



INTEGRAL UNIVERSITY, LUCKNOW

INTEGRAL INSTITUTE OF ALLIED HEALTH SCIENCES & RESEARCH

DEPARTMENT OF PARAMEDICAL SCIENCES

**MASTERS OF MEDICAL RADIOLOGICAL IMAGING
SCIENCES
(MMRIS)**

SYLLABUS

YEAR/ SEMESTER: II/III



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	RS601	Title of the Course	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging	L	T	P	C
Year	II	Semester	III	3	1	0	4
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to learn the aim, objective, philosophy and principle of Quality control, Quality Assurance and Care & Maintenance.						

Course Outcomes: After the successful course completion, learners will develop following attributes:

CO1	Student will have knowledge on Objectives of Quality Control & Quality Assurance.
CO2	Student will have knowledge on QA of Image Receptors & QA Program Tests.
CO3	Student will have knowledge on QA & QC of Cassette, Film and Care and Maintenance.
CO4	Student will have knowledge about care and maintenance of equipments in radiology department.
CO5	Student will have knowledge about QA & QC of Advance Modalities.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	INTRODUCTION TO QUALITY CONTROL & QUALITY ASSURANCE	Quality Control: Objectives of Quality Control, Improve the quality of imaging thereby increasing the diagnostic value; To reduce the radiation exposure; Reduction of film wastage and repeat examination; To maintain the various diagnostic and imaging units at their optimal performance. Quality Assurance: Basic concepts of quality assurance, Equipment selection phase; Equipment installation and acceptance phase; Operational phase; Preventive maintenance.	8	CO1
2	QA PROGRAMME IN THE RADIOLOGICAL FACULTY LEVEL	Quality Assurance Programme in the Radiological Faculty level: Responsibility, Purchase, Specifications, Acceptance, Routine testing, Evaluation of results of routine testing, Quality assurance practical exercise in the X ray generator and tube, Image receptors, Radiographic equipment, Fluoroscopic equipment, Mammographic equipment, Conventional tomography, Computed tomography, Film processing, manual and automatic, Consideration for storage of film and chemicals, Faults tracing, Accuracy of imaging, Image distortion for digital imaging devices.	8	CO2
3	QA TESTS	Quality Assurance Programme Tests: General principles and preventive maintenance for routine, daily, weekly, monthly, quarterly, annually, Machine calibration, LASER printer, Light beam alignment. X-ray out-put and beam quality check, KVP check, Focal spot size and angle measurement, Timer check, mAs test, Grid alignment test, High and low contrast resolutions, Mechanical and electrical checks, Cassette leak check, Proper screen-film contact test, Safe light test, Radiation proof test, Field alignment test for fluoroscopic device, Resolution test, Phantom measurements, CT, US and MRI.	8	CO3
4	ROUTINE CARE AND MAINTENANCE	Maintenance and care of equipment: Safe operation of equipment, Routine cleaning of equipment and instruments, Cassette, screen maintenance, Maintenance of automatic processor and manual processing unit & Routine maintenance of equipments. Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme. General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually: care in use, special care of mobile equipment.	8	CO4
5	QA & QC OF ADVANCE MODALITIES	Quality Assurance and quality control of Modern Radiological and Imaging Equipment which includes Digital Radiography, Computed Radiography, CT scan, MRI Scan, Ultrasonography and PACS related. Image artifacts their different types, causes and remedies.	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 Library Association, 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.
RS601	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√			√	√	



Integral University, Lucknow

Effective from Session: 2024-25

Effective from Session: 2024-25							
Course Code	RS602	Title of the Course	Patient Care in Diagnostic Radiology	L	T	P	C
Year	II	Semester	III	3	1	0	4
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to learn about the assessment and handling emergencies in the department as well as the infection controls amongst self and the patient.						

