INTEGRAL UNIVERSITY, LUCKNOW

INTEGRAL INSTITUTE OF ALLIED HEALTH SCIENCES & RESEARCH

DEPARTMENT OF PARAMEDICAL SCIENCES

MASTERS OF MEDICAL RADIOLOGICAL IMAGING SCIENCES (MMRIS)

SYLLABUS

YEAR/ SEMESTER: I/I

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	**RS501**	**Title of the Course**	**Radiological Physics**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	**I**	**3**	**1**	**0**	**4**
Pre-Requisite	Nil	**Co-requisite**	**Nil**				
Course Objectives	To ensure the knowledge of basic concept of Physics and radiation Physics.						

Course Outcomes: After the successful course completion, learners will develop following attributes:	
CO1	To study Discovery, Production, Types & Interaction with Matter.
CO2	To study about Tube & its Circuits.
CO3	To study about Radiographic Grid, Tube Cooling, Generators & Capacitor used in X-Ray Unit.
CO4	To study about X-ray generator circuits, Physical Quantity & Radiation Measurement Units.
CO5	To study about Radiation Detectors, Personal Dosimeters & Introduction to Advance Modalities.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**INTRODUCTION TO X-RAYS**	X-rays: Discovery, production and properties, Bremsstrahlung Radiations-Characteristics X-Rays, factors affecting X-ray emission spectra, X-ray quality and quantity, HVL measurements, heel effect, soft and hard X-Rays, added and inherent filtration, reflection and transmission targets. Interaction of ionizing radiation with matter-Types of interactions of X-and gamma radiation, Photoelectric & Compton, Pair production, annihilation radiation. Scatter radiation its formation and control: beam centering devices, collimators, cone diaphragms and grids.	8	CO1
2	**X-RAY TUBE HISTORY AND ADVANCEMENT**	Exponential attenuation (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number. LET, range of energy relationship for an alpha, beta particles with X-Rays. X-ray tube: historical aspects, construction of X-ray tubes, requirements for X-ray production(Electron source, target and anode material), tube voltage, current, space charge, early X-ray tubes(Coolidge tubes, tube envelop and housing) cathode assembly, X-ray production efficiency, anode angulation and rotating tubes, line focus principle, space charge effect, tube cooling, Modern X-ray tubes, stationary anode, rotating anode, grid controlled X-ray tubes, heel effect, off focus radiation, Grid-controlled and high-speed tubes, focal spot size, speed of anode rotation, target angle, inherent filtration, radiation leakage and scattered radiation.	8	CO2
3	**X-RAY TUBE COOLING, CIRCUIT, CAPACITOR & RECTIFIER**	Interlocking and X-ray tube overload protection. Heat dissipation methods, tube rating, heat units and operating conditions Filament current and voltage, X-ray circuits (primary circuit, auto transformer), types of exposure switch and timers, the principle of automatic exposure control (AEC) and practical operation, filament circuit, high voltage circuits, half wave, full wave rectification, three phase circuits. Types of generators, 3 phase, 6 and 12 pulse circuits, high frequency generators, falling load generators, Capacitors discharge and grid control systems.	8	CO3
4	**PHYSICAL QUANTITY & RADIATION MEASUREMENT UNITS**	Physical quantity, its unit and measurement, Fundamental and derived quantity, SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit, KVp, mA, mAs, Heat unit (HU). Radiation quantities and units: Radiation intensity, Exposure Roentgen, its limitations, Kerma and Absorbed Dose, Electronic equilibrium, Rad, Gray, Conversion factor for Roentgen to Rad, Quality factor, Dose equivalent, REM, Sievert. Quality factor, dose equivalent, relationship between absorbed dose and equivalent dose.	8	CO4
5	**RADIATION DETECTORS, PERSONAL DOSIMETERS**	Radiation detection and measurements: Principle of radiation detection, Basic principles of ionization chambers, proportional counters, G.M counters and scintillation detectors. Measuring system: free ionization chamber, Thimble ion chamber, Condenser chamber, Secondary standard dosimeter, Film dosimeter, Chemical dosimeter, Thermoluminescent Dosimeter & Pocket dosimeter.	8	CO5

Reference Books:

1. Diagnostics X-Ray Imaging Quality Assurance by M.A. Period and P. Chaloner.
2. Textbook of Radiology and imaging- by DavidSutton.
3. Christensen's Physics of diagnostic radiology.
4. The Essentaila of Physics of Medical Imaging by Bushberg.

5. Radiologic Science for Technologist by Stewart C Bushong.
e-Learning Source:
1. https://byjus.com/physics/electricity-and-magnetism/
2. https://byjus.com/chemistry/atoms-and-molecules/
3. https://en.wikipedia.org/wiki/X-ray

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	**Course Title**	**Attributes**							**SDGs No.**
RS501	Radiological Physics	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
		√	√	√			√	√	**3,4**

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	**RS502**	**Title of the Course**	**Conventional Radiological and Imaging Equipment**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	**I**	**3**	**1**	**0**	**4**
Pre-Requisite	**Nil**	**Co-requisite**	**Nil**				
Course Objectives	The main objective is to aware the student about X-Ray production, Circuit & other Conventional X-Ray Modalities.						

