to Patient Care.<br>2. Responsibilities of the Imaging Technologist.<br>3. Nursing procedure in Radiology.<br>4. General abdominal preparation<br>5. First aid in the X-Ray department |
| II | 1. Technique of Transportation of Patient in Radiology Department.<br>2. Patient care during Investigation.<br>3. Sterilization & sterile techniques.<br>4. Patient Education.<br>5. Informed Consent |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Introduction to Patient care & responsibilities of Technologist.
**CO2.** Study about Patient transportation techniques & Aseptic Precautions.
**CO3.** Know about basic procedures & first-aid in Radiology department.
**CO4.** Know about patient care during procedures & infection control.
**CO5.** Knowledge about patient education & communication for procedures.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 3 | 2 | 4 | 1 | 2 |
| CO2 | 3 | 3 | 1 | 2 | 3 | 1 | 2 |
| CO3 | 4 | 3 | 2 | 4 | 3 | 2 | 4 |
| CO4 | 4 | 2 | 1 | 2 | 3 | 1 | 2 |
| CO5 | 3 | 1 | 1 | 2 | 2 | 1 | 2 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1. | Chesney & Chesney | Care of patients in Diagnostic Radiology | |
| 2. | Gunn | Care of patients in Diagnostic Radiology | |
| 3. | Torres | Basic Medical Techniques and patient care for Radiologic Technologist | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 203-21** | | | |
| **Subject Title:** | **ADVANCED TECHNIQUES & INSTRUMENTATION OF ULTRASONOGRAPHY** | | | |
| **Contact Hours:** | **L:4** | **T:0** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about the advancements in techniques & Instrumentation of Ultrasonography. | | | |

**Details of the Course**

| Unit | Contents | Contact Hours |
|---|---|---|
| I | Ultrasound- Properties of ultrasound.<br>Interaction of ultrasound with matter.<br>Transducers-<br>Types of transducer<br>Advances in the design of modern ultrasound transducers.<br>Image display, Display modes<br>Real time ultrasound<br>Pulse echo ultrasound instrumentation, Beam former | 12 |
| II | Pulse transmitter – receiver, Controls<br>CRT displays – television monitors<br>Image storage, Scan converter memory<br>Photographic film, Multiformat camera<br>Laser imager, Colour & video thermal printers<br>Computer storage,<br>Pre and post processing techniques, Ultrasound Protocols | 12 |
| III | Doppler Imaging, Doppler principles<br>Continuous wave Doppler and Pulsed Doppler<br>Duplex scanning<br>Doppler spectral analysis & display, Color flow imaging<br>Power Doppler, Harmonic imaging<br>Real time compounding, Extended field of view.<br>Doppler Instrumentation,<br>Ultrasound contrast agents | 11 |

| | | |
|---|---|---|
| IV | Image characteristics and artifacts<br>Ultrasound tissue characterization and organ dynamics<br>Vascular, interventional, intra operative and ophthalmic<br>Ultrasonography- 3D & 4D ultrasound imaging<br>Acquisition, visualization and display methods,<br>Bio-effects and safety considerations in ultrasound<br>US system performance measurements<br>US equipment quality assurance - Conventional & Doppler system testing & documentation | 10 |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Knowledge about Ultrasound & its Properties.
**CO2.** Study about Ultrasound Transducers & its advancements.
**CO3.** Know about Doppler Imaging & Instrumentation.
**CO4.** Know about Image generation, Viewing & storage in Ultrasound.
**CO5.** Study about various advanced imaging such as 3D & 4D USG.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 4 | 3 | 4 |
| CO2 | 2 | 3 | 3 | 2 | 3 | 4 | 2 |
| CO3 | 4 | 3 | 4 | 4 | 4 | 3 | 4 |
| CO4 | 2 | 2 | 4 | 3 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 4 | 4 | 4 | 4 | 4 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1 | Carol M. Rumack | Diagnostic Ultrasound | |
| 2 | Allen Paul | Color Doppler Ultrasound | |
| 3 | M.Hussey | Basic physics and technology of medical diagnostic ultrasound | |
| 4 | Bartrum.R.J | Real time ultrasound manual for Physicians and Technical personnel | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 207-21** | | | |
| **Subject Title:** | **ADVANCED TECHNIQUES & INSTRUMENTATION OF ULTRASONOGRAPHY LAB** | | | |
| **Contact Hours:** | **L:0** | **T:0** | **P:3** | **Credits:2** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about the advancements in techniques & Instrumentation of Ultrasonography. | | | |