Course Outcomes

CO1	Understanding the concepts of patient care in radiology department with reference to different responsibility of imaging technologist.
CO2	Understanding nursing procedures in radiology including handling of emergency situations.
CO3	Recognizing care of patient during various procedures performed in radiology department and executing first aid.
CO4	Discussing and performing various infection control methods with psychological consideration.
CO5	Implementing effective communication skills with patients and co-workers.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	INTRODUCTION TO PATIENT CARE	Introduction to the patient care, Responsibility of the health care facility, Responsibilities of the Imaging technologist, General patient care, Patient transfer technique, Restraint technique, Aspects of patient comfort, Specific patient conditions, Security of the patient property, obtaining vital signs, Laying up a sterile trolley, IV injection administration.	10	CO1
2	NURSING PROCEDURE IN RADIOLOGY	Nursing procedure in radiology, General abdominal preparation, Clothing of the patient, giving an enema, Handling the emergencies in radiology, First aid in the X-Ray departments, Medicolegal Case.	8	CO2
3	PATIENT CARE DURING VARIOUS INVESTIGATION	Patient care during investigation, GI tract, biliary tract, respiratory tract, gynecology, cardiovascular, lymphatic system, CNS, etc.	8	CO3
4	INFECTION CONTROL	Infection control, Isolation technique, Infection source, Transmission modes procedures, psychological considerations, Sterilization & sterile technique.	6	CO4
5	PATIENT EDUCATION & COMMUNICATION	Patient education Communication, Patient communication problems, Explanation of examinations, Radiation safety/protection, Interacting with terminally ill patient, Informed consent.	8	CO5

Reference Books:

- Care of patients in diagnostic radiology – Chesney & Chesney
- Ehrlich RA, Coakes DM. Patient Care in Radiography-E-Book: With an Introduction to Medical Imaging. Elsevier Health Sciences; 2016 Jan 19.
- Bontrager KL, Lampignano J. Textbook of Radiographic Positioning and Related Anatomy-E-Book. Elsevier Health Sciences; 2013 Aug 7.
- Grol R, Wensing M, Eccles M, Davis D, editors. Improving patient care: the implementation of change in health care. John Wiley & Sons; 2013 Mar 18.
- Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012 Mar 20

e-Learning Source:

- <https://www.chcollege.org/meaning-of-patient-care>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1705904>

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.
RS602	Patient Care in Diagnostic Radiology	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√	√		√	√	



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	RS603	Title of the Course	Interventional & Nuclear Medicine Techniques	L	T	P	C
Year	II	Semester	III	3	1	0	4
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to learn about the special procedures done with the interventional approaches in radiology department and Nuclear Medicine Technologies.						

Course Outcomes

CO1	At the end of the course, student will have knowledge on: Equipment, procedure, technique and outcome of angiography & Arthrography.
CO2	At the end of the course, student will have knowledge on Interventional Procedures Cardiac, Vascular, and Nonvascular.
CO3	Students will have the Knowledge about Basic principle, instrumentation and clinical application of nuclear medicine Technology.
CO4	Students will have the Knowledge about Radioactive transformation
CO5	Students will have the Knowledge about Production, handling & transportation of radio-nuclides.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	INTRODUCTION TO INTERVENTIONAL RADIOLOGY	Introduction to Interventional Radiology: Need for interventional procedures, History, technique, patient care, Percutaneous catheterization, catheterization sites, Asepsis, Guide wire, catheters, pressure injectors, accessories. All forms of diagnostic procedures including angiography, angioplasty, biliary examination, renal evaluation and drainage procedure and aspiration cytology under fluoroscopy, CT, USG, MRI guidance. Digital Subtraction Angiography (DSA), Types, Instrumentation.	10	CO1
2	ANGIOGRAPHY & VENOGRAPHY	Angiography: Angiographic Equipment, Catheters & guide wires, Single and biplane angiographic equipment, Angiographic Table, Image intensifier, Flat panel detector, electromechanical injectors. Carotid Angiography (4 Vessel angiography), Thoracic and Arch Aortography. Vertebral angiography, femoral arteriography. Selective studies: Renal, SMA, Coeliac axis. Angiocardiography. Venography: Peripheral venography, Cerebral venography, Inferior and superior Venocavography, Relevant visceral phlebography.	8	CO2
3	INTRODUCTION TO NMT	Introduction to NMT and Radioactive Transformation, Basic atomic and nuclear physics, History of radioactivity, Units & quantities, Isotopes, Isobars, Isomers, Radioactivity and half-life, Exponential decay, specific activity, Modes of Radioactive decay, parent daughter decay.	8	CO3
4	PRODUCTION OF RADIO NUCLIDES & EQUIPMENT OF NMT	Production of Radio nuclides, Reactor produced radionuclide, Reactor principles; Accelerator produced radionuclide, Radionuclide generators, equipments of NMT, Gamma camera, PET, SPECT (working principle).	8	CO4
5	RADIO PHARMACY & HANDLING & TRANSPORT OF RADIO-NUCLIDES	Radio pharmacy & Handling & Transport of Radio-nuclides Cold kits, Radio pharmacy used in nuclear medicine, Radiopharmaceuticals used in various procedures, Safe handling of radioactive materials, Procedures for handling spills.	6	CO5