Course Outcomes	
CO1	Students will be able to learn about Production of X-Rays, Grid, Filter & High-Tension Circuits.
CO2	Students will be able to learn about Meters and exposure timers, Interlocking circuits & Beam Restriction Devices
CO3	Students will be able to learn about fluoroscopy & Grid.
CO4	Students will be able to learn about components of Fluoroscopy, Mobile & Potable, Mammography, cranial and dental units.
CO5	Students will be able to learn about General care & Maintenance of different Modalities.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**PORTABLE & MOBILE X-RAY UNITS**	Portable X-Ray equipments, Mobile X-Ray equipments, Capacitor discharge mobile equipment, Cordless mobile equipment, X ray equipment for the operating theatre.	8	CO1
2	**FLUOROSCOPY UNIT**	Fluoroscopy equipment, Construction and working principles of the image intensifier, Viewing the intensified image, Recording the intensified image, Digital fluoroscopy, Panel type image intensifier.	8	CO2
3	**FLUOROSCOPIC/ RADIOGRAPHIC TABLES & SPOT FILM DEVICE**	Fluoroscopy/radiographic tables, General features of fluoroscopy / radiographic tables, The serial changer, Remote control table, The spot film devices.	6	CO3
4	**DIGITAL RADIOGRAPHY**	Computerized Radiography, Digital Radiography, Equipment for Cranial and Dental radiography, General dental x-ray equipment, Pantomography equipment, and Equipment for mammography.	10	CO4
5	**DARKROOM TECHNIQUES**	Radiographic film construction and types, Film Packaging & Safety, Cassette, Intensifying Screen Construction and Maintenance, Darkroom Layout, location, Radiation Protection, Safe light, Pass box, Entrance of Darkroom, Developer, Fixer, Manual & Automatic Film Processing, Maintenance of chemical containers.	10	CO5

Reference Books:

1. Curry TS, Dowdey JE, Murry RC. Christensen's physics of diagnostic cardiology. Lippincott Williams & Wilkins; 1990.
2. Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012 Mar20.
3. Curry TS, Dowdey JE, Murray RC. Introduction to the physics of diagnostic radiology.
4. The Essentaila of Physics of Medical Imaging by Bushberg.
5. Radiologic Science for Technologist by Stewart C Bushong.

e-Learning Source:

1. https://youtu.be/R2-GB65Wa5w
2. https://youtu.be/JDYG-JEl6kI
3. https://youtu.be/IhjbvEnlRrM

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	3	3	3	3	3	2	3	2	3	2
CO2	2	3	2	3	3	3	3	3	2	3	3	3	2	3	3	3
CO3	3	2	3	2	3	2	3	3	2	2	3	3	2	3	3	3
CO4	2	3	2	3	3	3	2	3	3	2	2	3	2	3	3	2
CO5	2	3	3	3	2	3	2	3	2	3	2	3	2	3	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS502	Conventional Radiological and Imaging Equipment	√	√	√	√		√	√	3,4

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	**RS503**	**Title of the Course**	**Radiographic and Imaging Techniques**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	**I**	**3**	**1**	**0**	**4**
Pre-Requisite	**Nil**	**Co-requisite**	**Nil**				
Course Objectives	To impart detailed knowledge about different Radiological Projection along with special Radiography Techniques.						

Course Outcomes	
CO1	Students will be able to learn about Radiography of Upper limb, Lower limb & Shoulder girdle.
CO2	Students will be able to learn about Radiography of Vertebral column, Pelvic girdle, Skeletal survey & Skull.
CO3	Students will be able to learn about Dental & Respiratory Tract Radiography.
CO4	Students will be able to learn about Special Projections of Thorax, Abdominal Radiography & Special Radiographic Units.
CO5	Students will be able to learn about Localization of foreign bodies, Operation theatre techniques & Different Mobile Radiography Techniques.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**RADIOGRAPHY OF SKULL & DENTAL**	**Skull**: Basic projections for cranium, facial bones, nasal bones and mandible. Technique for Petrous temporals for mastoids, Internal auditory canal, Accessory nasal sinuses, Tempero-mandibular joint, Orbits and optic foramen, Zygomatic arches, Styloid process, Pituitary fossa, Jugular foramen. Technique for intra oral full mouth, Occlusal projections, Extra oral projections including orthopantomography, Supplementary techniques.	10	CO1
2	**RADIOGRAPHY OF UPPER & LOWER LIMB**	**Radiography of Upper Limb:** Techniques for hand, fingers, thumb, wrist joint, forearm, elbow joint, humerus, shoulder joint and sternoclavicular joint. **Lower Limb** Techniques for foot, calcaneum, ankle joint, leg, knee joint, patella and femur (lower two thirds).	10	CO2
3	**RADIOGRAPHY OF PELVIC GIRDLE & VERTEBRAL COLUMN**	**Pelvic Girdle** Techniques for pelvis, ilium, ischium and pubic bone, Techniques for hip joint and sacroiliac joint. **Vertebral Column** Techniques for Atlanto, occipital articulation, cervical vertebrae, cervical-thoracic junction, thoracic vertebrae, lumbar vertebrae, lumbo-sacral articulation, sacrum and coccyx.	7	CO3
4	**VERTEBRAL, THORACIC & ABDOMINAL RADIOGRAPHY**	**Respiratory System** Techniques for lungs, various views erect and lying, bones of thorax, techniques for sternum and upper lower ribs. **Gastro Intestinal system** Techniques for routine abdomen and radiographs on acute conditions. **Excretory system** Techniques for KUB and radiographs on acute conditions.	7	CO4
5	**OTHER RADIOGRAPHIC TECHNIQUES**	**Macroradiography:** Principle, advantage, technique and applications. **Stereography:** Procedure, presentation, for viewing, stereoscopes. **High KV techniques:** Principle and its applications. Bedside Radiography Soft tissue Radiography Localization of foreign bodies: Various techniques Operation theatre techniques Trauma radiography/Emergency radiography Neonatal and Pediatric Radiography	6	CO5