**Details of the Course**

| Unit | Contents |
|---|---|
| I | 1. Ultrasound & Ultrasonography.<br>2. Transducers & uses in Ultrasonography.<br>3. Real-time Ultrasound & Pulse transmitter.<br>4. Doppler Imaging & Duplex Scanning.<br>5. Image Generation & Storage in Ultrasonography. |
| II | 1. Ultrasound Contrast Agents.<br>2. Doppler Instrumentation.<br>3. Tissue Ultrasound.<br>4. 3D & 4D Ultrasonography. |

At the end of the course, the student will be able to

**CO1.** Knowledge about Ultrasound & its Properties.
**CO2.** Study about Ultrasound Transducers & its advancements.
**CO3.** Know about Doppler Imaging & Instrumentation.
**CO4.** Know about Image generation, Viewing & storage in Ultrasound.
**CO5.** Study about various advanced imaging such as 3D & 4D USG.

**Course Outcomes and Mapping**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 4 | 3 | 4 |
| CO2 | 2 | 3 | 3 | 2 | 3 | 4 | 2 |
| CO3 | 4 | 3 | 4 | 4 | 4 | 3 | 4 |
| CO4 | 2 | 2 | 4 | 3 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 4 | 4 | 4 | 4 | 4 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1 | Carol M. Rumack | Diagnostic Ultrasound | |
| 2 | Allen Paul | Color Doppler Ultrasound | |
| 3 | M.Hussey | Basic physics and technology of medical diagnostic ultrasound | |
| 4 | Bartrum.R.J | Real time ultrasound manual for Physicians and Technical personnel | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 204-21** | | | |
| **Subject Title:** | **ADVANCED TECHNIQUES & INSTRUMENTATION OF COMPUTED TOMOGRAPHY** | | | |
| **Contact Hours:** | **L:4** | **T:0** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about the advancements in techniques & Instrumentation of CT. | | | |

**Details of the Course**

| Unit | Contents | Contact Hours |
|---|---|---|
| I | Imaging principles in computed tomography<br>Instrumentation of CT scan<br>Advances in Detector technology, Slip ring technology<br>Helical CT, Single slice and Multi slice CT Scan system.<br>Isotropic imaging, Image display<br>Pre and Post Processing techniques<br>Image quality in single slice and multi slice helical CT scan<br>Patient radiation dose considerations in Helical CT. | 12 |
| II | Protocols for adult Whole-Body CT<br>Protocols for pediatric Whole-Body CT, Documentation<br>Common and specific artifacts in Helical CT images.<br>HRCT of Lungs<br>Technical aspects<br>Volumetric HRCT<br>Expiratory HRCT<br>HRCT protocols<br>Artifacts | 12 |
| III | CT angiography<br>CT fluoroscopy<br>Multidimensional reformations<br>MPR, Curved MPR, MIP<br>3D imaging & 4D CT.<br>CT Perfusion scanning.<br>CT colonoscopy<br>CT bronchoscopy | 11 |