Reference Books:

1. Kandarpa K, Machan L, editors. Handbook of interventional radiologic procedures. Lippincott Williams & Wilkins; 2011.
2. Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012 Mar 20.
3. Cherry SR, Sorenson JA, Phelps ME. Physics in Nuclear Medicine E-Book. Elsevier Health Sciences; 2012 Feb 14.
4. Bomford CK, Miller J, Kunkler H, Sherriff IH, Bomford SB, IH Kunkler SB. Walter and Miller's textbook of radiotherapy: radiation physics, therapy, and oncology. 1993.
5. Sutton, David. "A textbook of radiology and imaging." (1987).

e-Learning Source:

1. <https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/interventional-radiology#:~:text=What%20is%20interventional%20radiology%3F,ultrasound%20help%20guide%20the%20radiologist.>
2. https://www.cdc.gov/nceh/radiation/nuclear_medicine.htm#:~:text=Nuclear%20medicine%20uses%20radioactive%20material,x%2Drays%3A%20how%20they%20work
3. <https://www.iaea.org/resources/rpop/health-professionals/nuclear-medicine>

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	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	2	3	2	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2	3

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

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
RS603	Interventional & Nuclear Medicine Techniques	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√	√		√	√	



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	RS604	Title of the Course	Residency – III Lab	L	T	P	C
Year	II	Semester	III	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.	100	CO1, CO2, CO3, CO4, CO5

Reference Books:

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

e-Learning Source:

- https://en.wikipedia.org/wiki/High-resolution_computed_tomography
- <https://youtu.be/IhjvEnlRrM>
- https://en.wikipedia.org/wiki/Doppler_ultrasonography

PO-PSO CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
	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.
RS604	Residency – III Lab	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√	√		√	√	



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	RS605	Title of the Course	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging- Lab	L	T	P	C
Year	II	Semester	III	0	0	8	4
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to learn the aim, objective, philosophy and principle of Quality control, Quality Assurance and Care & Maintenance.						

Course Outcomes: After the successful course completion, learners will develop following attributes:

CO1	Student will have knowledge on Objectives of Quality Control & Quality Assurance.
CO2	Student will have knowledge on QA of Image Receptors & QA Program Tests.
CO3	Student will have knowledge on QA & QC of Cassette, Film and Care and Maintenance.
CO4	Student will have knowledge about care and maintenance of equipments in radiology department.
CO5	Student will have knowledge about QA & QC of Advance Modalities.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	COURSE CONTENTS	<ol style="list-style-type: none"> Objectives of Quality Control Quality Assurance activities Quality assurance programme in the radiological faculty level Quality assurance program tests General principles and preventive maintenance for routine, daily, weekly, monthly, quarterly, annually, machine calibration Basic concepts of quality assurance Quality assurance of film and image recording devices: Maintenance and care of equipment: Care and maintenance of diagnostic equipment: Quality Assurance and quality control of Modern Radiological and Imaging Equipment 	80	CO1, CO2, CO3, CO4, 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/mvjYRGirKHc
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.
RS605	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging- Lab	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√	√		√	√	



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	RS606	Title of the Course	Interventional & Nuclear Medicine Techniques – Lab	L	T	P	C
Year	II	Semester	III	0	0	8	4
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to learn about the special procedures done with the interventional approaches in radiology department and Nuclear Medicine Technologies.						