Reference Books:

1 Whitley AS, Jefferson G, Holmes K, Sloane C, Anderson C, Hoadley G. Clark's Positioning in Radiography 13E. CRC Press; 2015 Jul 28.
2 Bontrager KL, Lampignano J. Textbook of Radiographic Positioning and Related Anatomy-E-Book. Elsevier Health Sciences; 2013 Aug 7.
3 Bontrager KL, Lampignano J. Bontrager's Handbook of Radiographic Positioning and Techniques-E-BOOK. Elsevier Health Sciences; 2017 Feb 10.
4 Frank ED, Long BW, Smith BJ. Merrill's Atlas of Radiographic Positioning and Procedures-E-Book. Elsevier Health Sciences; 2013 Aug 13.

e-Learning Source:

1. https://www.slideshare.net/InfoUtilRT/upper-extremity-anatomy-positioning
2. https://youtu.be/LlStHhk5e9w
3. https://youtu.be/C2Ud4EwZVQM

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS503	Radiographic and Imaging Techniques	√	√	√	√		√	√	3,4

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	**RS504**	**Title of the Course**	**Residency - I Lab**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	**I**	**0**	**0**	**10**	**5**
Pre-Requisite	**Nil**	**Co-requisite**	**Nil**				
Course Objectives	The objective of the Residency Lab is to learn about patient handling, radiation protection and procedures done in the department.						

Course Outcomes: After the successful course completion, learners will develop following attributes:	
CO1	Students will be able to learn how to deal with a patient during examination in the Radiology department.
CO2	Students will be able to learn how to perform X-Ray Examinations.
CO3	Students will be able to learn how to perform contrast studies along with their preparation and management.
CO4	Students will be able to learn how to perform ward mobile radiography on critically ill patients.
CO5	Students will be able to learn how to perform CT scans, MRI, Fluoroscopy and Mammography.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**COURSE CONTENTS**	In the residency the professional is expected to work and contribute in the medical imaging unit.	80	CO1, CO2, CO3, CO4, CO5

Reference Books:

1. Seeram E. Computed Tomography-E-Book: Physical Principles, Clinical.
2. Applications and Quality Control. Elsevier Health Sciences; 2015 Sep 2.
3. Lakhkar B N, Banavali S, Shetty C. Radiological quiz-head and neck. Indian Journal of Radiology and Imaging.
4. Snopek AM. Fundamentals of Special Radiographic Procedures-E-Book. Elsevier Health Sciences; 2013 Aug 13.
5. Curry TS, Dowdey JE, Murry RC. Christensen's physics of diagnostic cardiology. Lippincott Williams & Wilkins; 1990.
6. Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012 Mar20.
7. Zwiebel WJ, Sohaey R. Introduction to ultrasound. WB Saunders Company;1998.
8. Hagen-Ansert SL. Textbook of diagnostic ultrasonography. Mosby Elsevier;2006.

e-Learning Source:

1. https://en.wikipedia.org/wiki/High-resolution_computed_tomography
2. https://youtu.be/IhjbvEnlRrM
3. https://en.wikipedia.org/wiki/Doppler_ultrasonography

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	1	2	1	1	1	1	3	1	2	3	3	2
CO2	1	3	2	2	2	1	3	2	1	3	3	2	2	2	3	3
CO3	2	3	3	2	2	3	1	2	1	1	3	2	2	3	3	3
CO4	1	3	2	1	3	1	3	3	1	3	3	3	2	1	3	2
CO5	2	3	1	1	1	1	2	1	1	2	3	1	2	2	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
RS504	Residency Lab- I	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
		√	√	√	√		√	√	**3,4**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	**RS505**	**Title of the Course**	**Radiological Physics -Lab**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	**I**	**0**	**0**	**8**	**4**
Pre-Requisite	**Nil**	**Co-requisite**	**Nil**				
Course Objectives	To ensure the knowledge of basic concept of Physics and radiation Physics.						