| | | |
|---|---|---|
| IV | CT coronary angiography<br>CT calcium scoring<br>Myocardial Imaging.<br>Care, Maintenance and tests<br>General care, Functional tests<br>Quality assurance program<br>Acceptable limits of variation, Corrective action. | 10 |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Knowledge about Computed Tomography & its Properties.
**CO2.** Study about Detector Technology & its advancements.
**CO3.** Know about Whole-body CT & HRCT.
**CO4.** Know about CT of different procedures like angiography, colonoscopy etc.
**CO5.** Study about various advanced imaging in CT such as 3D & 4D CT.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| CO2 | 2 | 4 | 4 | 3 | 3 | 4 | 3 |
| CO3 | 4 | 4 | 3 | 4 | 3 | 2 | 4 |
| CO4 | 4 | 4 | 3 | 4 | 4 | 2 | 4 |
| CO5 | 4 | 4 | 4 | 4 | 3 | 4 | 4 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1 | Euclid Seeram | Computed Tomography – Physical Principles, Clinical Applications & Quality Control. | |
| 2 | Stewart C. Bushong | Computed Tomography | |
| 3 | Bushberg | The essential physics of medical imaging | |
| 4 | Chiu.L.C | Clinical Computed Tomography for the Technologist | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 208-21** | | | |
| **Subject Title:** | **ADVANCED TECHNIQUES & INSTRUMENTATION OF COMPUTED TOMOGRAPHY LAB** | | | |
| **Contact Hours:** | **L:0** | **T:0** | **P:3** | **Credits:2** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about the advancements in techniques & Instrumentation of CT. | | | |

**Details of the Course**

| Unit | Contents |
|---|---|
| I | 1. Imaging Principles in Computed Tomography.<br>2. Instrumentation of CT Scan.<br>3. Detector Technology & its Advancements.<br>4. Adult Whole-Body CT.<br>5. Common & Specific Artifacts. |
| II | 1. CT Angiography, Colonoscopy, Bronchoscopy.<br>2. MPR & Curved MPR.<br>3. Myocardial Imaging.<br>4. General Care of CT Equipments. |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Knowledge about Computed Tomography & its Properties.
**CO2.** Study about Detector Technology & its advancements.
**CO3.** Know about Whole-body CT & HRCT.
**CO4.** Know about CT of different procedures like angiography, colonoscopy etc.
**CO5.** Study about general Care & tests of CT Equipments.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| CO2 | 2 | 4 | 4 | 3 | 3 | 4 | 3 |
| CO3 | 4 | 4 | 3 | 4 | 3 | 2 | 4 |
| CO4 | 4 | 4 | 3 | 4 | 4 | 2 | 4 |
| CO5 | 4 | 4 | 4 | 4 | 3 | 4 | 4 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1. | Euclid Seeram | Computed Tomography – Physical Principles, Clinical Applications & Quality Control. | |
| 2. | Stewart C. Bushong | Computed Tomography | |
| 3. | Bushberg | The essential physics of medical imaging | |
| 4. | Chiu.L.C | Clinical Computed Tomography for the Technologist | |

## SEMESTER-III

| I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY<br>DEPARTMENT OF ALLIED HEALTH SCIENCES | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 301-21** | | | |
| **Subject Title:** | **ADVANCED TECHNIQUES & INSTRUMENTATION OF MRI** | | | |
| **Contact Hours:** | **L:4** | **T:0** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | This subject will overview the MRI & Advanced Techniques, Instrumentation & Imaging in MRI. | | | |

**Details of the Course**

| Unit | Contents | Contact Hours |
|---|---|---|
| I | Principles of Advance Techniques of MRI,<br>Principles of Instrumentation of MRI,<br>Relaxation time in MRI,<br>T1 weighted image,<br>T2 weighted image,<br>Proton density image<br>Types of magnets,<br>RF Transmitter | 10 |
| II | Receiver coils, Gradient coils, Shim coils,<br>RF shielding computers,<br>Spin Echo sequence,<br>Turbo spin echo pulse spin,<br>Gradient echo sequence,<br>Turbo gradient echo pulse sequence,<br>inversion recovery sequence,<br>STIR sequence, SPIR sequence, FLAIR sequence, | 11 |
| III | Echo planner imaging and fast imaging sequences,<br>Advance pulse sequences,<br>Image formation,<br>2D Fourier Transformation method,<br>K space representation,<br>3D Fourier imaging,<br>MIP, MR contrast media, | 12 |