Course Outcomes	
CO1	At the end of the course, student will have knowledge on: Equipment, procedure, technique and outcome of angiography & Arthrography.
CO2	At the end of the course, student will have knowledge on Interventional Procedures Cardiac, Vascular, and Nonvascular.
CO3	Students will have the Knowledge about Basic principle, instrumentation and clinical application of nuclear medicine Technology.
CO4	Students will have the Knowledge about Radioactive transformation
CO5	Students will have the Knowledge about Production, handling & transportation of radio-nuclides.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	COURSE CONTENTS	1. Introduction to Interventional Radiology: Need for interventional procedures. 2. Catheterization, catheterization sites 3. Guide wire, catheters, pressure injectors, accessories. 4. Drainage procedure and aspiration cytology under fluoroscopy, CT, USG, MRI guidance. 5. Digital Subtraction Angiography (DSA), Types, Instrumentation. 6. Angiography 7. Venography 8. NMT and Radioactive Transformation 9. Modes of Radioactive decay, parent daughter decay. 10. Production of Radio nuclides 11. Gamma camera 12. PET 13. SPECT 14. Radio pharmacy & Handling & Transport of Radio-nuclides	80	CO1, CO2, CO3, CO4, CO5

Reference Books:

- Kandarpa K, Machan L, editors. Handbook of interventional radiologic procedures. Lippincott Williams & Wilkins; 2011.
- Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012 Mar 20.
- Cherry SR, Sorenson JA, Phelps ME. Physics in Nuclear Medicine E-Book. Elsevier Health Sciences; 2012 Feb 14.
- Bomford CK, Miller J, Kunkler H, Sherriff IH, Bomford SB, IH Kunkler SB. Walter and Miller's textbook of radiotherapy: radiation physics, therapy, and oncology. 1993.
- Sutton, David. "A textbook of radiology and imaging." (1987).

e-Learning Source:

- <https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/interventional-radiology#:~:text=What%20is%20interventional%20radiology%3F,ultrasound%20help%20guide%20the%20radiologist.>
- https://www.cdc.gov/nceh/radiation/nuclear_medicine.htm#:~:text=Nuclear%20medicine%20uses%20radioactive%20material,x%20Drays%3A%20how%20they%20work
- <https://www.iaea.org/resources/rpop/health-professionals/nuclear-medicine>

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

Course Code		Course Title		Attributes & SDGs						SDGs No.	
RS606	Interventional & Nuclear Medicine Techniques – Lab	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics		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: II/IV



Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	RS607	Title of the Course	Research Methodology and Biostatistics	L	T	P	C
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective of this module is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings. The students will also be made aware of the need of biostatistics and understanding of data, sampling methods, in addition to being given information about the relation between data and variables.						

Course Outcomes	
CO1	Apply the principles of research and biostatistics to health practice including the design and implementation of health-related research studies.
CO2	Plan and execute a research study, including clinical trials.
CO3	Use / organize bio-statistical analysis using computers and software's and prepare reports.
CO4	Critically evaluate research activities.
CO5	Make recommendations on policy and procedures. Plan and conduct an educational session.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	RESEARCH METHODOLOGY & DESIGN	Research Methodology: Introduction to research methods, identifying research problem. Ethical issues in research- Research design, Basic Concepts of Biostatistics.	08	CO1
2	DATA TYPES	Types of Data- Research tools and Data collection methods, sampling methods, Developing a research proposal.	08	CO2
3	BIOSTATISTICS	Biostatistics: Need of biostatistics, what is biostatistics: beyond definition, understanding of data in biostatistics, how & where to get relevant data, Relation between data & variables. Type of variables: defining data set, Collection of relevant data: sampling methods	08	CO3
4	INTERPRETATION	Normal Distribution, Standard deviation, Standard errors. Coefficient of Variation, t-test, Chi square test.	08	CO4
5	STATISTICAL ANALYSIS	Construction of study: population, sample, normality and its beyond (not design of study, perhaps), Summarizing data on the pretext of underlined study. Understanding of statistical analysis (not methods)	08	CO5

Reference Books:

1. Statistical Methods by S.P. Gupta
2. Methods in biostatistics for medical students by B.K.Mahajan
3. RPG Biostatistics by Himanshu Tyagi

e-Learning Source:

1. https://www.youtube.com/watch?v=UtiVXLO7c9A&list=PLR3kIPR1Qzzky45nZ4_1HIUCbjVNU0iZx
2. https://www.youtube.com/watch?v=txIS0N0I9xU&list=PLEIbY8S8u_DK7i4Fj6Hgq8sn_l42k9H1L
3. <https://www.youtube.com/watch?v=tr8M7jSIYm4>

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	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	3	2	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3

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

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
RS607	Research Methodology and Biostatistics	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√	√		√	√	



Integral University, Lucknow

Effective from Session: 2024-25

Effective from Session: 2024-25							
Course Code	RS608	Title of the Course	Advanced CT, MRI & USG	L	T	P	C
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to learn about the recent advancements & new imaging modalities. Outline of advanced CT/ MRI/ USG & Doppler.						