Course Outcomes: After the successful course completion, learners will develop following attributes:	
CO1	To study about Discovery, Production, Types & Interaction with Matter.
CO2	To study about X-ray Tube & its Circuits.
CO3	To study about Radiographic Grid, Tube Cooling, Generators & Capacitor used in X-Ray Unit.
CO4	To study about X-ray generator circuits, Physical Quantity & Radiation Measurement Units.
CO5	To study about Radiation Detectors, Personal Dosimeters & Introduction to Advance Modalities.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**COURSE CONTENTS**	1. X-rays: Discovery of x-rays-X-ray production and properties. 2. Interaction of ionizing radiation with matter. 3. Exponential attenuation (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number. 4. Radiation intensity and exposure, photon flux and energy flux density. 5. LET, range of energy relationship for alpha, beta particles with X-Rays. 6. X-ray tube: historical aspects, construction of X-ray tubes, requirements for X-ray production (Electron source, target and anode material), tube voltage, current, space charge, early X-ray tubes (Coolidge tubes, tube envelop and housing) cathode assembly. 7. Grid controlled and high-speed tubes, focal spot size, speed of anode rotation, target angle, inherent filtration, radiation leakage and scattered radiation). Interlocking and X-ray tube overload protection. 8. X-ray generator circuits. 9. Radiation quantities and units: Radiation intensity, Exposure Roentgen, its limitations, Kerma and Absorbed Dose, Electronic equilibrium, Rad, Gray, Conversion factor for Roentgen to Rad, Quality factor, Dose equivalent, REM, Sievert. Quality factor, dose equivalent, relationship between absorbed dose and equivalent dose 10. Film dosimeter, Chemical dosimeter, Thermoluminescent Dosimeter & Pocket dosimeter.	80	CO1, CO2, CO3, CO4, CO5

Reference Books:

1. Diagnostics X-Ray Imaging Quality Assurance by M.A. Period and P. Chaloner.
2. Textbook of Radiology and imaging- by DavidSutton.
3. Christensen's Physics of diagnostic radiology.
4. The Essentaila of Physics of Medical Imaging by Bushberg.
5. Radiologic Science for Technologist by Stewart C Bushong.

e-Learning Source:

1. https://byjus.com/physics/electricity-and-magnetism/
2. https://byjus.com/chemistry/atoms-and-molecules/
3. https://en.wikipedia.org/wiki/X-ray

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS505	Radiological Physics -Lab	√	√	√	√		√	√	3,4

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	**RS506**	**Title of the Course**	**Radiographic and Imaging Techniques- Lab**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	**I**	**0**	**0**	**8**	**4**
Pre-Requisite	**Nil**	**Co-requisite**	**Nil**				
Course Objectives	To impart detailed knowledge about different Radiological Projection along with special Radiography Techniques.						

Course Outcomes	
CO1	Students will be able to learn about Radiography of Upper limb, Lower limb & Shoulder girdle.
CO2	Students will be able to learn about Radiography of Vertebral column, Pelvic girdle, Skeletal survey & Skull.
CO3	Students will be able to learn about Dental & Respiratory Tract Radiography.
CO4	Students will be able to learn about Special Projections of Thorax, Abdominal Radiography & Special Radiographic Units.
CO5	Students will be able to learn about Localization of foreign bodies, Operation theatre techniques & Different Mobile Radiography Techniques.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**LIST OF PRACTICAL**	**1. Skeletal system:** a. Upper limb b. Lower limb c. Shoulder girdle d. Vertebral column e. Pelvic girdle and hip region f. Skull **2. Dental Radiography** **3. Upper respiratory tract** **4. Radiography of Thorax & Abdomen** **5. Ward mobile Radiography** **6. Macroradiography** **7. Stereography** **8. High KV techniques** **9. Soft tissue Radiography** **10. Localization of foreign bodies** **11. Operation theatre techniques**	80	CO1, CO2, CO3, CO4, CO5

Reference Books:

1 Whitley AS, Jefferson G,Holmes K, Sloane C, Anderson C, Hoadley G.Clark's Positioningin Radiography 13E. CRC Press; 2015 Jul28.

2 Bontrager KL, Lampignano J. Textbook of Radiographic Positioning and Related Anatomy-E-Book. Elsevier Health Sciences; 2013 Aug 7.

3 Bontrager KL, Lampignano J. Bontrager's Handbook of Radiographic Positioning and Techniques-E-BOOK. Elsevier Health Sciences; 2017 Feb 10.