| | | |
|---|---|---|
| IV | MR angiography,<br>TOF and PCA,<br>MR Spectroscopy,<br>Protocols in MRI for whole body,<br>MRI artifacts,<br>Safety aspects in MRI,<br>Cardiac MRI,<br>Abdominal imaging protocols | 12 |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Knowledge about Modern equipments in MRI.
**CO2.** Study about Magnets & Images.
**CO3.** Know about Sequences & Coils.
**CO4.** Know about 2D & 3D Fourier imaging.
**CO5.** Study about MR Angiography, Spectroscopy & Artifacts.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 4 | 3 | 4 |
| CO2 | 4 | 3 | 2 | 4 | 3 | 2 | 4 |
| CO3 | 4 | 3 | 3 | 4 | 2 | 2 | 4 |
| CO4 | 4 | 3 | 4 | 4 | 3 | 2 | 4 |
| CO5 | 4 | 3 | 4 | 4 | 3 | 2 | 4 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1 | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS AND TECHNICIANS | CBS |
| 2 | | ESSENTIAL OF RADIOLOGY | |
| 3 | THALIYAN | MRI MADE EASY | |
| 4 | D.R. Dance;<br>A.D.A Maidment;<br>K.H. NG;<br>I.D. Mclean | Diagnostic Radiology<br>Handbook for Radiology | Vienna International Centre |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 305-21** | | | |
| **Subject Title:** | **ADVANCED TECHNIQUES & INSTRUMENTATION OF MRI LAB** | | | |
| **Contact Hours:** | **L:0** | **T:0** | **P:3** | **Credits:2** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | This subject will overview the MRI & Advanced Techniques, Instrumentation & Imaging in MRI. | | | |

**Details of the Course**

| Unit | Contents |
|---|---|
| I | 1.Principles of MRI<br>2.Advanced Techniques of MRI<br>3.Instrumentation in MRI<br>4.2D & 3D Imaging |
| II | 5.MRI Sequencing<br>6.MRI Artifacts<br>7.MR Angiography<br>8.MR Spectroscopy |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Knowledge about Modern equipments in MRI.
**CO2.** Study about Magnets & Images.
**CO3.** Know about Sequences & Coils.
**CO4.** Know about 2D & 3D Fourier imaging.
**CO5.** Study about MR Angiography, Spectroscopy & Artifacts.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 4 | 3 | 4 |
| CO2 | 4 | 3 | 2 | 4 | 3 | 2 | 4 |
| CO3 | 4 | 3 | 3 | 4 | 2 | 2 | 4 |
| CO4 | 4 | 3 | 4 | 4 | 3 | 2 | 4 |
| CO5 | 4 | 3 | 4 | 4 | 3 | 2 | 4 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1 | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS AND TECHNICIANS | CBS |
| 2 | | ESSENTIAL OF RADIOLOGY | |
| 3 | THALIYAN | MRI MADE EASY | |
| 4 | D.R. Dance;<br>A.D.A Maidment;<br>K.H. NG;<br>I.D. Mclean | Diagnostic Radiology<br>Handbook for Radiology | Vienna International Centre |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 302-21** | | | |
| **Subject Title:** | **INTERVENTIONAL RADIOLOGY TECHNIQUES** | | | |
| **Contact Hours:** | **L:4** | **T:0** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about various procedures & practices in Interventional Radiology. | | | |