Course Outcomes

CO1	At the end of the course, student will have knowledge on: Latest upgraded hardware & software of different imaging modalities.
CO2	Students will have abundant Knowledge on New techniques used to achieve images for special conditions. Various post processing techniques.
CO3	Students will have Knowledge on Techniques of sonography-selection- Preparations - instructions and positioning of patient for TAS, TVS, TRUS, neck USG and extremities- biopsy procedures, assurance to patients.
CO4	Students will have Knowledge on CT of head and neck – thorax – abdomen – pelvis – Musculo skeletal system – spine – PNS. Anatomy– clinical indications and contraindications – patient preparation – technique – contrast media-types.
CO5	Students will have abundant Knowledge on 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.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1.	HELICAL & MDCT SCAN	Helical CT scan: Slip ring technology, advantages, Multi detector array helical CT , cone – beam geometry, reconstruction of helical CT images, CT artifact, CT angiography, CT fluoroscopy, HRCT Post processing techniques: MPR, MIP, Min IP, 3D rendering: SSD and VR, CT Dose	06	CO1
2.	MRI IMAGING METHODS	MRI imaging methods – Head and Neck, Thorax, Abdomen, Musculoskeletal System imaging, Clinical Indications and Contraindications, types of common sequences on imaging Protocols for various studies, Slice section, patient preparation, Positioning of the patient, Plain studies, Contrast studies, Special procedures, Reconstructions, 3D images, MRS blood flow imaging, diffusion/perfusion scans, strength and limitations of MRI.	08	CO2
3.	TECHNIQUES OF SONOGRAPHY	Techniques of sonography , selection, Preparations, instructions and positioning of the patient for TAS, TVS, TRUS, neck USG and extremities, Biopsy procedures, assurance to patients.	08	CO3
4.	CT OF DIFFERENT BODY PARTS	CT of Head and Neck, Thorax, Abdomen, Pelvis, musculoskeletal 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.	10	CO4
5.	NMT FOR DIFFERENT BODY PARTS	In vivo technique, Static and dynamic studies, Thyroid imaging, Imaging of bone, Respiratory system, Urinary system, GI system, Cardiovascular system, Iodine 131 uptake studies, Iodine 131 therapy of thyrotoxicosis and thyroid ablation.	08	CO5

Reference Books:

1. Faro SH, Mohamed FB, editors. Functional MRI: basic principles and clinical applications. Springer Science & Business Media; 2006 Nov, 22
2. Baert AL. Parallel imaging in clinical MR applications. Springer Science & Business Media; 2007 Jan 11.
3. Johansen-Berg H, Behrens TE, editors. Diffusion MRI: from quantitative measurement to in vivo neuroanatomy. Academic Press; 2013 Nov 4
4. Bernstein MA, King KF, Zhou XJ. Handbook of MRI pulse sequences. Elsevier.
5. Recent Trends in medical imaging (CT, MRI and USG)

e-Learning Source:

1. <https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/computed-tomography-ct-scan#:~:text=A%20CT%20scan%20is%20a%20diagnostic%20imaging%20procedure%20that%20uses,detailed%20than%20standard%20X%202Days>
2. <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/ct-scan>

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.
RS608	Advanced CT, MRI & USG	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√	√		√	√	



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	RS609	Title of the Course	Residency – IV Lab	L	T	P	C
Year	II	Semester	IV	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.	100	CO1, CO2, CO3, CO4, CO5

Reference Books:

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

e-Learning Source:

4. https://en.wikipedia.org/wiki/High-resolution_computed_tomography
5. <https://youtu.be/IhjvEnlRrM>
6. https://en.wikipedia.org/wiki/Doppler_ultrasonography

PO-PSO CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
	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.
RS609	Residency – IV Lab	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
		√	√	√	√		√	√	3,4



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	RS610	Title of the Course	Advanced CT, MRI & USG Lab	L	T	P	C
Year	II	Semester	IV	0	0	8	4
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to learn about the recent advancements & new imaging modalities. Outline of advanced CT/ MRI/ USG & Doppler.						