4 Frank ED, Long BW, Smith BJ. Merrill's Atlas of Radiographic Positioning and Procedures-E-Book. Elsevier Health Sciences; 2013 Aug 13.

e-Learning Source:

1. https://www.slideshare.net/InfoUtilRT/upper-extremity-anatomy-positioning
2. https://youtu.be/LlStHhk5e9w
3. **https://youtu.be/C2Ud4EwZVQM**

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS506	Radiographic and Imaging Techniques- Lab			√					**3,4, 11**

INTEGRAL UNIVERSITY, LUCKNOW

INTEGRAL INSTITUTE OF ALLIED HEALTH SCIENCES & RESEARCH

DEPARTMENT OF PARAMEDICAL SCIENCES

MASTERS OF RADIOLOGICAL IMAGING SCIENCES (MMRIS)

SYLLABUS

YEAR/ SEMESTER: I/II

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	**RS507**	**Title of the Course**	**Radiation Safety and Protection**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	**II**	3	1	0	**4**
Pre-Requisite	**Nil**	**Co-requisite**	**Nil**				
Course Objectives	The purpose of this course is to provide an understanding of physical concepts and underlying various technological applications. This course also provides fundamental idea about circuit analysis, working principles of machines. In addition, the course is expected to develop scientific temperament and analytical skill in students, to enable them logically tackle complex engineering problems in their chosen area of application.						

Course Outcomes	
CO1	Students will be able to learn about radiation safety in diagnostic Radiology.
CO2	Students will be able to learn about Measurement and Biological Effects of Radiation.
CO3	Students will be able to learn about Radiation Protection & Planning Consideration for Radiology.
CO4	Students will be able to learn about Regulatory Bodies of Radiology and Their Guidelines.
CO5	Students will be able to learn about Newer Radiation Safety Protocols & Role Of Radiology Staff In Different Aspects Of Work.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**BIOLOGICAL EFFECTS OF RADIATION**	Biological aspects of Radiological protection, biological effects of radiation, Direct and indirect actions of radiation, concept of detriment-Documentation and stochastic effect of radiation-somatic and general effects, Dose relationship, Effects of antenatal exposure.	8	CO1
2	**INTRODUCTIO N TO RADIATION PROTECTION**	Introduction to Radiation Protection, Need for Protection, Aim of Radiation Protection, Basic radiation units and qualities, Exposure, Absorbed dose equivalent, Quality factor, Tissue weighting factor.	8	CO2
3	**RADIATION LIMITATION FACTORS**	Limits of Radiation exposure, Concept of ALARA (or ALARP), ICRP regulation, Maximum permissible dose, Exposure in pregnancy, children, Protection in Diagnostic Radiology, Protection for primary radiation, Work load, Use factor, Occupancy Factor, Protection in scatter Radiation and leakage radiation, X-Ray room design, Structural shielding, Protective devices, Radiation sign ages.	8	CO3
4	**TECHNICAL RADIATION PROTECTION IN DIFFERENT EXAMINATION**	Technical protective considerations during Radiography, Evaluation of hazards, Effective communication, Immobilization, Beam limiting devices, Filtration, Exposure factors, **Protection in-**Fluoroscopy, mammography, mobile radiography, CT scan, Angiography room.	8	CO4
5	**REGULATORY BODIES OF RADIOLOGY AND THEIR GUIDELINES**	Regulatory Bodies & regulatory Requirements: International Commission on Radiation Protection (ICRP) / National Regularity body (AERB - Atomic Energy Regulatory Board) - Responsibilities, organization, Safety Standard, Codes and Guides, Responsibilities of licenses, registrants & employers and Enforcement of Regulatory requirements. (ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection). NABH guidelines, AERB guidelines, PNDT Act and guidelines.	8	CO5

Reference Books:

1. Sherer MA, Visconti PJ, Ritenour ER, Haynes K. Radiation Protection in Medical Radiography-E-Book. Elsevier Health Sciences; 2014Mar12.
2. Brandon AN, Hill DR. Selected list of books and journals in allied health. Bulletin of the Medical LibraryAssociation,1996.
3. Long BW, Frank ED, Ehrlich RA. Radiography Essentials for Limited Practice-E-Book. Elsevier Health Sciences; 2016 Sep6
4. Durrani SA, IlicR, editors. Radon measurements by etched track detectors: applications in radiation protection, earth sciences and the environment. World scientific
5. Turner JE. Atoms, radiation, and radiation protection. John Wiley & Sons; 2008Jan8

e-Learning Source:

1. https://en.wikipedia.org/wiki/Radiation_protection
2. https://youtu.be/mvjYRGjrKHc
3. https://www.slideshare.net/RubiSapkota/radiation-protection-and-personnel-monitoring-devices

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	3	3	3	3	3	3	2	2	3	3
CO2	2	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3
CO3	3	3	3	2	3	3	3	3	2	2	3	3	2	2	2	3
CO4	3	3	2	3	2	3	2	3	3	2	3	3	3	3	2	2
CO5	2	3	3	3	2	3	2	3	2	2	2	3	2	3	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS507	Radiation Safety and Protection	√	√	√	√		√	√	3,4

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	**RS508**	**Title of the Course**	**Modern Radiological and Imaging Equipment**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	**II**	3	1	0	**4**
Pre-Requisite	**Nil**	**Co-requisite**	**Nil**				
Course Objective	The purpose of this course is to provide an understanding of physical concepts and underlying various technological applications of advance modalities of radiology department.						