**Details of the Course**

| Unit | Contents | Contact Hours |
|---|---|---|
| I | Introduction & need for interventional procedures,<br>Informed consent, DSA,<br>Basic principles of interventional radiology techniques,<br>Types of interventional radiology techniques, Equipments,<br>Single and Bi-plane angiographic equipment,<br>Recording system<br>Patient care,<br>Preparation for procedure,<br>Post-procedure care. | 12 |
| II | Role of radiographer, Crash trolleys,<br>Emergency drugs, Catheters,<br>ECG pressure injector, Needles,<br>3D rational angiography,<br>Procedure, Diagnostic and therapeutic interventional procedure,<br>PTC, PTBD, Stenting neprostromy,<br>uretic stenting, guide wire drainage of collections/ abcess.<br>angiogram, angioplasty, immobilization,<br>radiofrequency in nerve blocks | 12 |
| III | Thyroid imaging,<br>GIT system,<br>Cardiovascular system,<br>Iodine 131 therapy for thyrotoxicosis,<br>Thyroid ablation,<br>PET imaging,<br>SPECT imaging,<br>Radiation safety nuclear medicine,<br>Radiation units,<br>Quantities of radiation. | 11 |

| | | |
|---|---|---|
| IV | Handling of radioactive materials, storage of radioactive materials, disposable of radioactive wastes, radiation monitoring, survey meters, wipe testing, contamination monitor, isotope calibrator, Types of noise, quality assurance of imaging equipments, variation in image precipitation, Technologist and technical parameters, Area monitor | 10 |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Introduction to Interventional Radiology Procedures.
**CO2.** Study about interventional radiology techniques & types.
**CO3.** Know about basic & advanced procedures of Interventional Radiology.
**CO4.** Know about PET, SPECT & Radiation safety in nuclear medicine.
**CO5.** Knowledge about radioactive materials & their storage & management.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 3 | 2 | 4 | 1 | 2 |
| CO2 | 3 | 3 | 1 | 2 | 3 | 1 | 2 |
| CO3 | 4 | 3 | 2 | 4 | 3 | 2 | 4 |
| CO4 | 4 | 2 | 1 | 2 | 3 | 1 | 2 |
| CO5 | 3 | 1 | 1 | 2 | 2 | 1 | 2 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1. | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS AND | CBS |
| 2. | D.R. Dance; A.D.A Maidment; K.H. NG; I.D. Mclean | Diagnostic Radiology Handbook for Radiology | Vienna International Centre |
| 3. | THALIYAN | MRI MADE EASY | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 306-21** | | | |
| **Subject Title:** | **INTERVENTIONAL RADIOLOGY TECHNIQUES LAB** | | | |
| **Contact Hours:** | **L:0** | **T:0** | **P:3** | **Credits:2** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about various procedures & practices in Interventional Radiology. | | | |

**Details of the Course**

| Unit | Contents |
|---|---|
| I | 1.Interventional Radiology Procedures.<br>2.Types of Radiology Equipments<br>3. Methods of patient care in interventional radiology<br>4. Angiography<br>5. Diagnostic & Therapeutic Intervention procedures |
| II | 6.PET<br>7. SPECT<br>8. Radiation Safety in Nuclear Medicine<br>9. Handling of Radioactive Materials<br>10. Techniques in Interventional Radiology |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Introduction to Interventional Radiology Procedures.
**CO2.** Study about interventional radiology techniques & types.
**CO3.** Know about basic & advanced procedures of Interventional Radiology.
**CO4.** Know about PET, SPECT & Radiation safety in nuclear medicine.
**CO5.** Knowledge about radioactive materials & their storage & management.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 3 | 2 | 4 | 1 | 2 |
| CO2 | 3 | 3 | 1 | 2 | 3 | 1 | 2 |
| CO3 | 4 | 3 | 2 | 4 | 3 | 2 | 4 |
| CO4 | 4 | 2 | 1 | 2 | 3 | 1 | 2 |
| CO5 | 3 | 1 | 1 | 2 | 2 | 1 | 2 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1. | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS AND | CBS |
| 2. | | ESSENTIAL OF RADIOLOGY | |
| 3. | THALIYAN | MRI MADE EASY | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 303-21** | | | |
| **Subject Title:** | **NUCLEAR MEDICINE IMAGING TECHNIQUES** | | | |
| **Contact Hours:** | **L:4** | **T:0** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about the advancements in techniques & Instrumentation of Ultrasonography. | | | |