Course Outcomes	
CO1	At the end of the course, student will have knowledge on: Latest upgraded hardware & software of different imaging modalities.
CO2	Students will have abundant Knowledge on New techniques used to achieve images for special conditions. Various post processing techniques.
CO3	Students will have Knowledge on Techniques of sonography-selection- Preparations - instructions and positioning of patient for TAS, TVS, TRUS, neck USG and extremities- biopsy procedures, assurance to patients.
CO4	Students will have Knowledge on CT of head and neck – thorax – abdomen – pelvis – Musculo skeletal system – spine – PNS. Anatomy– clinical indications and contraindications – patient preparation – technique – contrast media-types.
CO5	Students will have abundant Knowledge on 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.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1.	COURSE CONTENTS	1. Helical CT scan 2. MSCT 3. CT Angiography 4. CT Fluoroscopy 5. HRCT 6. MRI Head and Neck 7. MRI Thorax and Abdomen 8. MRI Musculoskeletal System 9. Patient preparation, Positioning of the patient 10. Contrast studies 11. Techniques of sonography 12. CT of Head and Neck 13. CT of Thorax, Abdomen & Pelvis 14. CT of Spine & PNS 15. NMT of Thyroid imaging 16. NMT of bone and Respiratory system 17. NMT of the Urinary system, GI system and Cardiovascular system 18. Iodine 131 uptake studies	80	CO1 CO2 CO3 CO4 CO5

Reference Books:

1. Faro SH, Mohamed FB, editors. Functional MRI: basic principles and clinical applications. Springer Science & Business Media; 2006 Nov, 22
2. Baert AL. Parallel imaging in clinical MR applications. Springer Science & Business Media; 2007 Jan 11.
3. Johansen-Berg H, Behrens TE, editors. Diffusion MRI: from quantitative measurement to in vivo neuroanatomy. Academic Press; 2013 Nov 4
4. Bernstein MA, King KF, Zhou XJ. Handbook of MRI pulse sequences. Elsevier.
5. Recent Trends in medical imaging (CT, MRI and USG)

e-Learning Source:

1. <https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/computed-tomography-ct-scan#:~:text=A%20CT%20scan%20is%20a%20diagnostic%20imaging%20procedure%20that%20uses,detailed%20than%20standard%20X%2Drays>
2. <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/ct-scan>

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.
RS610	Advanced CT, MRI & USG Lab	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√	√		√	√	



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	RS611	Title of the Course	Thesis/Dissertation	L	T	P	C
Year	II	Semester	IV	0	0	20	10
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective of the course is to help the students making a dissertation presentation.						

Course Outcomes

CO1	Students will be able to learn how to prepare presentation.
CO2	Students will have abundant Knowledge on explaining the presentation Infront of the Examiners.
CO3	Students will be able to learn about how to do new research in respected field.
CO4	Students will be able to learn about Methods of Data Collection.
CO5	Students will have abundant Knowledge on how to write dissertation and thesis.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	COURSE CONTENTS	<p>It is essential to monitor the learning progress of each candidate through continuous appraisal and regular assessment. It not only helps teachers to evaluate students, but also students to evaluate themselves. The monitoring be done by staff of the department based on participation of students in various teaching/ learning activities. It may be structured and assessment shall be done using checklists that assess various aspects. Model checklists are given which may be copied and used.</p> <p>Journal Review Meeting (Journal Club): the ability to do literature search, in depth study, presentation skills, and use of audio- visual aids are to be assessed. The assessment is made by faculty members and peers attending the meeting using a checklist (see Model Checklist).</p> <p>Seminars/ symposia: the topics should be assigned to the student well in advance to facilitate in depth study. The ability to do literature search, in depth study, presentation skills and use of audio- visual aids are to be assessed.</p>	200	CO1, CO2, CO3, CO4, CO5

Reference Books:

1. S. Ramakrishnan, K G Prasannan and R Rajan: Text book of Medical Biochemistry, Orient Longman, Madras, 1990.
2. D R Whitehat: Biochemistry of the Eye, 2nd edition, Butterworth Heinemann, Pennsylvania, 2003
3. S. Ramakrishnan: Essentials of biochemistry and ocular biochemistry, Annamalai University Publications, Chidambaram, India, 1992.

e-Learning Source:

1. https://www.youtube.com/watch?v=P_WNPiZGvbM
2. https://www.youtube.com/watch?v=P_WNPiZGvbM

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	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	3	2	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3

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

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
RS611	Thesis/Dissertation	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√	√		√	√	