Course Outcomes	
CO1	Students will be able to learn about Modern & Special Radiology Equipments.
CO2	Students will be able to learn about Tomography, Tomosynthesis, DSA and Beam Restriction Devices.
CO3	Students will be able to learn about Fluoroscopy & CT scan.
CO4	Students will be able to learn about USG & MRI.
CO5	Students will be able to learn about MR Spectroscopy and Nuclear Imaging Techniques.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**TOMOGRAPHY, TOMOSYNTHESIS, & VASCULAR IMAGING**	**Tomography:** Body section radiography, basic principle and equipment, multi section tomography, various types of topographic movements, **Tomosynthesis**, Stitch radiography **DEXA scan** (Dual energy x-ray absorptiometry). **Vascular Imaging Equipment:** Introduction, historical developments DSA Equipment, Principle, applications and definition of terms, Single Plane, Biplane, Hybrid DSA Lab, Digital Subtraction Techniques.	8	CO1
2	**USG**	**Ultrasonography:** Basic principle of U.S, various types of transducers, mechanism of image formation, various advancements including Doppler, Elastography, HIFU, ABVS and image artifacts. **Doppler USG:** Principle, Doppler Effect, Color Doppler, Continuous wave Doppler, Pulsed wave Doppler.	8	CO2
3	**MAMMOGRAPHY**	Mammography Equipment: X-Ray Tube, Filter, Compression Device, Filters, Generator, Control console, Digital Mammography & Common view of Mammography.	8	CO3
4	**CT SCAN**	**Computed Tomography**: Principle, data acquisition concepts, image reconstruction, instrumentations, image manipulation, Historical developments, Various generations, spiral/helical, single slice/multislice 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.	8	CO4
5	**MRI**	**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 & Advancement.	8	CO5

Reference Books:

1. The physics of radiology and imaging by K Thayalan.
2. Curry TS, Dowdey JE, Murray RC. Introduction to the physics of diagnostic radiology.
3. Tucker AK, Ng YY. Textbook of mammography. Churchill Livingstone; 2001.
4. Wentz G, Parsons WC. Mammography for radiologic technologists. McGraw-Hill,Health Professions Division; 1997
5. Zwiebel WJ, Sohaey R. Introduction to ultrasound. WB Saunders Company;1998.

e-Learning Source:

1. https://www.slideshare.net/shreyacathe/ct-scan-62017319
2. https://www.radiologyinfo.org/en/info/mammo
3. https://en.wikipedia.org/wiki/Doppler_ultrasonography

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	3	3	3	3	3	2	2	2	3	3
CO2	2	3	2	2	3	3	3	3	2	3	3	2	2	3	3	3
CO3	3	2	3	2	3	2	3	3	2	2	3	3	2	3	3	3
CO4	2	3	2	3	3	3	2	3	3	2	3	3	2	3	3	2
CO5	2	3	3	3	2	3	2	3	2	3	2	3	2	3	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS508	Modern Radiological and Imaging Equipment	√	√	√	√		√	√	3,4

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	**RS509**	**Title of the Course**	**Radiological and Imaging Procedures**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	**II**	**3**	**1**	**0**	**4**
Pre-Requisite	**Nil**	**Co-requisite**	**Nil**				
Course Objectives	The objective is to learn contrast-imaging techniques under the guidance of fluoroscopy, the administration of contrast media and its safety aspect and special procedures done in Radiology Department.						

Course Outcomes	
CO1	Students will be able to learn about Contrast media used in Radiology and their reactions along with management.
CO2	Students will be able to learn about the barium procedures of the GIT.
CO3	Students will be able to learn about the procedures of the Urinary system, HSG and hepatobiliary procedures.
CO4	Students will be able to learn about Sinography, CNS procedure, Arthrography, Angiography & Venography.
CO5	Students will be able to learn about microbiology and its branches.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**INTRODUCTION TO SPECIAL PROCEDURES & CONTRAST MEDIA**	**Special Radiographic/Radiological procedures**, Responsibility of radiographers, Patient Preparation, Indications, Contraindications, Technique, After Care and Preparation of Drug Trolley/Tray. **Contrast Media**: Positive and Negative, Ionic & Non–Ionic, Adverse Reactions to Contrast Media and Patient Management, Emergency Drugs in the Radiology Department, Aseptic technique.	8	CO1
2	**PROCEDURE OF GIT, SALIVARY GLAND AND BILIARY SYSTEM**	**Gastrointestinal Tract:** Barium Swallow, Barium Meal and Follow Through, Hypotonic Duodenography, Small Bowel Enema, Barium Enema, Double Contrast studies; Colostomy. Special techniques for specific disease to be examined. Including water soluble contrast media - eg. Gastrograffin Studies. Including CT, US and MRI Special Imaging Techniques. **Biliary system:** Intravenous cholangiography (IVC), Percutaneous cholangiography (PTHC), Endoscopic retrograde cholangio-pancreatography (ERCP), Operative Cholangiography, Post-Operative cholangiography (T-tube Cholangiography), Including CT, US and MRI Special Imaging Techniques.	8	CO2
3	**PROCEDURE OF URINARY SYSTEM, BREAST & SALIVARY GLANDS**	**Urinary system:** IVU, Retrograde Pyelography, Antegrade Pyelography, Cystography and MCU, Urethrography (RGU), Including CT, US and MRI Special Imaging Techniques. **Salivary glands:** Routine technique, procedure - sialography. **Breast Imaging:** Mammography: Basic views, special views, wire localization.	8	CO3
4	**PROCEDURE OF REPRODUCTIVE & RESPIRATORY SYSTEM & DCG**	**Reproductive system:** All the Techniques relating to Male and Female reproductive system including Hysterosalpingography. **Respiratory system:** - Bronchography: Including CT, US and MRI Special Imaging Techniques. **Dacryocystography**	8	CO4
5	**SINOGRAPHY, CNS PROCEDURE & ARTHROGRAPHY**	**Sinography:** Routine technique and procedure. **Central Nervous System:** Myelography, Cerebral studies, Ventriculography etc including CT, US and MRI Special Imaging Techniques. **Arthrography:** Shoulder, Hip, Knee, Elbow joints etc including CT, US and MRI Special Imaging Techniques.	8	CO5