**Details of the Course**

| Unit | Contents | Contact Hours |
|---|---|---|
| I | Basic attempt and nuclear physics,<br>Principle of nuclear physics,<br>Structure and composition of atom,<br>Composition of radioactivity, specific activity,<br>modes of radioactive decay,<br>structure of nucleus,<br>quantities and units of atom<br>Radiation detectors, Principle of radiation detector,<br>Ionization chambers | 12 |
| II | Gas-filler detectors, Scintillation detectors,<br>Proportional counters, Semiconductor detectors,<br>Geiger-muller conductors,<br>Production of radionuclides,<br>Principle of radionuclides,<br>Radionuclide generators,<br>Accelerator produced radionuclides,<br>Production of radionuclides | 12 |
| III | Instrumentation, Basic principle of anger camera,<br>Detector system,<br>Electronics collimators,<br>Image display system,<br>Recording system,<br>Scanning camera<br>Radio pharmacy,<br>Radio pharmaceuticals, | 11 |

| | | |
|---|---|---|
| IV | General principle of tracer technique,<br>Preparation of cold kit,<br>Compound of technetium-99mm<br>Radiation safety in nuclear medicine,<br>radiation units, radiation quantities,<br>handling of radioactive materials,<br>storage of radioactive materials,<br>spells of radioactive materials,<br>disposable radioactive waste,<br>radiation monitoring | 10 |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Knowledge about Basic Nuclear Physics for Radiology.
**CO2.** Study about Detectors & Conductors.
**CO3.** Know about Radionuclides & their Production.
**CO4.** Know about Instrumentation & system involved in Nuclear Medicine.
**CO5.** Study about radioactive materials & their Management.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 4 | 3 | 4 |
| CO2 | 2 | 3 | 3 | 2 | 3 | 4 | 2 |
| CO3 | 4 | 3 | 4 | 4 | 4 | 3 | 4 |
| CO4 | 2 | 2 | 4 | 3 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 4 | 4 | 4 | 4 | 4 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1 | Dr.S.K. | RADIOLOGY FOR RESIDENTS AND | CBS |
| 2 | | ESSENTIAL OF RADIOLOGY | |
| 3 | THALIYAN | MRI MADE EASY | |
| 4 | D.R. Dance;<br>A.D.A Maidment;<br>K.H. NG;<br>I.D. Mclean | Diagnostic Radiology Handbook for Radiology | Vienna International Centre |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 307-21** | | | |
| **Subject Title:** | **NUCLEAR MEDICINE IMAGING TECHNIQUES LAB** | | | |
| **Contact Hours:** | **L:0** | **T:0** | **P:3** | **Credits:2** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about the advancements in techniques & Instrumentation of Ultrasonography. | | | |

**Details of the Course**

| Unit | Contents |
|---|---|
| I | 1.Principles of Nuclear Physics<br>2.Radiation Detector<br>3.Conductors & Detectors<br>4.Radionuclides<br>5.Image Display System |
| II | 6.Recording System<br>7.Tracer Technique<br>8.Radiation Safety in Nuclear medicine<br>9. Radioactive Material Management |

At the end of the course, the student will be able to

**CO1.** Knowledge about Basic Nuclear Physics for Radiology.
**CO2.** Study about Detectors & Conductors.
**CO3.** Know about Radionuclides & their Production.
**CO4.** Know about Instrumentation & system involved in Nuclear Medicine.
**CO5.** Study about radioactive materials & their Management.

**Course Outcomes and Mapping**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 4 | 3 | 4 |
| CO2 | 2 | 3 | 3 | 2 | 3 | 4 | 2 |
| CO3 | 4 | 3 | 4 | 4 | 4 | 3 | 4 |
| CO4 | 2 | 2 | 4 | 3 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 4 | 4 | 4 | 4 | 4 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1 | Dr.S.K. | RADIOLOGY FOR RESIDENTS AND | CBS |
| 2 | | ESSENTIAL OF RADIOLOGY | |
| 3 | THALIYAN | MRI MADE EASY | |
| 4 | D.R. Dance;<br>A.D.A Maidment;<br>K.H. NG; | Diagnostic Radiology Handbook for Radiology | Vienna International Centre |