Reference Books:

1. Lakhkar B N, Banavali S, Shetty C. Radiological quiz-head and neck. Indian Journal of Radiology and Imaging.
2. Snopek AM. Fundamentals of Special Radiographic Procedures-E-Book. Elsevier Health Sciences; 2013 Aug 13.
3. Davies SG, Chapman S. Aids to radiological differential diagnosis. Elsevier Health Sciences; 2013 Nov 20.
4. Krishnamurthy, Medical Radiographic Technique & Darkroom Practice
5. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8thedition, University Press Publication.

e-Learning Source:

1. https://youtu.be/lYfL-V2C9Uw
2. https://youtu.be/zYl2G2Z_T7M
3. https://www.britannica.com/technology/microscope

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	3	3	3	3	3	2	3	2	3	2
CO2	2	3	2	3	3	3	3	3	2	3	3	3	2	3	3	3
CO3	3	2	3	2	3	2	3	3	2	2	3	3	2	3	3	3
CO4	2	3	2	3	3	3	2	3	3	2	2	3	2	3	3	2
CO5	2	3	3	3	2	3	2	3	2	3	2	3	2	3	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
RS509	Radiological and Imaging Procedures	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
		√	√	√	√		√	√	**3,4**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	**RS510**	**Title of the Course**	**Residency – II Lab**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	**II**	**0**	**0**	**10**	**5**
Pre-Requisite	**Nil**		**Nil**				
Course Objectives	The objective of the Residency Lab is to learn about patient handling, radiation protection and procedures done in the department.						

Course Outcomes: After the successful course completion, learners will develop following attributes:	
CO1	Students will be able to learn how to deal with a patient during examination in the Radiology department.
CO2	Students will be able to learn how to perform X-Ray Examinations.
CO3	Students will be able to learn how to perform contrast studies along with their preparation and management.
CO4	Students will be able to learn how to perform ward mobile radiography on critically ill patients.
CO5	Students will be able to learn how to perform CT scans, MRI, Fluoroscopy and Mammography.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Course Contents**	In the residency the professional is expected to work and contribute in the medical imaging unit	80	CO1, CO2, CO3, CO4, CO5

Reference Books:

1. Seeram E. Computed Tomography-E-Book: Physical Principles, Clinical.
2. Applications and Quality Control. Elsevier Health Sciences; 2015 Sep 2.
3. Lakhkar B N, Banavali S, Shetty C. Radiological quiz-head and neck. Indian Journal of Radiology and Imaging.
4. Snopek AM. Fundamentals of Special Radiographic Procedures-E-Book. Elsevier Health Sciences; 2013 Aug 13.
5. Curry TS, Dowdey JE, Murry RC. Christensen's physics of diagnostic cardiology. Lippincott Williams & Wilkins; 1990.
6. Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012 Mar20.
7. Zwiebel WJ, Sohaey R. Introduction to ultrasound. WB Saunders Company;1998.
8. Hagen-Ansert SL. Textbook of diagnostic ultrasonography. Mosby Elsevier;2006.

e-Learning Source:

1. https://en.wikipedia.org/wiki/High-resolution_computed_tomography
2. https://youtu.be/IhjbvEnlRrM
3. https://en.wikipedia.org/wiki/Doppler_ultrasonography

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	1	2	1	1	1	1	3	1	2	3	3	2
CO2	1	3	2	2	2	1	3	2	1	3	3	2	2	2	3	3
CO3	2	3	3	2	2	3	1	2	1	1	3	2	2	3	3	3
CO4	1	3	2	1	3	1	3	3	1	3	3	3	2	1	3	2
CO5	2	3	1	1	1	1	2	1	1	2	3	1	2	2	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS510	Residency – II Lab	√	√	√	√		√	√	**3,4**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	**RS511**	**Title of the Course**	**Modern Radiological and Imaging Equipment –Lab**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	**II**	**0**	**0**	**8**	**4**
Pre-Requisite	**Nil**	**Co-requisite**	**Nil**				
Course Objectives	The purpose of this course is to provide an understanding of practical concepts and underlying various technological applications of advance modalities of radiology department.						