| | | | |
|---|---|---|---|
| | I.D. Mclean | | |

| **I.K. GUJRAL PUNJAB TECHNICAL UNIVERSITY**<br>**DEPARTMENT OF ALLIED HEALTH SCIENCES** | | | | |
|---|---|---|---|---|
| **Course Name** | **M.Sc. RADIOLOGY & IMAGING TECHNOLOGY** | | | |
| **Subject Code:** | **MRIT 304-21** | | | |
| **Subject Title:** | **QUALITY CONTROL IN RADIOLOGY AND RADIATION SAFETY** | | | |
| **Contact Hours:** | **L:4** | **T:0** | **P:0** | **Credits:4** |
| **Examination Duration (hours)** | **3** | | | |
| **Objective(s):** | The aim and objective of this course is to know about the advancements in techniques & Instrumentation of CT. | | | |

**Details of the Course**

| Unit | Contents | Contact Hours |
|---|---|---|
| I | Objectives of Quality Control:<br>Improve the quality of imaging,<br>diagnostic values,<br>radiation exposure,<br>Reduction of film wastage,<br>maintenance of various diagnostic and imaging units<br>Quality Assurance activities: Equipment installation,<br>Equipment selection, | 12 |
| II | Operational phase; Preventive maintenance,<br>Purchase, specification, Acceptance,<br>Routine testings, X ray generator and tube, Image receptors,<br>Radiographic equipment; Fluoroscopic equipment;<br>Mammographic equipment,<br>Conventional tomography; Computed tomography<br>General principles and preventive maintenance for X-ray, storage of film and chemicals, Light beam alignment; X-ray out-put and beam quality, machine calibration | 12 |
| III | Film processing: manual and automatic,<br>Faults tracing; Accuracy of imaging, image distortion for digital imaging devices,<br>LASER printer calibration, Film latitude; Film contrast;<br>Film speed Resolution, Artifacts of films and image recording<br>Maintenance and care of equipment:<br>Routine cleaning of equipment and instruments,<br>Maintenance of automatic processor and manual processing units,<br>Record keeping and log book maintenance, special care of mobile equipment | 11 |

| | | |
|---|---|---|
| IV | Modern Radiological and Imaging Equipments,<br>Digital Radiography, Computed Radiography,<br>CT scan, MRI Scan, Ultrasonography and PACS related.<br>Image artifacts their different types,<br>causes and remedies,<br>Basic Computed Tomography,<br>Advanced computed tomography,<br>Advanced technique & instrumentation of MRI | 10 |

**Course Outcomes and Mapping**

At the end of the course, the student will be able to

**CO1.** Knowledge about Quality Control in radiology.
**CO2.** Study about Maintenance & working of various radiology equipments.
**CO3.** Know about Principles & preventive maintenance of X-ray, CT etc.
**CO4.** Know about Film processing & fault tracing & image distortion etc.
**CO5.** Study about various advanced imaging equipments & their maintenance.

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
|---|---|---|---|---|---|---|---|
| CO1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| CO2 | 2 | 4 | 4 | 3 | 3 | 4 | 3 |
| CO3 | 4 | 4 | 3 | 4 | 3 | 2 | 4 |
| CO4 | 4 | 4 | 3 | 4 | 4 | 2 | 4 |
| CO5 | 4 | 4 | 4 | 4 | 3 | 4 | 4 |

**Reference Books**

| S.No. | Author(s) | Title of the Book | Publisher/Year |
|---|---|---|---|
| 1 | Euclid Seeram | Computed Tomography – Physical Principles, Clinical Applications & Quality Control. | |
| 2 | Stewart C. Bushong | Computed Tomography | |
| 3 | Bushberg | The essential physics of medical imaging | |
| 4 | Dr.S.K. BHARGAVA | RADIOLOGY FOR RESIDENTS AND TECHNICIANS | CBS |