Course Outcomes	
CO1	Students will be able to learn about Modern & Special Radiology Equipments.
CO2	Students will be able to learn about Tomography, Tomosynthesis, DSA and Beam Restriction Devices.
CO3	Students will be able to learn about Fluoroscopy & CT scan.
CO4	Students will be able to learn about USG & MRI.
CO5	Students will be able to learn about MR Spectroscopy and Nuclear Imaging Techniques.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**LIST OF PRACTICAL**	1. Tomography: Body section radiography, basic principle and equipment, multi section tomography, various types of topographic movements, 2. Tomosynthesis, Stitch radiography 3. DEXA scan. 4. Vascular Imaging Equipment: Introduction, historical developments DSA Equipment 5. Computed Tomography 6. Ultrasonography 7. Transducers of USG 8. MRI 9. Contrast Agents in MRI, Image quality, Image artifacts and its compensators, NMR hazard and safety. Advances in MRI. 10. MR Spectroscopy 11. Radionuclide scanning including rectilinear scanner, gamma camera, PET, SPECT, their principles, working, applications and advancements.	80	CO1, CO2, CO3, CO4, CO5

Reference Books:

1. The physics of radiology and imaging by K Thayalan.
2. Curry TS, Dowdey JE, Murray RC. Introduction to the physics of diagnostic radiology.
3. Tucker AK, Ng YY. Textbook of mammography. Churchill Livingstone; 2001.
4. Wentz G, Parsons WC. Mammography for radiologic technologists. McGraw-Hill,Health Professions Division; 1997
5. Zwiebel WJ, Sohaey R. Introduction to ultrasound. WB Saunders Company;1998.

e-Learning Source:

1. https://www.slideshare.net/shreyacathe/ct-scan-62017319
2. https://www.radiologyinfo.org/en/info/mammo
3. https://en.wikipedia.org/wiki/Doppler_ultrasonography

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	3	3	3	3	3	2	2	2	3	3
CO2	2	3	2	2	3	3	3	3	2	3	3	2	2	3	3	3
CO3	3	2	3	2	3	2	3	3	2	2	3	3	2	3	3	3
CO4	2	3	2	3	3	3	2	3	3	2	3	3	2	3	3	2
CO5	2	3	3	3	2	3	2	3	2	3	2	3	2	3	2	3

2- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS511	Modern Radiological and Imaging Equipment –Lab			√					3,4, 11

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	**RS512**	**Title of the Course**	**Radiological and Imaging Procedures – Lab**	**L**	**T**	**P**	**C**
Year	**I**	**Semester**	**II**	0	0	8	4
Pre-Requisite	**NIL**	**Co-requisite**	**Nil**				
Course Objectives	The objective is to learn contrast-imaging techniques under the guidance of fluoroscopy, the administration of contrast media and its safety aspect and special procedures done in Radiology Department.						

Course Outcomes	
CO1	Students will be able to learn about Contrast media used in Radiology and their reactions along with management.
CO2	Students will be able to learn about the barium procedures of the GIT.
CO3	Students will be able to learn about the procedures of the Urinary system, HSG and hepatobiliary procedures.
CO4	Students will be able to learn about Sinography, CNS procedure, Arthrography, Angiography & Venography.
CO5	Students will be able to learn about microbiology and its branches.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**LIST OF PRACTICAL**	1. Contrast Media 2. Emergency Drugs in the Radiology Department 3. Gastrointestinal Tract 4. Salivary glands: Routine technique, procedure - sialography 5. Biliary system: (ERCP). Operative cholangiography, post-Operative cholangiography (T-tube Cholangiography). 6. Urinary system 7. Reproductive system 8. Breast Imaging 9. Respiratory system 10. Sinography: Routine technique and procedure. 11. Central Nervous System 12. Arthrography 13. Angiographic Studies 14. Venography	80	CO1, CO2, CO3, CO4, CO5

Reference Books:

1. Lakhkar B N, Banavali S, Shetty C. Radiological quiz-head and neck. Indian Journal of Radiology and Imaging.
2. Snopek AM. Fundamentals of Special Radiographic Procedures-E-Book. Elsevier Health Sciences; 2013 Aug 13.
3. Davies SG, Chapman S. Aids to radiological differential diagnosis. ElsevierHealth Sciences; 2013 Nov 20.
4. Krishnamurthy, Medical Radiographic Technique & Darkroom Practice
5. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8thedition, University Press Publication.

e-Learning Source:

1. https://youtu.be/lYfL-V2C9Uw
2. https://youtu.be/zYl2G2Z_T7M
3. https://www.britannica.com/technology/microscope

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	3	3	3	3	3	2	3	2	3	2
CO2	2	3	2	3	3	3	3	3	2	3	3	3	2	3	3	3
CO3	3	2	3	2	3	2	3	3	2	2	3	3	2	3	3	3
CO4	2	3	2	3	3	3	2	3	3	2	2	3	2	3	3	2
CO5	2	3	3	3	2	3	2	3	2	3	2	3	2	3	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
RS512	Radiological and Imaging Procedures – Lab	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
		√	√	√	√		√	√	3,4